Ungulate Pathways of the West

Challenges and Opportunities for Conserving Ungulate Migrations in the Western United States

by

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Abstract

Historically and ecologically important long-distance migrations by herd-living mammals, such as ungulates, have been lost in a growing number of places around the world, including North America. These journeys are phenomena of ecological significance and are an area of priority for conservation work. With the ecological value of migration clearly established in the scientific community, it has become well accepted among conservation biologists that increased connectivity across landscapes benefits other species. Until the recent fragmentation of landscapes by human settlements, most species lived in habitats with a high degree of connectivity. Understanding linkages between areas used by animals throughout the year is critical to their effective conservation because it allows efforts to be directed at critical breeding and wintering sites.

Thus the question, how are long-distance, terrestrial migrations being conserved? By taking an in-depth look at current conservation strategies and challenges associated with three contemporary efforts to conserve ungulate migrations in the Western U.S, this study aims to add a ground-level analysis to the current universe of more general recommendations currently provide in literature for the successful conservation of overland migration corridors. Through a case-study approach, the goal of this study is to provide insight into on-the-ground best practice techniques and tools which could improve migratory species conservation efforts.

Our conclusion involved additional analysis to identify the key challenges and best practices for conservation of ungulate migration corridors. Despite the challenges and constraints faced by governmental and non-governmental organizations, the study found opportunities for conservation and we present examples of an array of successful conservation strategies being carried out on private and public land.

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Introduction

Chapter 1
Background and Methods

This study applied a case-study approach to examine contemporary, on-the-ground efforts aimed at the conservation of long-distance ungulate migrations in the Western U.S. These case studies include the Round Valley mule deer in the Sierra Nevada, California; the Grand Teton National Park pronghorn in the Upper Green River Basin, Wyoming; and the Clarks Fork and Cody Elk in the Absaroka Divide, Wyoming. Challenges and opportunities for ensuring the long-term viability of ungulate migrations in the Western U.S. are identified in the context of assessing conservation strategies currently employed by managers and non-governmental organizations (NGOs). The study's ultimate conclusions are synthesized into ten challenges and corresponding best practices for conserving ungulate migrations. The potential audience for these conclusions includes decision-makers at municipal, county, state, and federal governmental bodies as well as employees of NGOs and other interested stakeholders.

Importance of Migrations

Migrations can be defined as "the seasonal round trip-movement between discrete areas not used at other times of the year" (Berger, 2004, p. 321). Historically and ecologically important long-distance migrations by herd-living mammals, such as ungulates, have been lost in a growing number of places around the world, including North America (Berger, 2004). Yet, migration is an ecological necessity for the survival of many species, often essential to maintaining the genetic diversity of populations and meta-populations of many species (Soule, 1991), and allowing for increased access to resources and habitat for far-ranging species (Schmiegelow, 2007).

The ability to migrate is important for the viability and maintenance of the migrating populations. The halting of these migrations results in a population decline of the wildlife that can be amplified by disturbance events and increased predation pressure (Coulon et al., 2006). When formerly migratory ungulates are confined solely to one range, negative density-dependent effects occur. Restriction to a single range can lead to reduced forage availability and quality (Christianson & Creel, 2009). The highest quality forage is quickly consumed by dominant individuals or efficient foragers, leaving a more homogenous and less nutritious diet for other herd members (Nicholson, Bowyer, & Kie, 2006; Dennehy, 2001). Nutritional deficiencies lead to reduced fertility and fawn survival (Cook et al., 2004). In addition to negative effects on population size, the halting of migration can have effects on the genetic diversity of populations. Studies of a roe deer (*Capreolus capreolus*) population constrained by barriers including highways, rivers, and canals experienced changes in genetic composition (Coulon et al., 2006). If minor, ultimately passable features such as these can noticeably alter the genetic diversity of herds, there is much reason to be concerned with the large effects that would result from greater degrees of isolation.

Migratory ungulates also serve an important stabilizing function in ecosystems, acting as keystone species (Kie & Lehmkuhl, 2001). The halting of migration can have a destabilizing effect on vegetative communities and species interactions, even on otherwise intact ecological systems such as National Parks and wilderness areas (Kie & Lehmkuhl, 2001). It has been demonstrated that the complete absence of ungulate herbivory can have negative effects on ecosystems. In a 42-year long experiment, Manier and Hobbs found the complete exclusion of large herbivores to cause significant reductions in biodiversity as measured by species richness and evenness (Manier & Hobs, 2007).

These journeys are phenomena of ecological significance and are an area of priority for conservation work (Berger, 2004). With the ecological value of migration clearly established in the scientific community, it has become well accepted among conservation biologists that increased connectivity across landscapes benefits other species. Until the recent fragmentation of landscapes by human settlements, most species lived in habitats with a high degree of connectivity. Understanding linkages between areas used by animals throughout the year is critical to their effective conservation because it allows efforts to be directed at critical breeding and wintering sites (Hobson, 1999).

Strategies for Conservation of Migration Corridors

Once an understanding of the critical linkages between habitats has been established, the next step is conservation of these linkages. One strategy for the protection of these linkages is the use of corridors. A corridor is defined as “a linear habitat, embedded in a dissimilar matrix, that connects two or more larger blocks of habitat and that is proposed for conservation on the grounds that it will enhance or maintain the viability of specific wildlife populations in the habitat blocks” (Beier & Noss, 1998). While criticism of corridors, both of their costs and ecological value, still exists (Simberloff, Farr, Cox, & Mehlman, 1992), research has shown that well-placed, well-designed corridors provide benefits to wildlife and are used by animals (Beier & Noss, 1998).

As conservation professionals have recognized and embraced the need to manage and preserve functioning communities and ecosystems at a landscape scale, conservation efforts addressing migratory animals have developed into strategies focusing on protecting movement corridors rather than single species populations. This focus on the corridor connecting two or more protected areas (Schmiegelow, 2007) is one of several connectivity strategies, and one that generally aims to provide dispersal pathways for as many species as possible within ecological reserves. As the need for conservation has grown, the demand to "achieve economies of scale and efficiency" in management actions has driven managers to preserve areas of high biodiversity rather than habitat for a single species of interest (Simberloff, 1998, p.247). This concept of preserving the most biodiversity and creating sustainable ecosystems has driven the majority of management plans in recent years (Christensen et al., 1996).

One criticism that has plagued existing corridor conservation initiatives is the difficulty of designing experiments capable of proving that corridors are providing benefits to wildlife (Beier & Noss, 1998; Simberloff, et al., 1992). In this study we focused on three existing single species migration corridors of known value: the Clarks Fork and Cody elk, the Round Valley mule deer, and the Grand Teton National Park pronghorn. In each of these three cases, wildlife managers have already determined the critical habitat for these populations and identified the migration corridors through which they currently migrate. Protection of these existing migration corridors is one way to begin to build the type of conservation corridors defined by Beier and Noss and advocated by many conservation organizations.

Purpose of this Study

By taking an in-depth look at current conservation strategies and challenges associated with three contemporary efforts to conserve ungulate migrations, this study aims to add a ground-level analysis to the current universe of more general recommendations currently provide in literature for the successful conservation of overland migration corridors. Because the individual case studies and details behind migration conservation initiatives are generally treated with little depth in the literature, the three case studies and the analysis presented within this document provide insight into on-the-ground best practice techniques and tools which could improve migratory species conservation efforts. We feel these methods are seldom discussed in the scientific or management literature and could lead to more dynamic conservation efforts.

This study focuses on the first step in the design of any corridor conservation strategy, preserving connectivity for species that depend heavily upon long-distance movements. Many organizations, discussed later in the chapter, have identified conservation corridors as useful tools to preserve species in the face of increasing habitat fragmentation from development of human settlements and the effects of climate change. This study closely examines the conservation of migration corridors as a way to understand some of the challenges and best practices surrounding the protection of sustainable and functional wildlife corridors.

We selected only existing migration corridors because they represent the simplest form of a conservation corridor. These migration routes fit the definition of a corridor as provided by Beier and Noss "a linear habitat, embedded in a dissimilar matrix, that connects two or more larger blocks of habitat" (Beier & Noss, 1998). They also confer the analytical advantage of forgoing the question of use. Having survived the existing levels of development and possible effects of climate change they are likely robust. From an ecological standpoint, it is simple to preserve a corridor with an established migratory population. Much less is known about preserving corridors for long term migrations of species as our climate changes. By identifying the challenges to conservation of these migration corridors, we establish a baseline for the minimum requirements for more complex corridor conservation. It is not intended to be an endorsement of single-species management principles, but rather an example of how a single-species focus can play an important role in ecosystem management. The conservation strategies, challenges, and opportunities for the mule deer, pronghorn, and elk can apply to the less far-ranging species that are found within these same ecological communities. It is not the intent of this study to determine if corridors are the solution to conservation of migratory species but rather to examine how the current suite of conservation strategies are being utilized by managers and NGOs and to draw conclusions across cases about what is and is not working on the ground.

Growth of Interest in Migration Conservation Efforts

The number of public and private entities concerned with wildlife corridors is increasing and the issue has now become a well-recognized concern in the environmental and wildlife fields. Notable authors in the field of conservation biology, such as Michael Soule and John Terborgh, authors of *Continental Conservation: Scientific Foundations for Regional Conservation Networks* (1999), and Dave Foreman, author of *Rewilding North America* (2004), published on the topics of wildlife corridors and have proposed management solutions to protect migrations and create linkages between existing habitat spaces such as national parks and wildlife refuges. This interest from the academic community in wildlife movement or migrations, and in finding solutions to habitat loss and fragmentation, triggered NGOs and federal and state management agencies to take action on the topic.

The Soule and Terbough publication was complied for the Wildlands Project, which was cofounded by Soule and later renamed the Wildlands Network. This organization is built on providing a "science-based vision for wildlife, people, and nature in the 21st Century" (Wildlands Network, 2008). On their website, the Wildlands Network states that while its "call for restoring keystone species and connectivity was met, at first, with amusement, these goals have now been embraced broadly as the only realistic strategy for ending the extinction crisis" (Ibid.). This statement articulates the past struggle interested groups faced in undertaking connectivity issues so that decision makers would take actions to conserve spaces for migrating wildlife. The current opportunities that exist to tackle these conservation challenges are due to the acknowledgement of the importance of wildlife migrations and habitat connectivity.

Some of the increasing interest in habitat connectivity involves work at the multi-ecoregion level. For example, one group working in the Greater Yellowstone Ecosystem is the Yellowstone to Yukon (Y2Y). Their "primary goal is to ensure that the Yellowstone to Yukon region retains enough connected, well-managed and good-quality wildlife habitat so that animals can safely travel between protected areas… as they roam in search of food and mates" (Yellowstone to Yukon, n.d.). Officially established in 1997, Y2Y is a network made up of individuals, environmental nongovernmental organizations, businesses, and foundations. Most of what Y2Y does involves working as a "guide and connector" to those organizations and individuals working on conservation issues in the Yellowstone to Yukon region. They help disperse funds, share science-based information, and help create partnerships between organizations and individuals belonging to their network (Ibid.).

Similarly, Freedom to Roam (FTR) is a coalition much like the network of Y2Y and is made up of "corporations, state and federal agencies, recreation, hunting, and fishing groups, environmental organizations, ranchers, and others who seek ways for the needs of people and the current and future needs of wild animals to co-exist" (Freedom to Roam, 2009). This organization was first funded by and under the umbrella of the clothing company Patagonia, but now it is a project of the Tides Center. Soon FTR will be its own independent nonprofit. Projects underway by FTR include creating a "Corridors Hot Spots Map" along with trips and programs for citizens to address important wildlife corridors in the United States (Ibid.).

Unlike the two newer organizations, The American Wildlands (AWL) has been working for the last 30 years advocating for wild places in the Intermountain West. Initially they worked on securing wilderness designation for public lands. In the 1980's AWL broadened its focus and began monitoring resource extraction (i.e. logging) on public lands. In the 1990's AWL again shifted its focus and "became a leader in advancing the concept of habitat connectivity and wildlife movement corridors…" (American Wildlands, n.d.) Two of its programs, "Corridors of Life" and "Safe Passages" directly relate to wildlife migration and corridor conservation. Groups like AWL have been present to help shape policy and new initiatives.

Planning for wildlife corridors is becoming increasingly important to policy-makers in the West. Recently the Western Governors' Association (WGA) has also taken steps to recognize and develop strategies for western states to protect wildlife corridors. Their initial action came in February 2007 when the WGA passed a policy resolution to protect wildlife migrations and critical habitat in the West. This resolution stated the context in which wildlife migrations need to be preserved—over a mosaic of landownership and crossing political boundaries in states reliant on the economic, ecological, and cultural value of intact wildlife migrations (Western Governors' Association, 2007). In addition to the background information guiding the policy resolution, the WGA issued a policy statement to Congress to amend sections of the Energy Policy Act of 2005 which allow for categorical exclusions of National Environmental Policy Act (NEPA) reviews for oil and gas exploration in wildlife corridors and crucial wildlife habitat on federal lands (Ibid.). Jointly, the WGA asked the Secretaries of the Interior and Agriculture to consider placing a moratorium on categorical exclusions in areas of critical wildlife habitat and migration corridors (Ibid.). Their call for policy changes also addressed federal and state land managers and their responsibility to provide appropriate environmental analysis and monitoring in areas of natural resource development (Ibid.).

Around the same time as the June 2008 WGA conference in Jackson, Wyoming, the WGA released a document which established the *Western Wildlife Habitat Council* (WWHC) along with a report in which six working groups created chapters on Science, Energy, Transportation, Land Use, Climate Change, and Oil and Gas [development] in relation to wildlife migrations (Western Governors' Association, 2008). The purpose of the WWHC is to "coordinate and manage implementation of the *WGA Wildlife Corridors Initiative Report,"* and "eventually may become an independent, affiliated organization…" (Western Governors' Association, 2008, p. 1). The report established common themes, including the need for science-based research and inventory of critical corridors and wildlife habitat; the role each Western state should take in identifying wildlife corridors and crucial habitat and in prioritizing wildlife areas to govern appropriate actions by the states when considering development; and a call to take to identify appropriate measures to address conservation practices on both public and private lands (Western Governors' Association, 2008, pp. 5-6).

NGOs commonly help state and local governments address and identify conservation priorities regarding wildlife migrations and corridors. In California, recognizing that there was little coordinated statewide effort to "systematically identify, study, and protect wildlife corridors" the California Wilderness Coalition, The Nature Conservancy, and others produced *Missing Linkages: Restoring Connectivity to the California Landscape* in 2001 (Beier, 2006). The report was seen as "the first step in saving those threatened wildlife corridors--identifying exactly where [the corridors] are". However, while the report focused on raising awareness and on identification of migration corridors, it did not comprehensively explain what efforts were underway for migration corridor conservation and the challenges and successes that organizations faced in migration corridor conservation. Within the report, the problems were highlighted, but there was a lack of how strategies were being implemented and what could serve as models and evaluations of success.

There are new efforts underway in California to protect corridors, or habitat linkages, for wildlife to roam. South Coast Wildlands (SCW), a not-for-profit conservation group, "dedicated to ensuring functional habitat connectivity across the South Coast Ecoregion" (South Coast

Wildlands, n.d.) has developed a number of comprehensive linkage designs and implementation strategies based off the 2001 report. A sampling of the most recent reports include “A Linkage Design for the Joshua Tree—Twenty Palms Connection” in 2008; “South Coast Missing Linkages: A Wildland Network for the South Coast Ecoregion” in 2008; “South Coast Missing Linkages: A Linkage Design for the Peninsular-Borrego Connection” in 2006; and “South Coast Missing Linkages: A Linkage Design for the Santa Monica-Sierra Madre Connection” in 2006. SCW works with scientists, NGOs, land manager and planners, and regulatory agencies to “develop and implement regional conservation strategies” (Ibid.).

Corridor Design developed their approach to protecting wildlife corridors while working on the 2001-2006 SCW “Missing Linkages” reports. This independent organization uses analysis tools, such as geographic information systems (GIS), to make knowledge from experts available to the general public to facilitate better conservation of corridors. The group is funded by a grant from Northern Arizona University and also worked with the Arizona Missing Linkages Project. (Corridor Design, 2008)

Similar to the SCW in California, there are other state efforts in place across the West. In Arizona, the Arizona Wildlife Linkages Workgroup created an assessment on the State’s wildlife linkages in collaboration with nine public agencies and beginning in April 2004 (Arizona Wildlife Linkages Workgroup, n.d.). The assessment was undertaken due to increased urban development and “presents challenges regarding highway safety and conservation of our wildlife resources for the future” (Ibid.). The assessment includes a map of linkages and conservation priorities. This assessment, like others, is also missing implementation and guidance to oversee conservation projects (Ibid.).

The assessment by the Arizona Wildlife Linkages Workgroup primarily addressed the issue of transportation and highway vehicle and wildlife collisions. Similarly, the Southern Rockies Ecosystem Project (SREP), “a non-profit conservation science organization working to protect, restore and connect ecosystems in the Southern Rockies of Colorado, Wyoming and New Mexico” (Southern Rockies Ecosystem Project, n.d.a), and the Colorado Department of Transportation developed the “Linking Colorado’s Landscapes” project (Ibid.). This initiative also worked with regional experts to identify priorities such as key wildlife crossings. In addition it included phases for implementation—building off the established priorities. (Southern Rockies Ecosystem Project, n.d.b).

It is into this context of existing conservation work that this study must be placed. The majority of research completed on corridor conservation and the importance of preserving migration, has been general and theoretical. Our study uses the understanding created by this existing analysis and examines what is being done on the ground to conserve ungulate migrations in three contemporary case studies in the Western U.S.

Research Questions

The following research questions guided our examination of the conservation strategies and challenges associated with our three case studies of ungulate migrations in the Western U.S.:

1. **Threats**
   a) What are the current and anticipated threats to seasonally migrating ungulates in the Western U.S.?
   b) What strategies have been employed, with what effect, in addressing these threats?
   c) What strategies appear to be more and less effective and why?
2. **Land Management and Legal Frameworks**
   a) What entities have authority to manage the land over which ungulates migrate and what is the legal context in which they do so?
   b) How are these entities acting to address the threats to migrating ungulates?
   c) As grounded in entities' interpretations of their legal frameworks, what management challenges exist for addressing threats to migrating ungulates?
3. **Wildlife Agency Response and Conservation Strategies**
   a) How do wildlife agencies in identify threats, develop responses, implement strategies, and monitor effectiveness in conservation efforts?
   b) What facilitates and what constrains wildlife agency action to address the threats to migrating ungulates?
4. **Response by Non-governmental Organization and Conservation Efforts**
   a) What NGOs are involved in conservation efforts involving migrating species?
   b) How do different kinds of NGOs employ conservation strategies to provide for habitat and wildlife conservation? [In other words, when are they involved and how are they involved?]

c) What facilitates and what constrains NGO involvement and influence in each of these four stages of the conservation process?

5. Communication Strategies

a) What approaches have been taken, by whom, to raise awareness of these parties and motivate their conservation behavior? What were the considerations in choosing these approaches?

b) What approaches appear to be more and less effective and why?

c) What appear to be the greatest challenges and opportunities in raising awareness and motivating behavior?

Research Methods

To answer the research questions listed above, we chose to follow a case-study approach, first selecting three long-distance ungulate migration corridors in the Western U.S. to examine. In order to identify conservation strategies being employed within each case study we used a literature review, interviews, and additional research. We next completed a variety of cross-case analysis chapters examining threats to the migrating ungulates in our case studies and the conservation strategies and challenges being applied to address these threats. Our conclusion involved additional analysis to identify the key challenges and best practices for conservation of ungulate migration corridors.

I. Initial Case Study Investigation

This study uses three case studies to explore contemporary efforts aimed at the conservation of long-distance ungulate migration corridors in the Western U.S., and, ultimately, to identify both challenges and best practices associated with the conservation of ungulate migrations. We determined that a case study approach would be a good method to employ because it would provide for both in-depth study and cross-case comparison of on-the-ground efforts aimed at conservation of migration corridors, an issue not often or thoroughly discussed in management documents. Additionally, the research questions we were interested in asking were "how" and "why" questions focused on particular contemporary events, for which Gray (2004) has indicated a case study methodology is suited. We also determined that using semi-structured interviews in the context of a case study approach would give us the ability to capture a level of detail not available in publications, provide an on-the-ground perspective of managing for migration routes, and help us understand the social dynamics surrounding each migration route and migrating population. Using case studies ultimately allowed us to derive conclusions based on the information we learned in interviews and research through a deductive process, rather than an inductive, hypothesis-driven approach (Gray, 2004).

After developing the research questions listed above, our investigation into the topic of long-distance ungulate migrations began with efforts in the towns of Pinedale and Jackson, Wyoming focused on the Grand Teton National Park pronghorn migration. Through introductions and opportunities to engage in local events, made possible by the Green River Valley Land Trust and Bridger-Teton National Forest, we interviewed a diverse set of individuals, organizations, and agencies interested in the migration route and were immersed in tthe culture of the area. This experience helped us to identify issues related to the ability of ungulates to migrate long distances and to better understand the cultural and ecological importance of their migration and migration routes. Ultimately we decided to incorporate this work into a broader study of multiple ungulate migration routes in order to see how the lessons we learned from the pronghorn route applied to other migrations and to draw conclusions based on an examination of the threats and management actions across cases.

II. **Literature Review**

After deciding to use a case-study approach, we conducted a preliminary literature review to guide our selection of case studies. We began by reviewing scientific studies discussing long-distance migrations, purposefully focusing on overland, seasonal migrations. Berger's review article, *The Last Mile: How to Sustain Long-Distance Migration in Mammals* (2004), served as an excellent source for identifying the universe of long-distance, overland, seasonal migrations, and we chose to use his definition of a migration as a "seasonal round-trip movement between discrete areas not used at other times of the year" (p. 321). This definition focused our study on migrations that move over lands with complex ownership patterns, and therefore are a greater challenge to conserve.

III. **Selection of Case Studies**

After a lengthy literature review we determined that the methods used by in Berger's review article, *The Last Mile: How to Sustain Long-Distance Migration in Mammals* (2004) identified a large enough pool of long-distance migrations, over 100, from which to select our case studies. We conducted initial research on a number of migration routes, focusing on overland, seasonal, and long-distance migrations, early on identifying a fourth criteria of migration by an ungulate species in order be able to more easily compare threats and management actions across case studies. We narrowed our selection by looking for migration routes that fit other shared criteria, including that the migrations were mainly, or only, within the U.S.; that we found evidence of stakeholder interest in the migration route, such as by an NGO campaign focused on the migration route; and that there were anthropogenic (or human-caused) threats to the migration route. We further narrowed our list of potential cases by seeking diversity across case studies in species, jurisdiction, and other characteristics, listed below, to make for a richer and broader array of threats and issues. The final three case studies we selected are listed in Table 1.1 below.

Table 1.1, Criteria for selection of case studies

	Round Valley mule deer migration	**Grand Teton National Park pronghorn migration**	**Clarks Fork and Cody elk migration**
Criteria shared among case studies			
Annual seasonal migration	X	X	X
Migration of at least 70 km round trip over land	X	X	X
Migration of an ungulate	X	X	X
Migration within the U.S. only	X	X	X
Stakeholder interest in conservation of the migration	X	X	X
Anthropogenic threats to migration exist	X	X	X
Criteria for ensuring variety among case studies and applicability to a broader sample of migrations			
Ungulates	Mule Deer	Pronghorn	Elk
Number of individual animals	2000-3000	300	5000-6000
States (management jurisdictions)	California	Wyoming	Wyoming
Level of human development	Medium; increasing	High; increasing	Low
Our initial perception of the level of threat	Medium	High	Low

IV. **Interviews**

Next we developed interview questions targeted at specific agencies and organizations, conducted interviews for each case study, and completed narratives for each case study. From January 2008 to March 2009 we conducted semi-structured interviews with a variety of organizations and agencies for the mule deer and elk case studies. Our interviews in May 2008 in Wyoming were conducted using a similar set of interview questions. Table 1.2 summarizes the numbers of individuals interviewed, by agency or organization. Chapters 2-4 provide narratives for each of the case studies we examined.

Table 1.2, Number of individuals interviewed by agency or organization

U.S. Forest Service employees	14
Bureau of Land Management employees	3
State agency employees	10
County and Municipal Planners	7
University/Co-op Extension	1
Other Public Official	3
Non-Governmental Organization employee	13

V. **Cross-Case Analysis**

Using the information gathered from the interviews and additional research, we completed cross-case analysis chapters to answer each set of research questions listed above. We first used information collected from literature and interviews to generate a list of threats faced by each migrating ungulate herd, the results of which are synthesized in Chapter 5. Using our understanding of threats to the three ungulate migrations, results from our literature review and interviews, and additional research, we analyzed the strategies being employed by managers and NGOs to address these threats and identified challenges associated with addressing these threats.

Specifically, Chapter 6 focuses on conservation strategies employed by governmental entities that have responsibility to regulate land use on the habitat through which the ungulates migrate, i.e., the land use planners and managers. Chapter 7 examines the strategies employed by governmental entities that have responsibility to manage the ungulate populations themselves, the wildlife managers. Chapter 8 looks at the strategies NGOs have employed to ensure threats to the migrating ungulate species are addressed. Chapter 9 examines, in particular, the varying communication strategies used by entities falling within all of these groups. In each of these chapters management challenges are identified for addressing threats to migrating ungulates and ensuring the continuance of migration corridors.

VI. **Conclusions**

After completing our cross-case analysis chapters we identified ten challenges and corresponding best practices for conserving ungulate migrations. These conclusions can be used to inform the efforts of the many individuals, organizations, and agencies concerned with conservation of overland migration corridors and to add a ground-level analysis of best practices to the current understanding of the importance of migrations.

Section II
Narratives for Case Studies of Migrating Ungulates

The following chapters describe the three ungulate migrations: Round Valley mule deer in the Sierra Nevada, California, Grand Teton National Park pronghorn in the Upper Green River Basin, Wyoming, and Clarks Fork and Cody elk in the Absaroka Divide, Wyoming. Within each chapter is background information about the particular migrating herd, including a description of the route; summaries of the threats; involved organizations; and conservation status. These narratives were written to support the cross-case analysis within Section IV and conclusions in Section V. Information was attained through literature and media review and through interviews with practitioners, managers, and conservation leaders.

Chapter 2
Round Valley Mule Deer Herd, Sierra Nevada, California

Introduction and Background

As the snow melts in early April on the eastern Sierra Nevada of California, a long-distance migration begins for thousands of Rocky Mountain mule deer (*Odocoileus h. hemionus*) (see figure 2.1) eager to leave their heavily-browsed winter grounds in Round Valley (Kucera, 1988b; Kucera, 1992). These deer will traverse an average of 67 kilometers[1] in search of lush summer pastures at higher elevations in the Eastern Sierra (Berger, 2003). Bitterbrush and sagebrush are the most important source of nutrition for the migrating deer, although they also seek forage of perennial grasses, annual grasses, and forbs (Kucera & Mayer, 1999).

Figure 2.1. Mule deer in the Sierra Mountains. Photo Credit: Randomtruth 2009

The herd of approximately 2000 migrating animals, as estimated in 1997[2] (Pierce, Bowyer, & Bleich, 2004), is today commonly referred to as the Round Valley mule deer herd, after their primary, shared wintering grounds just west of Bishop, CA. The deer reside in Round Valley from approximately October 15 through May 15 (Bleich, Pierce, Jones, & Bowyer 2006), splitting into two groups to move into higher elevations when the snow recedes (Kucera, 1992). One group migrates north and west, the other, south and west (Ibid.). A portion of the deer in each migrating group will remain to summer on the eastern side of the Sierra, while a majority of

[1] The maximum distance traveled by the deer one-way is 96 kilometers (Berger, 2004).

the migrating deer cross over the crest of the Sierra (Ibid.); in the north they cross to Sierra National Forest and, in the south, to Kings Canyon and Sequoia National Parks (Kucera, 1988b). Radio collaring and visual confirmation have shown that individual deer have strong fidelity to their summer ranges, returning to the same location in consecutive years (Kucera, 1992). There is evidence, however, that the percentage of deer crossing the crest of the Sierra has decreased from more than 85% (Kucera, 1992) to potentially less than 50% (V. Bleich, personal communication, January 8, 2009).

The Sierra Nevada provides a moist vegetated west slope with abundant summer range, but its arid and steep eastern slopes create a topographically-limited winter range for mule deer. The Round Valley mule deer's combined summer range spans 2500 km^2 (Kucera, 1992) at elevations of 2,200 to >3,600m (Kucera, 1988b), while they use approximately 90 km^2 of Round Valley at the base of the eastern Sierra Nevada as a winter range (Kucera, 1992). Vegetation on the summer range includes sagebrush, Jeffrey pine, Lodgepole pine, Red fir, among others, (Storer & Usinger, 1968), while vegetation on the winter range is mostly sagebrush and bitterbrush, providing important winter forage for the mule deer, with some Pinon pine, Mahogany, and Blackbrush (Storer & Usinger, 1968; Kucera, 1997; Loft et al., 1998). The winter range is bounded by the steep Wheeler Ridge to the west and the deep canyon of Lower Rock Creek Gorge to the east, and includes a 1-mile natural bottleneck near the community of Swall Meadows that north-migrating deer must pass through (Eastern Sierra Land Trust, 2006). Additionally limiting the winter range has been a series of severe fires in the late 1990s that covered more than 10,000 acres total and burned extremely hot, leading to slow regeneration of sagebrush and bitterbrush (Pierce, Bowyer, & Bleich, 2004).

Areas used by migratory mule deer also support a full complement of native carnivores which are the main predators to the mule deer. These include mountain lions (*Puma concolor)*, coyotes (*Canis latrans)*, and bobcats (*Lynx rufus)* (Pierce, Bleich, & Bower, 2000).

I. **Management and Development Along Route**

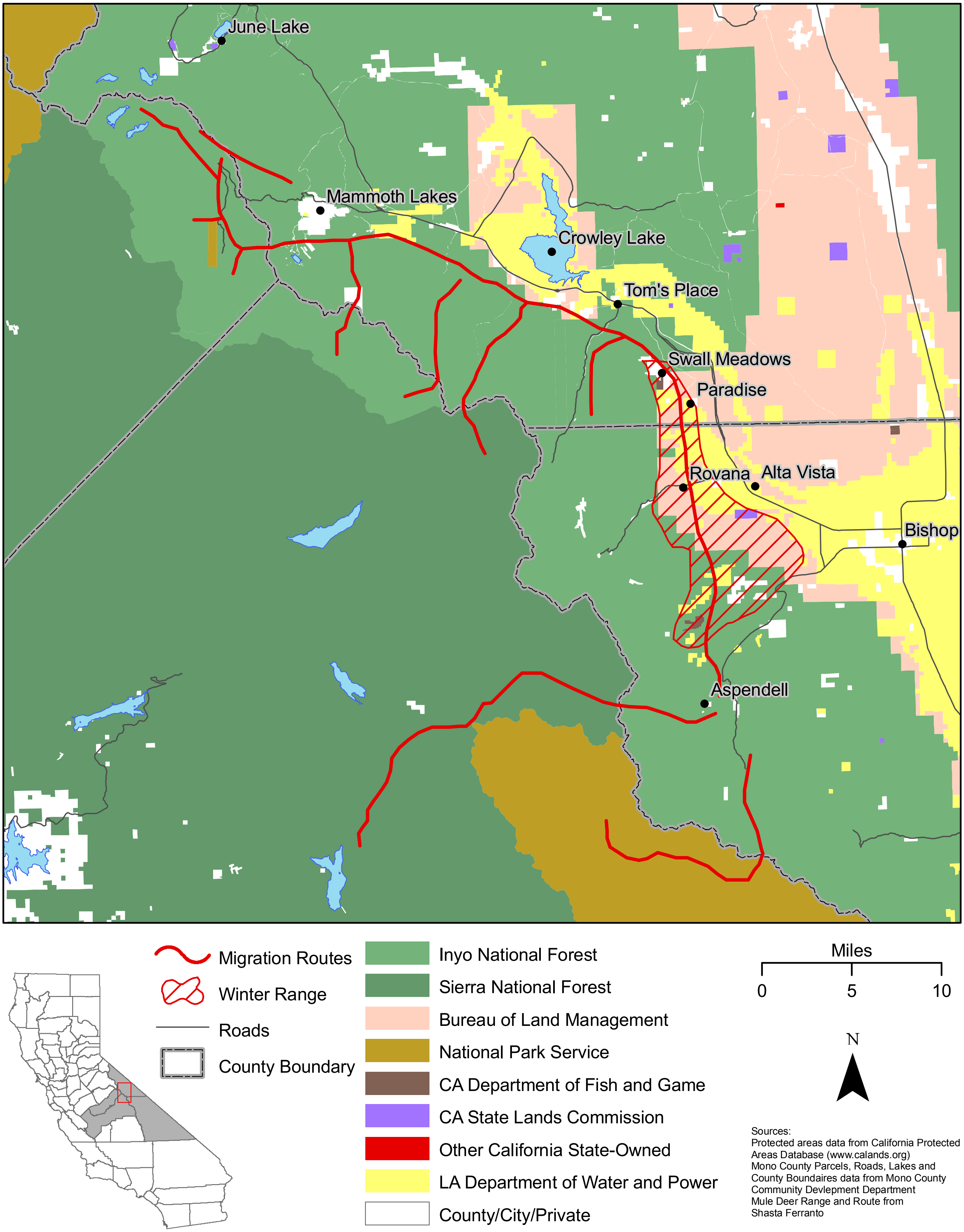
Lands within the Round Valley mule deer seasonal ranges and migration corridor include both private and public lands that are managed by a variety of governmental entities, as illustrated by Map 2.1. The winter range straddles the county line between Mono and Inyo Counties, and includes the un-incorporated, small towns of Swall Meadows, Rovana, and Paradise. The portion of the herd that moves north passes near multiple small residential communities within Mono County on the way to a spring holding area that includes the incorporated town of Mammoth Lakes. Those deer that cross the Sierra crest find themselves within Madera and Fresno Counties. The portion of the herd that moves south maintains a holding area in Inyo County, and those that cross the crest are within Fresno County (see, e.g., Kucera, 1988b).

The remaining lands along the northern and southern route are held mainly by the U.S. Forest Service (USFS) as part of Inyo National Forest. The Bureau of Land Management (BLM) and Los Angeles Department of Water and Power hold most of the remaining parcels to the north and south.

The winter range is primarily composed of lands managed by BLM and the Los Angeles Department of Water and Power, with a small parcel held by the California Department of Fish and Game (CDFG). The northern summer range for the deer that cross the Sierra crest is largely held by USFS as part of Sierra National Forest, although Devil's Post Pile National Monument, part of the National Park Service, is also in the summer range. The southern summer range includes Kings Canyon and Sequoia National Parks as well as Sierra National Forest.

Privately-owned lands within the winter range and northern migration route face increasing residential development. Both the private lands and the public lands also experience recreation and tourism with Mammoth Lakes being a focal point, particularly for skiing. Camping, hiking, nature viewing, mountain biking, and mountain climbing are also popular throughout the counties. California State Highway 395 runs the distance of the northern migration route.

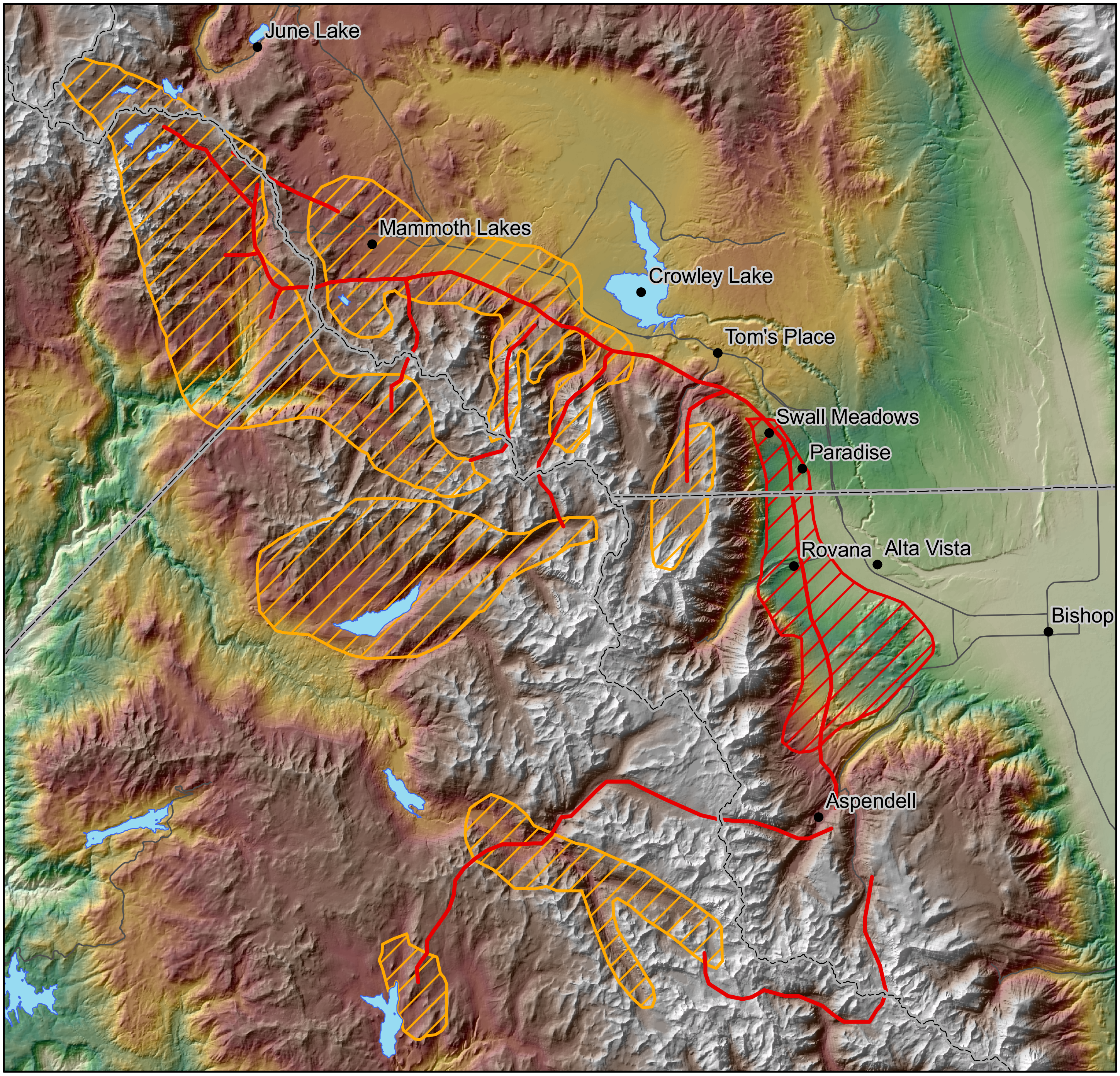
Map 2.1, Land Ownership: Round Valley Mule Deer Migration



Sources:
Protected areas data from California Protected Areas Database (www.calands.org)
Mono County Parcels, Roads, Lakes and County Boundaires data from Mono County Community Devlepment Department
Mule Deer Range and Route from Shasta Ferranto

Layout: A. Fotinos

Map 2.2, Round Valley Mule Deer Migration Routes



Migration Routes

Winter Range

Summer Range

Roads

County Boundary

Miles

0 5 10

Elevation

4330 Meters

230 Meters

N

Sources:
Roads, Lakes and County Boundaires data from Mono County Community Devlepment Department
Mule Deer Range and Route from Shasta Ferranto
DEM data is ~30m resolution from USGS National Map Seamless Server

Layout: A. Fotinos

II. **Significance of Migration and Previous Research**

Most mule deer migrations in the western United States are altitudinal, meaning they move up in the spring and down in the fall (Kucera, 1988b). Few are transmontane migrations, meaning that the mule deer cross over mountains from one side to the other (Ibid.). This makes the Round Valley herd interesting because the unique combination of terrain and climate in the eastern Sierra Nevada provides summer range on one side of the Sierra (the west) and winter range on the other (the east) (Ibid.). The extreme geography of the Sierra limits where the mule deer can cross from one side to the other, but since some prime summer ranges are on the western slopes, many migrating deer will cross (Ibid.). Mule deer are also generally valued for hunting, and sportsmen groups have taken a strong interest in conserving the migrating Round Valley mule deer.

Most of the information about the Round Valley mule deer herd comes from several connected studies. The first significant studies of the migratory Round Valley mule deer herd were conducted by then-PhD student Tom Kucera in the 1980s. At the time there was a proposed expansion of ski facilities in the vicinity of Mammoth Mountain, California, which resulted in funding for the project to study potential effects on the mule deer (V. Bleich, personal communication, January 8, 2009).[3] Kucera's 1988 thesis and subsequent papers set a baseline for knowledge about the migration (Ibid.). The California Department of Fish and Game (CDFG) maintained the continuity of Kucera's work in terms of deer body conditions and population numbers until 1991, funded in part by the California Deer Association (Ibid.). Interest by CDGF, the California Deer Association, and others in studying the population stemmed partially from a large reduction in the herd from 6000 animals in 1985 to less than 1000 in 1991, a six-year period[4] (Pierce, Bowyer, & Bleich, 2004).

From 1991 until 1999 CDFG, with the help of another graduate student, conducted research to try to explain this reduction in numbers, examining the effects of mountain lion predation on habitat use by the herd. They noted that the reduction in numbers coincided with a decrease in the carrying capacity of the winter range occurring through 1988 (Pierce, Bowyer, & Bleich, 2004). When these studies failed to identify a strong link with predation, however, CDFG

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[3] Ultimately, the ski area chose not to expand their facilities.
[4] The herd increased to about 2000 by 1997 (Pierce, Bowyer, & Bleich, 2004) and today has reached about 3000 individuals according to retired CAGF wildlife biologist Vern Bleich (personal communication, January 8, 2009).

turned its focus to examining the proportion of migrating deer, how many were crossing the Sierra crest, and the conditions of the summer range areas. They found that fewer of the migrating deer have been crossing the Sierra crest in recent years (V. Bleich, personal communication, January 8, 2009) than during Kucera's study (1992), and that there is high fawn mortality among those deer that do cross[5] (V. Bleich, personal communication, January 8, 2009). No firm conclusion has been put forth to explain this (Ibid.).

Threats to the Migration

As identified by state and federal land managers, as well as non-governmental organizations, the most significant threats to the migration route and its population are invasive species, fire, and development along the Swall Meadows bottleneck, as well as some development in the Mammoth Lake region.

I. **Fire and Invasive Species**

An increasing threat to the Round Valley mule deer is the invasion of cheatgrass (*Bromus tectorum*) onto the scrubland ecosystems that make up their winter range. Cheatgrass is a common ruderal invasive weed throughout the western United States, and is known to increases fire frequency by increasing the fine fuels that carry fire (Keeley & McGinnis, 2007). Karen Ferrell-Ingram, Executive Director for ESLT states, "The main weed that comes into this migration corridor that is a problem is [Cheatgrass] *Bromus tectorum*" (personal communication, January 14, 2009). Ferrell-Ingram goes on to describe the community changes brought on by cheatgrass: "it really changes in the fire frequency. We are faced with more frequent fires, and the plant communities that the deer and other wildlife depend on are not adapted to that kind of fire frequency. The bitterbrush (*Purshia tridentate*)… that's their [the deer's] main food for the fall and winter is not as well adapted to fire and so we've lost a lot of bitterbrush from fire within the corridor" (Ibid.). Retired CDFG employee and former director of the Round Valley mule deer project confirms that "there have been 2 major fires on the winter range itself…those were accidental starts…if fire destroys a large portion or in fact, any of the mature bitterbrush on the range it could be decades if not centuries before it is reestablished. Bitterbrush is a very

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[5] Poor fawn survival has been recognized as a main reason for a state-wide decline in deer populations in California (California Department of Fish and Game, 1976). According to the CDFG's 1976 deer management plan (currently in the process of being updated), there was an overpopulation of deer in the 1950s, after which the population began to decline. In their management plan CDGF set the goal of achieving 1965 levels in individual herds (Ibid.).

important winter food source [for the deer]" (V. Bleich personal communication, January 8, 2009).

The availability of bitterbrush is affected not only by fire but also by livestock overgrazing. Both of these factors are confirmed in a report conducted by CDFG in conjunction with USFS and BLM on Deer populations and habitat. According to that report, fire management is an issue for deer in Round Valley because successional changes following a fire are slow in the harsh environment reducing the availability of bitterbrush. The report recommends that the agencies consider buying more land to increase the size of the winter range. In the summer range for the Round Valley deer herd livestock grazing varies from none in remote areas to heavy in easily accessible areas east of the Sierra crest (Kucera 1992, 1988). Livestock overgrazing on public lands and a lack of fire management are the key threats in the summer range according to the 3-agency report. Additionally, the report identifies portions of the larger area of Eastern and South Sierra where there is a lack of forage for deer as a priority for management efforts (Loft, et al. 1998).

II. **Residential Development**

Development acts generally to reduce the fitness of mule deer through the generation of habitat loss, habitat fragmentation and physical barriers to movement, and disturbances associated with human activity (Kucera & McCarthy, 1988, Lutz et al., 2003). Land and wildlife managers essentially agree that residential development represents the greatest immediate threat to the continued viability of this mule deer migration route (T. Kucera, personal communication, January, 2009; S. Nelson, personal communication, January, 23, 2009; K. Ferrell-Ingram, personal communication, January, 14, 2009). In addition to the instant effect of habitat loss, development sets in motion what are best described as a series of cascading events, each creating additional sources of stress for the animals. Ferrell-Ingram describes this phenomenon as “everything that comes along with fragmentation; increased traffic, so you’ve got more collisions with deer; increased dogs and pets that harass deer; increased weeds and exotic plants that come in with subdivision…and more roads and more pavement” (K. Ferrell-Ingram, personal communication, January, 14 2009).

Of particular concern to the Round Valley mule deer is the potential for future development near Swall Meadows, at the 1-mile wide migration bottleneck, and near Mammoth Lakes within the spring holding area for those deer migrating north (Kucera & McCarthy, 1988).[6] Although this area provides "no resource other than a travel opportunity" (Ibid.), further development could have deleterious on the continued viability of the migration. There is a similar degree of development within the winter and the migration corridor, while much of the summer range lies within USFS and NPS administered land. Aside from private development and recreational use within the winter range, there is only light livestock use of the area; most grazing of livestock in Round Valley occurs when deer are not present. In this section we present a review of the effects of human development on mule deer and arrive at implications for the optimal management of development in the summer and winter ranges, as well as along the migration route.

III. **Human Activity**

In addition to physical anthropogenic structures, associated activity can significantly affect the behavior, and therefore the fitness of mule deer. Human recreational activities, especially those associated with Mammoth Mountain create substantial sources of stress for the Round Valley herd. While there has been some disagreement within the management community as to the severity of the stress associated with human recreation, there is reason to believe that it may be substantial. During the period of coincidence of human recreational activity and deer migration, vehicle kills are not uncommon (Bleich et al., 2006). Wildlife managers generally agree that vehicular traffic represents a substantial threat to the migratory mule deer population. There is much less agreement within the management community as to the extent of stress on the mule deer herd resulting from "lower impact" recreation, such as hiking, rock climbing, etc.

IV. **Predation**

Scientific inquiry aimed at the identification of factors affecting the viability of the migratory mule deer population has often focused on effects of predation, primarily indicating coyotes and mountain lions. The results of the early work have been largely unequivocal, with one researcher explaining "[w]e could not come up with…any clear indication that predation played any role whatsoever in the dynamics of this deer population." (V. Bleich, personal communication, January 8, 2009). With the role of predation on the deer's winter range largely ruled out, researchers have turned their attention to the summer range, investigating predator-

[6] CDFG studied a proposed development in 2003-2004 involving a subdivision and Los Angeles Department of Water and Power (LADWP) in the winter range but that might be near Swall Meadows – see CDFG; Rimrock Ranch proposed development in 2000 according to Linkages report.

prey dynamics in this portion of the habitat (Ibid.). Although a causal link between summer range predation and the fitness of migrants has not yet been demonstrated, many researchers maintain this hypothesis is due to the drastic decrease in the percentage of the herd that completes the entire migration in recent decades (Ibid.). This shift sends somewhat mixed messages for those engaged in mule deer conservation. On one hand, the large percentage of the population that is viable without making the summer migration is encouraging in terms of the absolute persistence of the herd. Conversely, any reduction in range necessarily comes with an ultimate reduction in the absolute carrying capacity (K) of a herd (Ballard, Lutz, Keegan, Carpenter, & deVos, 2001). Therefore, inquiry into the mechanisms driving reductions in the percentage of migratory animals is a worthwhile pursuit, and there are sound theoretical grounds for investigating predators as a possible factor driving herd numbers down.

Involved Organizations

V. **Governmental agencies**

A. **California Department of Fish and Game**

The California Department of Fish and Game (CDFG), within the California Resources Agency, manages the mule deer population in California although it relies on other state and federal agencies for most of the associated habitat management (Loft et al, 1988). The CDFG "maintains…species and natural communities for their intrinsic and ecological value and their benefits to people" through habitat protection and maintenance and management of recreational, commercial, scientific, and educational uses (California Department of Fish and Game, n.d.a). CDFG is also tasked with commenting, often in regards to mule deer as an indicator species, on the environmental impacts of other state and local agency projects that are subject to review under the California Environmental Quality Act (Loft et al., 1998).

CDFG has staff dedicated to implementing a deer management program; these staff monitor deer populations and habitat quality with the help of other agencies and groups (California Department of Fish and Game, n.d.c). CDFG is currently developing new goals for their program within a *Strategic Plan for California Deer* because they believe the goal they are currently working under, a goal set in a 1976 plan to restore deer populations to those of 1965, is no longer realistic (Ibid.). The CDFG is also currently conducting a Fresno County Fawn Mortality Study to determine why there are high levels of mortality among fawns in the group of

Round Valley mule deer that summer to the west of the Sierra crest (Mule Deer Foundation, n.d.).

B. **California Fish and Game Commission**

The California Fish and Game Commission, a group of five governor-appointed members who are independent from the CDFG but also part of the California Resources Agency, also plays a role in the management of mule deer populations, setting hunting restrictions that take into account recommendations made by the CDFG (California Game and Fish Commission, n.d.) Hunting restrictions extend to federal public lands, and hunting is allowed on all of the public land within the migration route, excluding only NPS lands (Loft et. al, 1998). In the late 1990s the Commission requested that the CDFG work with the USFS and BLM to devise ways to improve habitat for deer on public lands, so the three agencies completed an assessment on deer populations and habitats throughout California (Ibid.). The report identified closed timber or shrub stands in the eastern Sierra as a priority for agency work, but neither Inyo nor Sierra National Forests participated in the workshop (Ibid.).

C. **United States Forest Service – Inyo National Forest**

Although federal agencies do not manage populations of individual species, the USFS and BLM are generally responsible for maintaining habitat for wildlife under their jurisdiction through multiple-use mandates that require them to manage their land to meet multiple goals. Inyo National Forest is a major land owner along the northern and southern migration routes (Kucera, 1988b; see Map 1.1). Inyo National Forest currently operates under a 1988 Land and Resource Management Plan, commonly known as a forest plan (Inyo National Forest, 1988). The forest plan provides general guidance calling for maintenance or enhancement of "key winter ranges, holding areas, migration routes, and fawning areas," (Ibid., p. 98), although the forest is not currently engaged in many habitat enhancement or improvement projects, instead focusing on fire prevention and control (R. Perloff, personal communication, January 23, 2009).

D. **Bureau of Land Management – Bishop Field Office**

BLM is a major land owner within the winter range and also owns some parcels of the northern and southern migration routes (Kucera, 1988b). BLM also operates under a management plan, the Bishop Resource Management Plan finalized in 1993 (Bureau of Land Management, 1993). The plan provides seasonal protection of the Round Valley mule deer herd within their winter range and yearlong protection of the Round Valley mule deer herd within the corridor, along with a goal of acquiring private land acquisition to provide protection of additional mule deer habitat within these areas (Ibid.).

E. **Los Angeles Department of Water and Power**

The Los Angeles Department of Water and Power also owns land within the winter range as well as within the northern and southern migration routes, largely in connection with an aqueduct supplying water from Owens Valley to the city of Los Angeles (Kucera, 1988b; see Map 1). Los Angeles Department of Water and Power maintains an office in Bishop and manages for watershed quality (B. Tillemans, personal communication, January 12, 2009).

VI. **Non-governmental Organizations**

Multiple local and some national, non-profit groups have taken interest in ensuring that a healthy Round Valley mule deer herd, and viable migration route, continues to exist.

A. **California Deer Association**

The California Deer Association (CDA) is a non-profit state-wide wildlife conservation organization. It was founded in 1996 by a sportsmen's organization focused on protecting deer populations and habitats. Their goal is to spend "75% of every net dollar into on the ground projects." CDA money is spent on habitat improvement, research, land acquisition, local/youth projects, and education. They award funds to private and public organizations that propose projects within the scope of CDA's mission to "improve our California deer herds and other wildlife through direct financial support for habitat improvement and research projects" (CDA, 2009). CDA has been involved with the CDFG-led Round Valley mule deer research project for several years, providing $10,000 in 2008. It also awarded $50,000 to the Eastern Sierra Land Trust to procure an easement in the migration corridor (CDA, 2006).

B. **Eastern Sierra Land Trust**

The Eastern Sierra Land Trust (ESLT) is a relatively new organization but one of the main advocates for conservation of the Round Valley mule deer herd migration corridor. ESLT serves Mono and Inyo Counties, and was founded in 2001. The Round Valley mule deer herd wintering habitat and migration are important conservation issues to ESLT (K. Ferrell-Ingram, personal communication, January 14, 2009). Individuals living in the community of Swall Meadows had mixed success at raising awareness of the issue of corridor restriction for the deer and, growing concerned with development within the 1-mile bottleneck near Swall Meadows; they looked to establish a land trust to conserve private land through conservation easements

(Ibid.). ESLT established its first three conservation easements, all of which were donated, on a total of 62 acres near Swall Meadows (Eastern Sierra Land Trust, 2006; Eastern Sierra Land Trust, n.d.). The group also received a grant in 2006 from the CDA to help place more winter range of the herd in a conservation easement (Eastern Sierra Land Trust, 2006). CDA has provided additional funding to ESLT to raise awareness of the mule deer through brochures and other information dissemination (K. Ferrell-Ingram, personal communication, January 14, 2009).

C. **Mule Deer Foundation**

The Mule Deer Foundation (MDF) is a multi-state organization which has spoken in support of CDFG's efforts to monitor the Round Valley mule deer population and has provided input to CDFG and the Fish and Game Commission on deer management in general (Fletcher, 2008). Similar to CDA, MDF has a mission "to ensure the conservation of mule deer, black-tailed deer and their habitats". They also have provided funds for the fawn-mortality study in 2006 (Monteith & Bleich, 2007), and volunteers on education projects for local schools (California Deer Association, 2009b). They also occasionally partner with other organizations such as CDA for habitat restoration projects (Meulengracht, 2009).

D. **Other groups interested in wildlife migration in California**

Other state and federal agencies and non-profits have shown an interest in conserving migration corridors in general in California. In 2000, the California Wilderness Coalition and the Nature Conservancy, joined with the Zoological Society of San Diego, the Biological Resource Division of the United States Geological Survey, and California State Parks, to hold a conference to discuss and collect information on wildlife corridors and the state of habitat fragmentation in the state. At least 12 other non-profits were named partners in the Missing Linkages report they produced from the conference and many more had representatives in attendance. The goal was to locate wildlife corridors and identify threats to their continued existence, as well as to raise awareness about the need to protect these areas. Their resulting report, *Missing Linkages: Restoring Connectivity to the California Landscape*, while not naming the Round Valley mule deer herd, identified development along the winter range as the most significant threat to the path of the migratory herd (Penrod, Hunter, & Merrifield 2001).

Conservation Summary

Non-governmental and governmental organizations are addressing the Round Valley mule deer migration in different ways. As noted, the main NGO's currently engaged in conservation of the Round Valley mule deer migration corridor are the ESLT, the CDA, and MDA. The most invested and involved in conservation of the mule deer habitat and migration is the ESLT, with their primary tool for conservation being the conservation easement. By forming informal partnerships with local resource agencies and other conservation organizations, ESLT has raised awareness of the migration corridor issue to help with conservation of the corridor in and around the Swall Meadows bottleneck. With some funding from the CDA, other sources and donations, ESLT has focused on raising awareness through its newsletters, information on its website, limited environmental education programs, organizing field trips, connecting the corridor issue with overall conservation of the area, and organizing symposiums and festivals to bring conservation organizations and the community together to learn not just about the issue but also about overall conservation efforts.

Federal, state, and local agencies address some of the threats within the Round Valley mule deer migration corridor based on their respective missions and management plans. The two most significant threats to the continuation of the Round Valley mule deer are the pressures from residential development and human activity. These threats are difficult for wildlife managers to address beyond the identification of critical habitat. The threat from fire on the winter range and migration route is best managed by continuing the reseeding of bitterbrush, in order to replace and reduce the establishment of cheatgrass. Predation will not be viewed as a threat of high priority for managers unless it is established that human activity is increasing the risk of predation.

CDFG has been one of the most involved agencies with the migration corridor issue through its focus on conducting research on the Round Valley mule deer herd. The research projects have resulted in over 10 years of studies that focused on predation, habitat quality, mapping route, development impacts. A strategy that has allowed them to pursue research projects has been partnering with academic institutions and other NGO's in order to increase resources and funds.

The value of partnerships was identified on various levels between other private and public groups. The Wildlife Conservation Board is providing public funds to increase the number of easements in the migration corridor. Additionally, the Mono County Collaborative Planning Team created a memorandum of understanding among several agencies, including Mono County as well as CDFG, Caltrans, LADWP, and local national forests regarding mule deer habitat. The collaborative planning team came about recognizing that “While the specific missions of the entities involved in this collaborative planning process may differ, there are many more similarities in resource and socioeconomic responsibilities, concerns and opportunities” (Mono County Collaborative Planning Team 2000). Much of the team’s work has been on invasive species, and less on habitat and population management of deer but the process has provided the opportunity for increased communication on management and planning decisions.

Chapter 3
Grand Teton National Park Pronghorn Herd, Upper Green River Basin, Wyoming

Introduction and Background

In the southern portion of the Greater Yellowstone ecosystem, a remarkable long distance migration occurs each spring (late March to early May) and fall (late October to early November) by approximately 300 pronghorn antelope[7] (*Antilocarpa americana*) and will be referred to as the Grand Teton National Park (GTNP) pronghorn herd. Pronghorn are an ungulate found only west of the Mississippi River in the United States and Mexico and are characterized by large protruding eyes, thick "pronged" horns, and a white, beige, and brown coat (O'Gara, 2004, p. 118; see figure 3.1).

Figure 3.1. Adult male pronghorn Photo credit: Erin E. Willett (2008)

The GTNP pronghorn travel between 160-275 each year from winter range on the high sage bush steps of the Upper Green River Basin to their summer range in Grand Teton National Park (GTNP) and the Jackson Hole Valley surrounding GTNP (Sawyer & Lindzey, 2000, pp. 1, 7). According to archeological evidence in the Upper Green River Basin, pronghorn have been traveling this corridor for over 6,000 years (Miller & Sanders, 1999). In addition to its historical significance, the path taken by the GTNP pronghorn is the longest migration undertaken by a

[7] Population fluctuates between 150 and 400 animals. (Sawyer and Lindzey, 2000, p. 2).

non-avian species in the continental United States, second only to the Arctic caribou in the Western Hemisphere (Berger et al. 2006, p. 10).

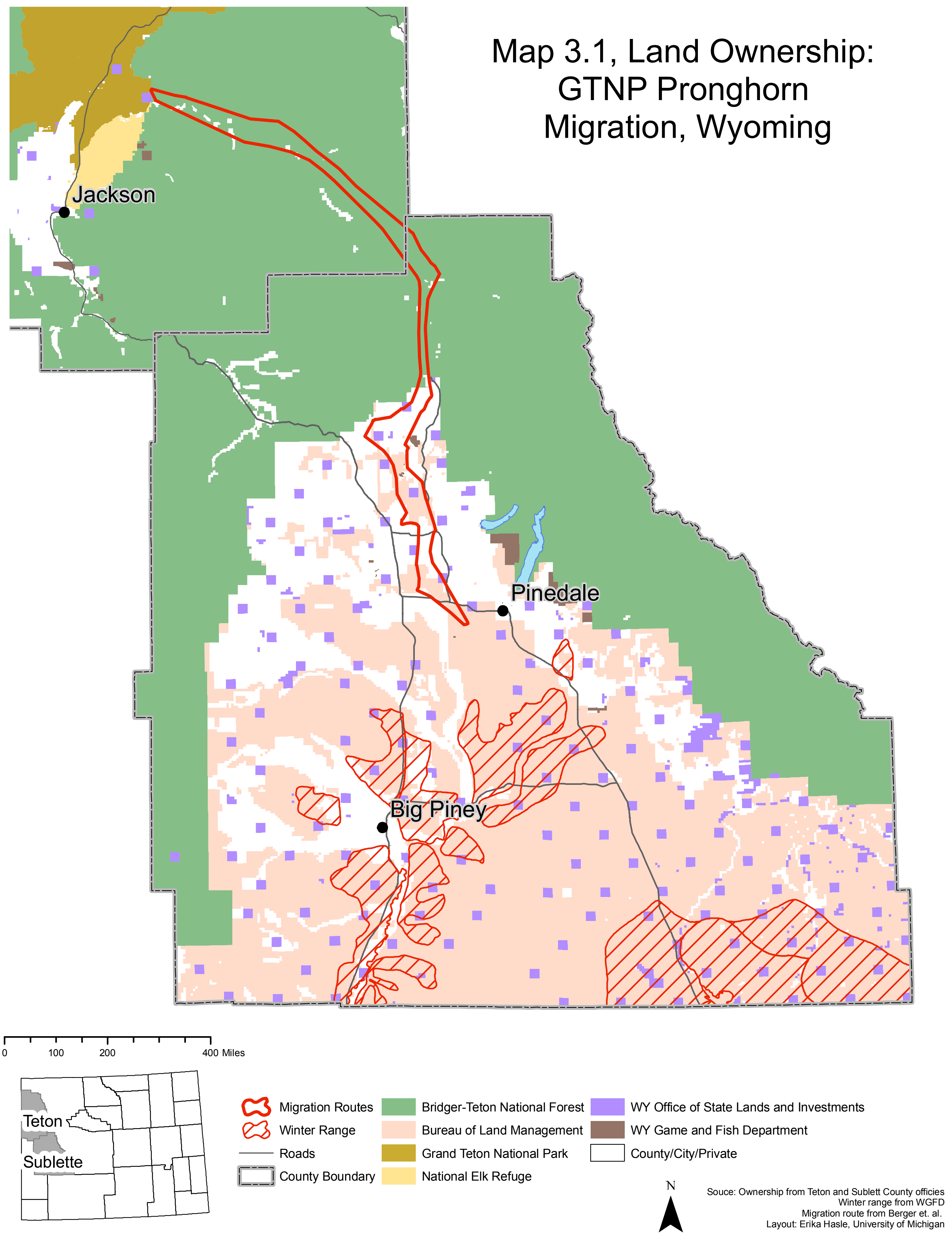
The GTNP pronghorn winter range is in Sublette County, Wyoming, along the Mesa and Stand Draw area (Sawyer & Lindzey, 2000, p. 10). The Mesa serves as a winter range to many big game species and also includes the Pinedale Anticline Oil and Gas Project Area (PAPA) (BLM, ROD, 2008, 2.8.4.5). The high arid plateau is covered by sagebrush and is adjacent to the New Fork River. The migration terrain varies from lush open valley areas in GTNP (summer range), characterized by moderate slopes and large stands of sagebrush (*Artemisia tridentate*), to a more rugged landscape in the Gros Ventre River Drainage with steeper slopes and higher elevations (Sawyer & Lindzey, 2000, p. 25).

I. Management and Development Along the Route

As the GTNP pronghorn leave their winter range and migrate north along the corridor described by Berger et al. and illustrated in Map 3.1, they pass through a mosaic of private and public lands, traveling amongst scattered rural residential development until they enter Bridger-Teton National Forest (BTNF). The private lands within the migration corridor in Sublette County are subject to increasing residential development, while the major land uses on the public lands are livestock grazing and natural gas development. The public lands within the winter range are mostly used for natural gas development, as mentioned above.

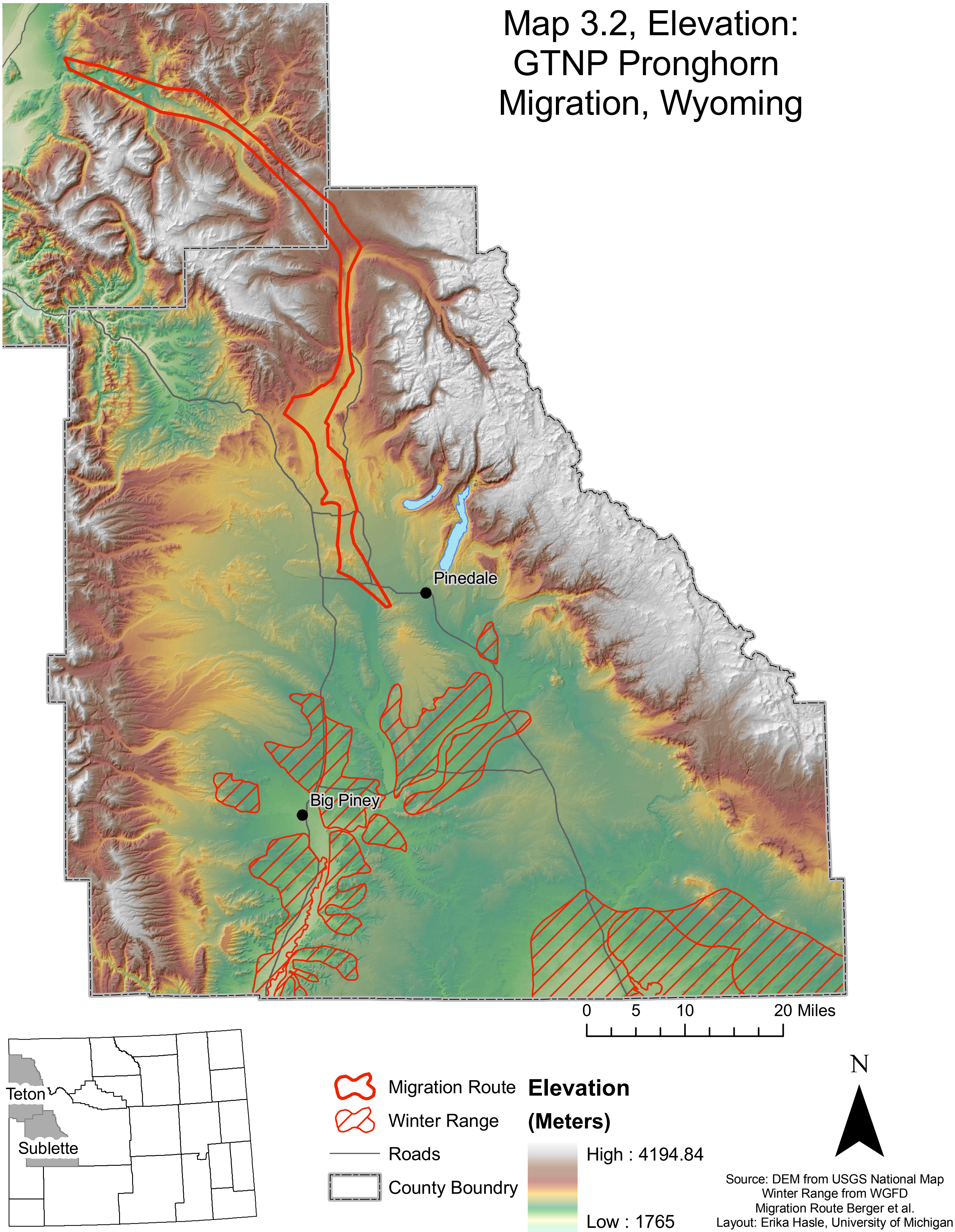
Private lands within the winter range and along the corridor are managed mostly by Sublette County, although there are some private lands within Teton County that lie in the middle of Bridger-Teton National Forest. Federal public lands are managed by both the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) as part of Bridger-Teton National Forest. A smaller percentage of the lands are managed by two state agencies, the Wyoming Office of State Lands and Investments and Wyoming Game and Fish Department (WGFD). The GTNP pronghorn's summer range lies within GTNP, the Jackson Hole Valley, and the Gros Ventre River Drainage (Sawyer & Lindzey, 2000).

During their migration, the pronghorn encounter a series of bottlenecks, or "areas along the migration route where topography, vegetation, development, and/or landscape features restrict animal movements to narrow or limited regions" (Sawyer & Lindzey, 2000, p. 20). One of the most significant bottlenecks in the migration route is located at Trapper's Point, a geographic area named for its historically significant hunting grounds, located west of Pinedale.



Map 3.1, Land Ownership:
GTNP Pronghorn
Migration, Wyoming
Jackson
Pinedale
Big Piney
0
100
200
400 Miles
Teton
Sublette
Migration Routes
Winter Range
Roads
County Boundary
Bridger-Teton National Forest
Bureau of Land Management
Grand Teton National Park
National Elk Refuge
WY Office of State Lands and Investments
WY Game and Fish Department
County/City/Private
N
Souce: Ownership from Teton and Sublett County officies
Winter range from WGFD
Migration route from Berger et. al.
Layout: Erika Hasle, University of Michigan

Map 3.2, Elevation: GTNP Pronghorn Migration, Wyoming



Here the pronghorn encounter a river valley and undulating hills as well as a well-traveled highway and subdivision of 2-acre parcels that cuts through the center of the varied terrain (Sawyer & Lindzey, 2000, p. 11, 20). Another significant bottleneck, referred to by many in the area as the Funnel, is located to the north near the southern boundary of Bridger-Teton National Forest. There, the pronghorn must move through a 100-400 meter wide path for approximately 5 kilometers in distance which is narrowed by terrain, heavy conifer density, and a cluster of homes (J. Riis, personal communication, March 15, 2008).

II. **Significance of Migration and Previous Research**

Attention to the pronghorn migration is thought by some to have begun with scientific inquiry into the status of the migratory population due to the presence of natural gas development in pronghorn wintering habitat (Anonymous Wyoming Scientist, February 23 2008). The first substantial research effort was funded by Wyoming Cooperative Fish and Wildlife Research Unit, and conducted by Hall Sawyer and Fred Lindzey during the late 1990's. Their report, entitled *The Jackson Hole Pronghorn Study,* used radio collar data collected during the spring and fall migrations to identify the migration corridor, the location of bottlenecks, areas of stress for pronghorn along the route and constraints on winter range due to natural gas exploration (Sawyer & Lindzey, 2000). Pronghorn were collared in Grand Teton summer range and tracked for two seasons.

While agencies, like Wyoming Game and Fish Department, and non-governmental organizations and industry have also expressed interested in the status of the population—all of the available scientific studies on the GTNP pronghorn migration and the condition of the pronghorn population and habitat have been commissioned and/or funded by oil and gas companies operating in Sublette County. Today, the conservation of this historic migration is carried out by agencies, non-governmental organizations, and individuals including landowners with interest in the route. With new strategies for conservation and partnerships among various groups, the pronghorn migration, coined the Path of the Pronghorn by those working on this issue, is becoming a model for conservation of a migration corridor.

Threats

I. **Fencing**

Scientists and conservationists from both governmental and non-governmental organizations in Sublette country consistently cite fences, specifically “non-wildlife-friendly fences” as an impediment to the pronghorn migration (Wyoming Game and Fish Department biologist, personal communication, May 10 2008).[8] Non-wildlife friendly is either woven wire fence, buck and pole fencing, or four/five-strand barbed wire fencing. Biologists at the Wyoming Game and Fish Department (WGFD) are aware of each fence the herd encounters along its semi-annual migration through Sublette County and Bridger Teton National Forest (BTNF) to Grand Teton National Park (GTNP) (Ibid.). Because these managers work closely with ranchers and other residents to ensure the continued viability of the migration, they are privy to numerous accounts of the fence crossing dynamics of the pronghorn (Ibid.).

A report released in 2000 found at least 47 fences perpendicular to the current migration route (Sawyer & Lindzey, 2000). Wyoming is a “fence out state,” meaning that each private land owner must erect fences surrounding portions of his own land that he wishes to keep off limits to wildlife and the livestock of others. Not surprisingly, this policy leads to an increase of fences. While there are several “wildlife friendly” fencing options, but replacing or retrofitting fencing is expensive and time intensive for landowners to undertake. With increased residential home production,[9] more fences and other elements of the human settlements can induce stress to migrating pronghorn (Berger, Berger, & Beckmann, 2006) and decrease foraging efficiency (Beckmann, Berger, & Berger, 2008). Fencing on public lands and along roadways, as well as traffic itself, provides obstacles to pronghorn as they migrate. Several fences of particular concern are located along Highway 191, a well-traveled thoroughfare, which substantially contributes to the Trapper’s Point bottleneck. This area of the migration has been described as a “gauntlet” by researcher Joel Berger (Moen, 2008).

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[8] While some scientific studies have been conducted specifically testing hypotheses of the ability and willingness of pronghorn to cross certain types of fences, there is too little information or this sort available to draw sweeping conclusions. Therefore, where appropriate, our review of the scientific literature is supplemented with anecdotal accounts obtained from experts in the field of wildlife management such as Wyoming Game and Fish biologists. In the case of pronghorn fence crossing, the value of such “anecdotal” accounts should not be underestimated.

[9] More specific information on housing and ranch development will be provided in the section on anthropogenic development to follow.

II. **Roads**

The stress exerted on migratory pronghorn from roadways comes primarily in three forms: "1) ungulate-vehicle collisions, 2) reduced habitat/resource selection, and 3) decreased movement across roadways leading to habitat fragmentation and potentially genetic isolation" (Gagnon, Schweinsburg, & Dodd, 2007). While these concerns are significant from an ecological standpoint, the decreases fitness and mortality of ungulates is largely immaterial to decisions concerning the construction of roadways. As of today, no federal law is in existence requiring the consideration of wildlife passage into highway construction and improvement projects (Humane Society of the United States, 2009). Therefore the most important information to obtain about roadways is how they can be augmented or supplemented to better facilitate ungulate passage. In a study of wildlife crossing additions to highway projects, Bank et al. found these structures typically only resulted in a 7-8% increase in the total cost of the project (Bank et al. 2002).

III. **Residential Development**

The populations of Sublette and Teton Counties have grown significantly over the past two decades with Sublette County in particular has experienced record levels of growth. The population of Sublette County is estimated to have expanded by an additional 23%-60% every year from 2000 to 2007, with the rate of change continually increasing each year (Jacquet, n.d.). Sublette County's Socioeconomic Analyst Jeffrey Jacquet[10] reports that the County Assessor's Office counted 637 single family homes constructed between 2000 and 2005, 488 of which were in rural northern Sublette County or Pinedale (2007). The Sonoran Institute reports that in the period from 2000 to 2004, 40% of the new houses were built within 2 miles of, or within, Pinedale and 44% were built in rural Sublette County areas (Carpenter, n.d.). The numbers of new houses built also climbed every year (Jacquet, 2007).

Current housing subdivisions, where parcels are less than 30 acres, are concentrated at the southern end of the migration route, west of Pinedale at the intersection of US-191 and WY-352 at Trappers Point, and in the middle of the route before it enters BTNF near White Point Road. These two areas are often referred to as two major "bottlenecks" for the pronghorn as they exist at sections of the route that are already narrowed by topographic features.

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[10] Mr. Jacquet resigned from the position in August 2008, but will be referred to in this section as the Socioeconomic Analyst.

IV. **Oil and Natural Gas Development**

Natural gas exploration and development, a contributing factor to the human population increase in Sublette, is relatively recent in Sublette County and has steadily increased from 1995 to 2005 (Jacquet, 2006, p. 20). Because it is estimated that 25-30 trillion feet of cubic gas may exist in Southwestern Wyoming, the extraction activities will continue to intensify in the foreseeable future (Berger 2006, p. 10). Much of pronghorn winter range, south and southwest of the identified corridor, lies in two distinct areas of natural gas exploration, the Jonah Field and the Pinedale Anticline Project Area (PAPA) (Berger et al. 2006).[11] The PAPA, in an area also known as the Mesa, is a narrow section of land that stretches diagonally northwest to southeast from just outside Pinedale to approximately 70 miles north of the incorporated town of Rock Springs, located on U.S. Interstate 80 (Jacquet, 2006, p. 16). The Jonah Field is a dense production site, located 35 miles south of Pinedale. Both the Jonah field and the PAPA gas reserves are classified as "tight sand reservoirs"[12] necessitating "substantially larger workforce requirements over a longer period of time as compared to conventional on-shore fields" (Sublette County Socioeconomics, 2009).

In January of 2008, the Jonah field and the PAPA had 15 and 28 active rigs respectively (Sublette County Socioeconomics, 2009). Although these numbers seem low, the extent of development is more accurately portrayed through the conservative estimate of 685 and 200 total gas pads[13] in the Jonah and PAPA respectively (Berger et al., 2006). This estimate was made in 2005, and given the substantial increase in the number of active rigs between the time the estimate was made and the present (Sublette County Socioeconomics, 2009) it is reasonable to assume that there has been a substantial increase in the number of gas pads present. The average area of a gas pad is roughly 19,600 m^2, resulting in over 17 km^2 of direct loss of often valuable habitat from the creation of gas pads alone (Berger et al., 2006). During periods of significant snow accumulation, sagebrush is the life-sustaining species of forage (Yoakum, 2004). This species takes a minimum of 15-20 years to reestablish in areas that have been cleared (WGFD biologist, personal communication, May 2, 2008). Finally, the infrastructure necessary to operate

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[11] Both administered by the Bureau of Land Management (BLM)

[12] For a thorough discussion "tight sand reserves" refer to the following pdf file, available at http://sublette-se.org/files/tight_gas.pdf

[13] Researchers defined a "gas pad" as an area with cleared vegetation, association with a water pond, and a visible road to the pad.

active rigs and the activity and noise produced must be taken into account to accurately calculate their aggregate disturbance effects.

Residential development and land use practices have been cited as the "most ubiquitous factor[s] affecting the welfare of pronghorn during the last 150 years" (Yoakum 2004, p.434). It is theorized that the cumulative effects of human development have reduced pronghorn numbers in the West to "1 pronghorn for perhaps every 30 or 40 when Lewis and Clark crossed the continent in 1804-1806." (Yoakum, 2004, p 434). Of course not every instance of development poses an equal threat to the viability of the GTNP pronghorn. These animals are primarily limited by the availability of winter forage and a relatively unobstructed path between their summer and winter grounds (WGFD biologist, personal communication, May 2, 2008). Human structures within the migration route itself or on critical winter range pose the greatest threat.

Involved Organizations[14]

A diverse assemblage of agencies, organizations, and individuals are involved in the conservation of the pronghorn migration route. Since 2000, interest and participation in migration conservation has grown due to local, state, and national media coverage and by concern for connectivity of landscapes by state and federal agencies, nongovernmental organizations and individual activists and citizens. These concerns come from an interest in the retention of wildlife movements and migrations, impact of gas developments on wildlife, retention of the aesthetics of the area, and overall interest in the preservation of the Greater Yellowstone ecosystem. Those interested in the GTNP pronghorn migration tend to focus on four separate areas: wildlife management, land management, stewardship or private land conservation, education and advocacy. Stakeholder groups can also be categorized through the dichotomy of governmental agencies and non-governmental organizations. In Sublette and Teton Counties, there is an intersection between different interests such as private landowners and/or nongovernmental organization and/or public land management agencies, which has resulted in collaborative efforts in management on public and private lands, along with funding towards conservation efforts, particularly on private lands.

[14] The list below is not exhaustive, but outlines the roles and interests of the major stakeholders. Additional chapters will discuss particular involved and interested parties in more detail.

I. **Governmental Agencies**

A. **Wyoming Game and Fish Department**

The Wyoming Game and Fish Department (WGFD) manages wildlife for the state of Wyoming. Since pronghorn is a big game sport animal, WGFD issues hunting permits for pronghorn and monitors the population. Statewide management decisions are guided by WGFD's Pronghorn Working Group which has been meeting since 1999 (Wyoming Game and Fish Department, n.d.). The agency tracks mortality, sex ratio, and population numbers. WGFD also has wildlife-friendly fence standards, which they encourage other agencies and individuals to use. Over the last five years, WGFD has been working with landowners on private lands and on public lands to retrofit and install wildlife-friendly fences. WGFD can apply for funds for projects of this nature through the Wyoming Wildlife and Natural Resources Fund, Wildlife Heritage Foundation, and the Forest Service Scenic Foundation, along with internal WGFD funds and other landowner incentive programs (Wyoming Game and Fish Department Trust, Grants Request Form, November 2005). Additionally WGFD can also allocate funds through the Wyoming Game and Fish Department Trust (WGFDT). WGFDT gave $5,000 to the Wildlife Conservation Society, a national nongovernmental organization, for a Pronghorn Migration Corridor project which would install interpretative signs about the pronghorn migration (Wyoming Game and Fish Commission Recipient Grant Agreement, May 2003).

B. **United States Forest Service – Bridger-Teton National Forest**

A large portion of the corridor falls within the boundaries of Bridger-Teton National Forest (BTNF). On May 31, 2008 BTNF recognized the portion of the migration corridor that exists within their boundaries by amending their land and resource management plan (BTNF Decision Notice, May 2008). Prior to this formal recognition, forest service employees asked other agencies and organizations to sign a non-binding pledge to recognize the path of the pronghorn. This pledge stated that "[we] recognize the importance of this migration to Wyoming's wildlife and cultural heritage, and pledge to work together to help ensure this protection for the benefit of the area's ecology and enjoyment by current and future generations" (BTNF Path of the Pronghorn Pledge, March 2008).

C. **National Park Service – Grand Teton National Park**

GTNP managers have a broad interest retaining biodiversity within the park. Because pronghorn summer grounds are located within the boundaries of GTNP, and this migratory herd is the only source of pronghorn for the park, the protection of these animals falls within the purview of park managers. Efforts by GTNP around conservation of the pronghorn have been limited and include a partnership with Bridger-Teton National Forest (Hatch, February 6, 2008); the funding of a University of Wyoming graduate student writing about the pronghorn migration (Grand Teton National Park, May 12, 2008), and the sharing of information by GTNP wildlife biologist Steve Cain with the Wildlife Conservation Society biologists for a collaborative study of the pronghorn in the Upper Green River Basin (Beckmann et al., 2008). Within their partnership with Bridger-Teton National Forest, GTNP signed the Path of the Pronghorn pledge and in June, 2008 and placed an outdoor interpretative display in the park describing the migration (Hatch, 2008).

D. **Bureau of Land Management – Pinedale Field Office**

Much of the public land traversed by the pronghorn is administered by BLM, Pinedale Field Office. In August 2008, BLM released their Resource Management Plan (RMP). The prior RMP allowed for oil and gas leases within the corridor. However, in the recently revised RMP, the Pinedale Field Office withdrew from potential oil and gas leasing some areas where migratory animals travel or introduced stipulations that would forbid drilling during migratory periods. One place of particular concern under BLM management is near the Trapper's Point bottleneck and is now recognized as an area of critical environmental concern (Pinedale Field Office, 2008). The BLM also signed the pledge distributed by Bridger-Teton National Forest (Hatch, 2008).

E. **Jonah Interagency Office**

Jonah Interagency Office, made up of Bureau of Land Management, Wyoming Department of Agriculture, Wyoming Game and Fish Department, and Wyoming Department of Environmental Quality; was created under the Jonah Project Record of Decision (ROD) to manage on-site and off-site mitigation activities as well as on-site monitoring, is organized largely through BLM staff (Jonah Interagency Mitigation and Reclamation Office, n.d.). The JIO is also charged with providing "adaptive management recommendations [based on current mitigation effectiveness] to the BLM regarding overall field development" (Ibid.). This is accomplished using a $24.5 million monitoring and mitigation fund, supplied by EnCana Oil & Gas (USA), Inc. and BP America Production Company. $16.5 million of the committed funds are designated for off-site mitigation of wildlife impacts and $8 million may be used to mitigate other environmental impacts (Ibid.). In June 2008, the Jonah Interagency Office gave a $1 million grant to the Green River Valley Land Trust for a wildlife-friendly fencing initiative within the pronghorn migration corridor (Jonah Interagency Mitigation and Reclamation Office, 2008).

II. Non-governmental Organizations

There are a number of other local, regional, and national environmental advocacy groups with interest (or had interest) in the conserving the pronghorn migration. Organizations vary in message, interest and investment in pronghorn migration conservation.

A. Wildlife Conservation Society

The Wildlife Conservation Society is a nongovernmental organization based out of New York that works on wildlife issues worldwide (Wildlife Conservation Society, n.d., a). In recent years, they made the Path of the Pronghorn one of their top Western priorities (Wildlife Conservation Society, n.d., b). WCS field biologists began a study on the impact of expanding gas development on pronghorn winter range (Wildlife Conservation Society, n.d. c). In addition to publishing *Wildlife and Energy Development: Pronghorn in the Upper Green River Basin,* WCS biologists Joel Berger and Kim Murray Berger have published papers on the pronghorn migration in journals such as "Biology Letters" and have become spokespeople for achieving conservation of the migration route through a national designation, similar to that of a national monument or national park (Glick, 2007).

B. Wyoming Outdoor Council

Wyoming Outdoor Council, an environmental Wyoming-focused advocacy organization located in Lander, Wyoming, used educational approaches to communicate the pronghorn migration to the public between 2004 and 2006[15]. They focused efforts about the pronghorn migration in Sublette County with public awareness events and materials (M. Taylor, personal communication, February 28, 2009). The Wyoming Outdoor Council planned field trips to Trapper's Point with presentations by archeologists and biologists to talk about the historical significance of the route. They were also supporters of the idea for a nationally recognized corridor. Until late 2007, Wyoming Outdoor Council and the Wildlife Conservation Society were

[15] Information ascertained by a review of WOC *Frontline Newsletters* and informal interviews.

the main groups working on conservation of the Path of the Pronghorn; however WOC has not had any campaigns addressing this issue since a key staff member resigned.

C. **Upper Green River Valley Coalition**

The Upper Green River Coalition, a small regional nonprofit advocacy organization located in Pinedale, helped the Wyoming Outdoor Council organize events, such as field trips to Trapper's Point, and supported the idea of a nationally-recognized migration corridor. Their main interest, however, is on promoting sustainable gas development that is considerate of the health of wildlife and biodiversity in the Upper Green River Basin (Upper Green River Basin Coalition, n.d.). Because the Coalition is the only environmental advocacy organization working in Pinedale, many residents concerned with environmental issues use them as a resource for information and many outside environmental groups partner with them for area events and campaigns (Anonymous NGO representative, personal communication, May 16, 2008).

D. **Green River Valley Land Trust**

The Green River Valley Land Trust (GRVLT) is a land trust working out of Pinedale on private land conservation and with private land owners (Green River Valley Land Trust, n.d. a). GRVLT supports ranching and has many ranchers on their Board. GRVLT's Corridors Conservation Campaign (CCC) targets migrating species and is specifically working on preserving the pronghorn migration by creating targeted easements and helping landowners retrofit fencing. Through the CCC, GRVLT hopes to address connectivity of wildlife habitats and is first addressing big game, specifically the pronghorn migration (Green River Valley Land Trust, n.d. b). Currently, GRVLT is leading the way in conservation of the pronghorn migration route on private lands in Sublette County due to their initiative and with outside support from JIO funds.

Conservation Summary

Path of the Pronghorn is such a well recognized issue due to non-governmental participation. As discussed in Chapter 8, NGOs led the way in communicating the importance of this issue to citizens and public agencies. NGOs working on this issue embody a wide spectrum of interests from policy interests to conservation stewardship goals. Although many efforts were not intentionally integrated or a part of a greater collaborative strategy among NGOs, the range of efforts by various NGOs has had an impact in the perception of the issue. Successes are evident from the variety of events, programs, and policy positions undertaken by NGOs to influence decision makers and make the Path of the Pronghorn an identifiable single species migration issue.

One of the most unique characteristics about the conservation status is the designation of the migration route by Bridger-Teton National Forest. According to WCS biologist Kim Murray Berger, "This represents a tremendous conservation victory and demonstrates that by working together we can find solutions to preserve our nation's wildlife heritage," (Wildlife Conservation Society, d, n.d.). BTNF worked with interested parties and amended their forest plan with broad support of other agencies and NGOs (Environmental News Service, June 17, 2008).

Around the same time in the summer of 2008, the Green River Valley Land Trust was awarded a $1 million grant from the Jonah Interagency Office for a project to work with local landowners to replace or retrofit fencing to be wildlife-friendly. According to GRVLT, "the Campaign will focus on a different group of species each year. Its current focus is on big game, including pronghorn and their historic migration between summer range in Grand Teton National Park and winter range in Sublette County." (Green River Valley Land Trust, n.d.). Because development is a potential threat and fencing poses an obstacle, GRVLT's major efforts will go towards retrofitting and installing wildlife-friendly fencing free of charge to the landowner. In regards to the wildlife-friendly initiative, the initiative "allows GRVLT to work with interested landowners to provide cost-free wildlife-friendly fencing along key migration corridors. GRVLT hopes to protect big game such as pronghorn…" (Ibid.). Interest around this issue continues to grow and more parties are joining the ranks of Path of the Pronghorn champions.

Chapter 4
Clarks Fork and Cody Elk Herds, Absaroka Divide, Wyoming

Introduction and Background

Large herds of elk (*Cervus elaphus*) live in northwestern Wyoming, along the eastern edges of Yellowstone National Park within Park County, Wyoming. Portions of these elk herds summer in the remote wilderness and backcountry of Shoshone National Forest and Yellowstone National Park. However, in order to reach their preferred winter habitat they must migrate eastward over the >3000m (9,800ft) Absaroka Divide Mountains to utilize forage at lower elevation. Those that travel farthest eastward eventually exit Shoshone National Forest's wilderness and must navigate a patchwork landscape of land uses and management jurisdictions.

These migrating elk make up the majority of two Wyoming Department of Game and Fish (WDGF) designated herds, the Cody and Clarks Fork. For the purposes of this case study we refer to both, with the bulk of our references focusing on the Clarks Fork elk. Herd movements of both herds are described in research in the early 1980s, when approximately 80% of the elk made a long seasonal migration, with the remaining 20% completing a much shorter,<20km movement, predominately from higher to lower elevations (Rudd et al 1983).

Elk are the second largest members of the deer family (*Cervidae*). Mature males may exceed 1,100 pounds; females may exceed 660 pounds (O'Gara, 2002). In general appearance, males have large antlers with thick necks and dark brown manes on their throat (see figure 4.1). Females do not have antlers. Elk have brownish to tan color on their backs and a distinctive tan rump patch (Hudson, Haigh, & Bubenik, 2002).

Figure 4.1. One male and two female elks grazing in Yellowstone National Park. Photo Credit: Julie Falk (1999).

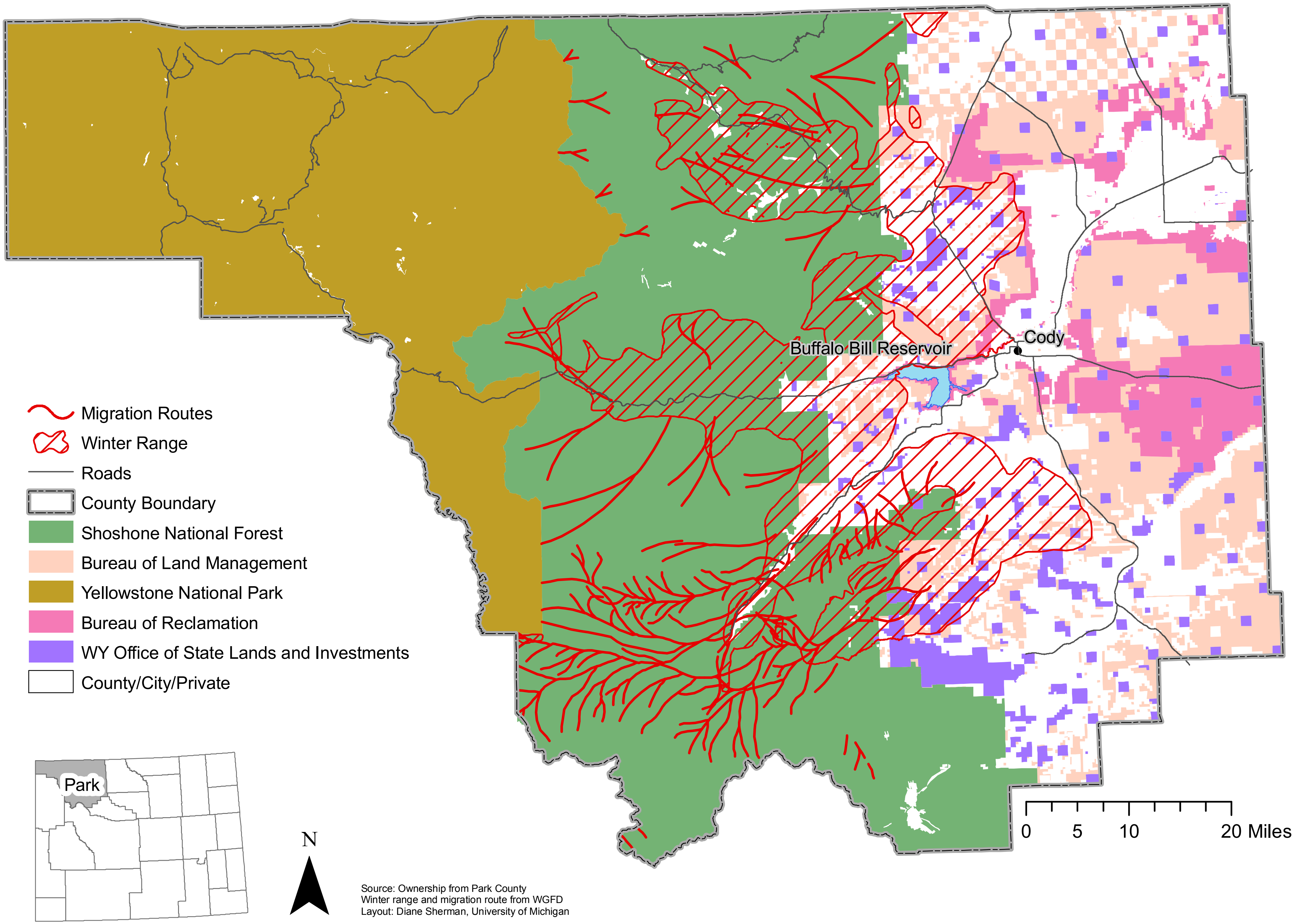
The Clarks Fork elk, WGFD herd unit 217, move primarily north of Highway 14 and Cody, WY and south of Highway 212. They spend their summer on high elevation ranges within Yellowstone National Park and the western edge of Shoshone National Forest, cross over the Absaroka Divide Mountains, and move through smaller creek and river drainages. They then break into two larger groups, one that follows the Clarks Fork River and another that follows Sunlight Creek into the Sunlight Basin. The Cody elk, WGFD herd unit 216, move primary in the vicinity of Highway 14, with some moving along Sunlight Creek and into Sunlight Basin while others take a more southerly route along the North Fork of the Shoshone River.

Along their route, the elk move through vegetation communities of Douglas fir, Lodgepole pine, Spruce-fir, Whitebark pine and other forested communities. Their winter grounds in the foothills of the Absaroka Divide Mountains are dominated by subalpine meadow and Wyoming big sagebrush, and irrigated croplands with some Douglas fir, and Spruce-fir stands for cover and security.

I. **Management and Development Along Route**

As indicated above and illustrated by Map 4.1, the seasonal ranges and migration corridor of the two elk herds includes a variety of public and private lands managed by various governmental entities. The winter range and some of the most eastern portions of their migration route include private lands within Park County, on which there is a scattering of residential development alongside the eastern boundary of Shoshone National Forest. These lands are

Map 4.1, Land Ownership: Absaroka Elk Migration, Wyoming



experiencing some residential development pressures, although much of the land use in the area is currently agricultural – ranching on private lands and grazing allotments on public lands.

The public lands within the winter range and eastern portions of the migration route include lands managed primarily by the Bureau of Land Management (BLM), the U.S. Forest Service (USFS) as part of Shoshone National Forest, and a state agency, the Wyoming Office of State Lands and Investments. A small portion of the winter range is managed by Bureau of Reclamation. The majority of the migration route and the entirely of the summer range are on public lands, the route within Shoshone National Forest and the summer range within Yellowstone National Park.

II. **Significance of Migration and Previous Research**

The Clarks Fork and Cody migration is a fascinating case because most of the elk routes that the herd uses are within intact landscapes and are protected from development, yet conditions on the elk winter range along with other ecological factors are having a big impact on the migrations. Unlike other cases presented in this study, the threats to movement and connectivity for the Clarks Fork and Cody elk are less imminent, making it a useful case study for considering how conservation efforts aimed at corridors are designed and implemented. Because these movements are a direct link between Yellowstone, the Shoshone National Forest wilderness and rural inhabited lands around Cody, there are a number of previous and ongoing conservation efforts to preserve the number and distribution of elk and other wildlife throughout the region. These efforts provide a good foundation for discussion and analysis.

Research into the Cody and Clarks Fork elk herds is now leading to a complex understanding of recent population trends, specifically, a decreasing shift in the proportion of elk that migrate great distances. It is clear that animal distributions have changed in a short span of time. A 2004 study from the University of Wyoming that considered GAP analysis data to rank known big game migration routes threatened by fragmentation shows that the Absaroka foothills provide a high level of connectivity (Feeney, 2004). According to wildlife managers responsible for the two herds, vegetative cover has not changed in such a way that it has become a limiting factor for elk movements either, indicating some other factors must explain the recent shift (D. McWhirter, personal communication, January 20, 2009).

The description of the migration presented here is derived from radio collar work conducted by Rudd et al. in late 1979 and 1980. Most of the fall migrations to lower elevations east of the Absaroka Divide occur in the month of November in response to snow accumulation and decreases in daily minimum temperature from (Rudd, 1983). Current work, being completed by Wyoming Game and Fish, the U.S. Fish and Wildlife Service, and the University of Wyoming Cooperative Research Service, is using GPS to better describe the route of this migration (Wyoming Game and Fish Department, 2006).

In the Rudd et al. study, radio colored elk in 1979 and 1980 exhibited high fidelity to winter range. This is typically due to the fact that winter is a time of greater resource scarcity. However, as indicated by a study conducted by Craighead in 1972, occasionally elk used alternate winter ranges (Craighead, 1972). Rudd reported that some mixing occurs between herds on the summer range inside YNP, including mixing of Cody elk with individuals from the National Elk Refuge in Jackson. This is a significant detail because the Jackson elk herd winter on the National Elk Refuge, which is a known source of infection for Brucellosis (*Brucella abortus*).

<u>**Threats**</u>

Current research indicates that the population distribution of elk in the Clarks Fork herd is changing. Matthew Kauffman, Assistant Professor in the Department of Zoology and Physiology at the University of Wyoming, described the situation: “Historically, the population was 70% migratory and 30% resident, and in the last 10 years or so, there has a been a big shift in the distribution of the herd towards the east out on the foothills and on private land just north of Cody. At the same time, work that we’re doing shows that now, the population is about 30% migratory and about 70% resident” (personal communication, December 12, 2008). This shift from migratory to resident elk is still being quantified and evaluated.

I. **Residential Development**

The primary long-term threat to migratory Clarks Fork and Cody elk is residential development and subdivision of larger properties that fragment the habitat. A 2005 report by the WGFD Aquatic Habitat, Terrestrial Habitat, Habitat and Access Maintenance, and Lands Administration Sections cited the Rocky Mountain Elk Foundation’s Absaroka Conservation Initiative (ACI), which identified rural residential development as the main threat to elk. The Clarks Fork and Cody elk cannot survive as migratory species solely on public land. Elk security areas are most often thought of as dense forest cover with low road densities (Burcham, Edge, &

Marcum, 1999). Clearly, subdivision of private land would diminish habitat availability and decrease elk security.

For the migratory portion of the Clarks Fork elk, the threat is most immediate on their winter range. Lynnette Otto, a U.S. Forest Service biologist at Shoshone National Forest, described the situation, “We’re [Shoshone National Forest] probably in a better position than a lot of places. We’ve got a lot of wilderness and we don’t have a lot of roads on this forest, but the private land around this forest as you go east is developing pretty rapidly” (personal communication, January 16, 2009). Security for elk is defined as large patches of continuous cover that are isolated from open roads (Hillis et al., 1991). This area is so open and elk require a level of habitat security such that these changes may be making a big difference in the way the elk are using the landscape (C. Otto, personal communication, January 16, 2009).

II. **Drought**

The recent observations that resident elk are feeding in irrigated pastures and fields is one explanation behind the decrease in the migratory population of the Clarks Fork elk. While there have always been resident and some migratory elk that grazed on private land, Assistant Professor in the Department of Zoology and Physiology at the University of Wyoming, Dr. Matthew Kauffman confirmed, “We know resident elk are using pastures and increasingly using private land” (personal communication, December 12, 2008). This includes irrigated pastures in the foothills outside Cody (Ibid.). The observation of resident elk foraging in irrigated pastures is significant and not surprising because the region is experiencing a long-term drought. The hypothesis is that “the drought conditions are most pronounced at the higher elevation habitat inside the park where the migratory elk summer inside YNP. The migratory elk are being influenced by drought on their summer range much more then the resident elk are” (M. Kauffman, personal communication, December 12, 2008). Early results from the Absaroka Elk Ecology project show differential offspring production between resident and migratory elk. Resident elk appear to be producing more offspring then migratory elk, leading researches to believe that resident elk are finding better forage and benefiting reproductively (Ibid.). Population trend counts from the WGFD confirm a trend toward poor calf productivity and survival in migratory elk that winter largely within the BTNF and off private land (WGFDa, 2006). Higher levels of productivity and recruitment are found in resident elk who dominate private lands along the Absaroka Front (WGFDa, 2006).

III. **Predation**

Another explanation for the shift in population demography from migrants to residents, "is that there is differential predation pressure on the two segments of the herd…Both segments of the herd are exposed to wolf predation but the migratory are exposed to higher [wolf] populations and a greater number of packs" (M. Kauffman, personal communication, December 12, 2008). A recent study of another elk herd within the Greater Yellowstone Ecosystem suggests that predation by wolves triggers behavioral changes in elk that causes them to alter foraging and habitat selection (Creel, Christianson, Liley, & Winnie, 2007). In reference to Creel et al.'s conclusion that wolf harassment keeping elk keeping on the move was enough to cause reductions in pregnancy Kauffmann suggested "Most elk managers are taking that report with a grain of salt," but that in the public's mind there is some validity to "this idea that elk are being harassed by wolves and spending a lot of time on the move" (M. Kauffman, personal communication, December 12, 2008).

IV. **Disease**

Another threat to elk within the Greater Yellowstone Ecosystem that is prominent in the public mind is the threat of brucellosis (*Brucella abortus*), and Chronic Wasting Disease (CWD). CWD is a transmissible spongiform encephalopathy native to elk, and deer in North America that is associated with loss of overall body condition and a neurodegeneration that is always fatal (Williams and Young, 1982). Brucellosis is a bacterial disease that affects a variety of wildlife and livestock populations causing abortions in females (Cross, Edwards, Scurlock, Maichak, & Rogerson, 2007).

In wildlife and livestock, uninfected animals contract brucellosis by licking birth exudates of infected herd members (Bienen & Tabor, 2006). If brucellosis only affected wildlife, the Wyoming Game and Fish Department feels confident it could maintain successful populations. But, because it can infect livestock, an additional impact of brucellosis is the economic cost outbreaks have on cattle ranching (Cleveland, 2005). Feedgrounds were originally initiated to keep wildlife away from livestock but it is likely the same feedgrounds may be contributing to the spread of a disease that affects livestock (Cross et al., 2007). In February, 2004, Wyoming lost its brucellosis free status in the northwest corner of the state because of contact with infected elk (Ibid.). The costs associated with loss of brucellosis free status exceeded five million dollars (Ibid.).

A strong correlation has been found between elk use of feed grounds and higher levels of brucellosis seroprevalence. Non-feed ground elk are commonly reported to have levels between 2 – 3%, with feed ground elk having ~26% (Cross et al., 2007). In contrast to this reported trend, Doug McWhirter and Jerry Altermatt, WGFD Biologist and Game and Terrestrial Habitat Biologist, respectively, indicate that their unpublished data from the recent research on the Clarks Fork elk has documented seroprevalence rates of 6%-13% (D. McWhirter, personal communication). In the literature, the assumption has been made that non-feedground elk acquire brucellosis from feedground elk when they commingle on the summer range. However, because brucellosis transmission between elk is most likely between February and June, there may be little commingling of fed and non-fed elk during the transmission period. Therefore, it is not currently known whether feedgrounds may be sustaining or increasing the transmission of brucellosis to non-fed elk through commingling on summer ranges or through infected elk "switching" winter ranges to non-fed herd units. Whether or not these hypotheses explain the higher than expected seroprevalence in the Clarks Fork elk herd is also unknown. It can be assumed, however, that landowner concerns will increase as brucellosis seroprevalence increases.

In October 2008 a moose in star valley Wyoming tested positive for Chronic Wasting Disease, meaning the disease has crossed the Continental Divide into northwest Wyoming (Hatch, 2008). According to the WGFD website, deer in eastern park county have also tested positive for CWD (Wyoming Game and Fish Department, 2009). A widespread outbreak of CWD would be devastating to the elk population and difficult to control while elk still congregate at feeding grounds (Bienen & Tabor, 2006).

Organizations Involved

In addition to public authorities, including WGFD, USFS, the Park Service, BLM, state department of transportation, and county commissioners, many groups are active or interested in habitat protection within Park County. Most notable amongst these groups are the Wyoming Cooperative Extension, Rocky Mountain Elk Foundation, the Nature Conservancy, Wyoming Stock Growers Agricultural Land Trust, the Greater Yellowstone Coalition, Boone & Crockett Club, and several additional sport hunting or environmental groups. The multitude of actors involved in elk conservation in Park County is most likely a testament to the area's vibrant hunting culture and the wildlife linkage to Yellowstone through Shoshone National Forest. In a 2008 study of local Shoshone Forest users commissioned by the state of Wyoming's Governor's Office, 47 percent of respondents indicated they use the forest for sport hunting, about the same percentage as listed for picnicking (54%) or for hiking (49%) (Clement, 2008).

An introduction to these organizations' directives and involvement in conservation of the Clarks Fork and Cody elk herds and migrations follows. These descriptions should provide a fundamental understanding of the most involved or interested organizations and their participation through 2008, and is not intended as a catalogue of every conservation participant.

I. Government Agencies

A. Wyoming Game and Fish Department

The brunt of the challenge dealing with management of these herds across the multi-jurisdictional landscape falls to WGFD. They are responsible for setting elk herd unit population goals and adapting management practices including hunting intensity, regulations, and habitat conservation and restoration (W.S. 23-1-301-303, W.S. 23-1-401). Duties include serving in an advisory role to federal, state, and county authorities as they propose or process development proposals that may impact wildlife. WGFD reviews proposals and provides comments and recommendations that are consistent with their mission to: "Restore and/or manage habitat to enhance and sustain wildlife populations in the future" (Wyoming Game and Fish Department, 2007).

The Wyoming Game and Fish Commission, the agency's policy-making group, is largely responsible for the specific goals and objectives sought through the agency's activities. Beyond its annual role defining hunting regulations, the Commission has taken a proactive approach to defining habitat enhancement goals, policies and procedures, evidenced by its adoption in 2001 of a Strategic Habitat Plan. Commission policy also helps guide the Lands Administration Branch, which works towards the Department's property rights objectives for "improved habitat conservation" and increasing access for hunting and fishing. The Commission holds easements and the Branch plays a modest role in easement acquisition, generally in cooperation with many partner organizations. In the Cody area these partners include: Wyoming Stockgrowers Agricultural Land Trust, Rocky Mountain Elk Foundation, and The Nature Conservancy (D. McWhirter, personal communication, January 20 2009).

B. **United States Forest Service – Shoshone National Forest**

Cody and Clarks Fork elk encounter few impediments as they travel through Shoshone National Forest to summer range within Shoshone and Bridger-Teton National Forests and Yellowstone National Park. The majority of migratory pathways range across Shoshone National Forest, which as an extension of Yellowstone's wild ecosystem, includes designated wilderness areas at about 55% of total forest area and inventoried roadless areas accounting for an additional ~30% of area (Shoshone National Forest., "2006 Preliminary Roadless Area Inventory").

Shoshone National Forest and Bridger-Teton National Forests are operating based on forest plans from 1986 and 1990, respectively, with revised plans in draft phases. The two forests, in their plans, consider the seasonal elk populations as it relates to the Forest Service's role managing habitat for wildlife. Management of the actual wildlife populations and individuals is the responsibility of state wildlife agencies. However, updates on the status of wildlife populations, including the migrating elk, are required of the Forest Service by law. The forests also undertake habitat quality projects to ensure desired conditions for connectivity and cover, among many other objectives outlined in each forest's forest plans. Connectivity and cover directly address the issue of migration corridor viability for many species.

Activities to maintain connectivity and cover requirements for elk are not one of the highest priorities for Shoshone National Forest because experts report the area is in a condition that generally meets elk needs. Habitat enhancements, when they do happen, are primarily projects made possible because of cooperation with Game and Fish (C. Otto, personal communication, January 16, 2009). At times when the Forest has good ideas but no money, they have received funds from the Rocky Mountain Elk Foundation and WGFD. The Shoshone National Forest "rarely does any management projects for game animals without including Wyoming Game and Fish, and often times it is a project of their suggestion" (Ibid.). In recent years these projects have entailed grazing allotment management for wildlife, and some conifer and aspen cutting and burning to stimulate aspen regeneration or benefit sagebrush communities.

C. **National Park Service – Yellowstone National Park**

The National Park Service follows a "natural regulation" management approach to the elk herds throughout the park, including the Clarks Fork and Cody elk that summer in the far eastern reaches of the park. Political factors led to the adoption of the "natural regulation" strategy in 1967. This approach has been controversial, with the Park Service taking significant and sustained criticism of elk management and associated habitat effects in the northern part of the park.

Each National Park is managed according to its own strategic plan, Annual Performance Plan, and creates an Annual Performance Report (all required by the National Park Management Omnibus Act of 1998). The 2000 strategic plan does not indicate any goals singularly and specifically for elk management, as would be expected in a natural regulation approach. Instead, Park Service policy is for management prescriptions to clearly define desired natural conditions to be achieved and maintained (NPS Management Policies, 2001). According to Wyoming Game and Fish biologists, Park Service scientists share elk data collected in the Park's eastern backcountry area, and has facilitated state agent access to that area for research purposes (D. McWhirter, personal communication, January 20, 2009).

D. **Bureau of Land Management – Cody Field Office**

BLM oversees the use of lands in a patchwork federal ownership pattern between Cody and Shoshone National Forest. This Absaroka foothills territory contains winter range for the Cody and Clarks Fork herds, as well as year round range for non-migrating individuals in these herds. The BLM manages these areas for multiple uses.

To comply with National Environmental Policy Act requirements, the BLM reviews proposed projects and considers wildlife impacts. The BLM Cody Field Office entertains many development projects in its >1 million acre area, such as power lines for NRG corridors, oil/gas well drilling, mineral extraction, right a ways for driving/hauling materials between private lands. Additionally, the office's wildlife biologist develops projects with resource specialists that help improve wildlife habitat in this area. BLM's responsibility is to provide for a healthy wildlife habitat for all of the animals that exist on the land (D. Harrell, personal communication, January 21, 2009).

E. **Greater Yellowstone Coordination Committee**

A significant and long-standing effort to coordinate ecosystem management and facilitate communication between management authorities in the Greater Yellowstone Area began in 1964 with a memorandum of understanding between the Forest Service and the National Park Service. The Committee worked to define a "Vision for the Future," which in 1990, declared a desired future condition for Yellowstone and the surrounding areas that could be achieved through coordinated management goals. Additional overarching guidance was released in 1991 with "A

Framework for Coordination of National Parks and National Forests in the Greater Yellowstone Area." Recent efforts appear more focused into sub-committee level interactions and coordination. Of the 14 subcommittees, guidance coming from the Brucellosis Committee, Jackson Hole Elk Working Group, and Northern Yellowstone Cooperative Wildlife Working Group are most relevant, but not directed at specific actions and goals for the Clarks Fork and Cody elk herds.

F. **Absaroka Elk Ecology Project**

Because the migration routes, timing, and the influence of predators are not well understood at this time, the Wyoming Game and Fish Department, the University of Wyoming, and the U.S. Fish and Wildlife Service began a 5-year research project in this area in 2007, called the Absaroka Elk Ecology Project. The entire Clarks Fork elk herd unit and a portion of the Cody herd is included within the research area. In their literature describing the project, the agencies cite major habitat changes to the elk winter and summer ranges over the past 20 years and an increased influence from predators on the research population as reasons for the project. It will help them to understand why some Game and Fish hunt area populations are doing well, while others decline, helping them to adjust hunting levels and other management.

The project has received the support of a large group of affected management and user groups that include the following:

- USDA/APHIS/Wildlife Services
- Shoshone National Forest
- Yellowstone National Park
- Wyoming Animal Damage Management Board
- Wildlife Heritage Foundation of Wyoming
- Bureau of Land Management
- Rocky Mountain Elk Foundation
- Sportsmen for Fish & Wildlife
- Bowhunters of Wyoming
- Cody Country Outfitter & Guides Association
- Pope & Young Club
- Boone & Crockett Club

II. **Non-governmental Organizations**

Conservation organizations have played a major role in habitat conservation in the Absarokas. The Rocky Mountain Elk Foundation is possibly the most invested in the area, having undertaken a formal campaign in recent years, the Absaroka Conservation Initiative. The organization's mission is also most singularly focused on elk conservation. The Nature Conservancy decided to make a large investment in this region as well, with its Heart Mountain Ranch and the associated grassbank on the property. Some additional conservation groups with involvement or interest in elk migration or related habitat conservation include: Wyoming Stock Growers Agricultural Land Trust, the Greater Yellowstone Coalition, the Yellowstone 2 Yukon Conservation Initiative, Wyoming Wildlife Federation, Greater Yellowstone Big Game Migration Project (partner with Northern Rockies Conservation Cooperative), and the Wildlife Heritage Foundation of Wyoming as a grantor to the Absaroka Elk Ecology Project.

A. **Rocky Mountain Elk Foundation**

The Rocky Mountain Elk Foundation is a national non-profit dedicated to ensuring "the future of elk, other wildlife, and their habitat" (Rocky Mountain Elk Foundation, n.d.). The group undertakes its own landscape scale planning and has indicated the Absarokas as a priority landscape by working with private landowners and public land managers. This led the Foundation to work with WGFD to create a conservation plan for the area and undertake a major campaign beginning in 2001, the Absaroka Conservation Initiative. A great deal of Foundation funds – in the half a million dollars and up range – have been expended in this effort, leveraged with about that same amount from public and private partners. The scope of this involvement includes habitat enhancement, research, education, and protection projects. Area land managers in Park County cite the RMEF as the most involved and proactive group in conservation of the Clarks Fork and Cody herds. However, sources indicate this campaign has stalled for unknown reasons.

B. **The Nature Conservancy in Wyoming**

Recently named one of Game and Fish's 2008 landowners of the year, the Nature Conservancy's Heart Mountain Ranch is an example of private conservation interests working cooperatively with local agencies. TNC purchased the ranch in 1999, and the grassbank's first season was 2002. While the ranch was purchased to maintain the unusually high level of biodiversity on the property, the grassbank component of the project directly affects ungulate populations in the area because it allows ranchers in that area some additional flexibility to deal with forage competition from wild animals. Consequently, TNC works closely with WGFD, BLM, the Forest Service, and surrounding ranchers, and is able to use the grassbank to take pressure away from certain allotments at times.

C. **Sporting and agriculture groups**

The case for conservation of elk populations and migration routes throughout the Absarokas hinges largely on the value people assign to it as a prime hunting destination. Recreation groups are very active in elk habitat conservation in the area, especially evident given the support many of these groups have given to the Absaroka Elk Ecology Project. Sportsmen for Fish & Wildlife, Bowhunters of Wyoming, Cody Country Outfitter & Guides Association, the Pope & Young Club, and the Boone & Crockett Club are all listed as supporters of the current research. Some of these groups are also involved in habitat enhancement work. Among recreation user groups, the Rocky Mountain Elk Foundation stands out as a leader in the area.

As described earlier, ranching interests are concerned about cattle-elk interactions due to brucellosis and to forage competition when large elk herds are resident on private properties. Two of the most involved organizations representing these ranching interests are the Wyoming Livestock Board and the Wyoming Farm Bureau Federation. The primary management concern of these organizations is preventing the transmission of brucellosis from bison and elk to cattle. Working with or in consultation to Wyoming Game and Fish Department, they have been instrumental in developing the procedures now used for dealing with wild animals potentially posing a risk to cattle and with input on several Brucellosis Management Action Plans in the state.

Conservation Summary

The level of local support for some types of conservation initiatives including research underway or recently completed, and coordination and prioritization of effort into the area bordering Shoshone National Forest, suggest that the residential development and fragmentation problem may not end up making as negative an impact in the Absarokas as it has in other parts of the West.

Protecting large intact land areas is the primary conservation goal in the Eastern Absarokas region. Development along the edge of Shoshone National Forest is not a significant short-term threat, but over the long term could affect behavior and lead to even greater ratio of resident elk to migrating elk. This outcome would likely lead to further increases in human-wildlife conflict, with fragmentation being the issue impeding movement. Whether or not this development happens, there is another big issue with the resident population, primarily due to livestock-wildlife competition for forage and brucellosis transmission potential.

Local planning can help reduce the impact of development on migrating elk. The County Planning and Zoning Commission provides guidance to the commissioners. As subdivision applications and site plans are reviewed, the area planners reference a big game habitat and migration route overlay provided by Wyoming Game and Fish. This attention to the overlay is not always required, but planners active in Park County indicated their preference for decisions made with as much information as available (L. Gillett, personal communication, January 14, 2009). The existence of important wildlife values, and guidance from the Department of Game and Fish on habitat, corridors, and potential mitigation measures, may influence how the commissioners review and approve development proposals, when those are legally required.

On public land, federal agencies are actively engaged in habitat related projects. Of the two highly involved federal agencies, the Bureau of Land Management is in a position to have a greater impact addressing Cody and Clarks Fork elk habitat needs because of its jurisdiction over critical winter habitat in the area west of Cody. The other agency, Shoshone National Forest, provides a continuous block of protected area where elk movements are unimpeded.

For Shoshone National Forest, the forest planning process has provided guidance for 'habitat connectivity' and 'secure habitat', both especially important for migrating elk. According to Shoshone National Forests' Draft Land Management Plan (2008), desired conditions include vegetative patterns that "allow animals to move across landscapes," roads and infrastructure that "do not impede big game," and some secure habitat within big game migration corridors to "facilitate big game movement." Additional guidance on desired elk conditions is offered: "Elk occur at population levels that provide hunting and viewing opportunities that contribute social and economic benefits to local communities" (Ibid.). Among multiple uses, elk habitat, and hunting and viewing opportunities are considered important.

Overall, in efforts to sustain wildlife migrations, the lead role in Wyoming generally falls to the Game and Fish Department. In corridor conservation efforts, state transportation departments are generally a key partner or instigator of planning activity as well, due to the huge after-the-fact costs associated with infrastructure modifications for wildlife. But, in this case with the Clarks Fork and Cody elk herds, Wyoming Department of Transportation is not particularly important because of the minimal impact the Chief Joseph Scenic Byway has on movement and mortality. A lead scientist in the Absaroka Elk Ecology Project indicated the Byway is not a concern for the Clarks Fork migration (M. Kauffman, personal communication, December 12, 2008).

The long-term data set resulting from WGFD's periodic population counting and hunter surveys are clearly valuable for helping fill in the details of health and population dynamics for the Cody and Clarks Fork elk. As this data becomes more sophisticated with the addition of GPS collaring to measure movement and dispersal, predator activity, and vegetative monitoring of forage species, all goals of the ongoing Absaroka Elk Ecology Project, the information may yield more reliable predictive models and improved management strategies. The project seeks to answer why there has been such a significant shift in elk distribution since 2000, with geographic shifts in population: expanding resident herds in some areas and a reduction in elk calves per cow in migratory individuals that drops their reproductive rate below that of non-migratory individuals (D. McWhirter, personal communication, January 20, 2009). It should also provide a conclusion as to the effect of wolf predation as a contributing factor in these shifts.

Section III
Threats

Chapter 5
Threats to Ungulate Migrations

Introduction

This chapter introduces and analyzes the current threats to the viability of the migrations in our three case studies. Through communications with wildlife managers, land managers, and conservationists as well as a thorough review of the literature, we gained both practical and theoretical insight into the troubles these populations face at each stage of their amazing journeys. While the investigations are centered on examining the threats specific the three herds selected for our case studies, much of the information gleaned from this research is directly applicable to other ungulate migrations in the Western US, as well as throughout the world.

In order to gain an appreciation for biological phenomena of the present, it is often helpful to look at the past. Historically the western US has been the stage of many amazing ungulate migrations. Perhaps the most well known tragedy is that of the Bison (*Bison bison*). The most current estimate of the number of bison that roamed the entire continent of North America before the arrival of white settlers is between 50 and 75 million (Wilcove, 2008). Bison migrations may have roamed as far as 300-400 miles twice annually (Ibid.). These animals in turn supported immensely larger populations of gray wolves (*Canis lupus*) and grizzly bears (*Ursus arctos horribilis*) than are present today (Ibid.). Additionally, bison played a central role as a primary food source for many of the Plains Indian tribes (American Museum of Natural History, 2009). The bison ultimately fell victim to a threat that will not be mentioned in any of the following sections: over-hunting. Sadly, the once great herds of the plains were hunted to near extinction by the mid 1880's.

While the decline of bison in the western United States is not the focus of this study, it does exemplify the immense effects humans can have migratory ungulate populations. All three of the species we examine in our in this study have experienced various pressures associated with human development and activity. While the specifics mechanisms through which humans exert pressure on migratory ungulate have changed, the results have remained largely the same. Presently around 75% of the migrations for bison, elk (*Cervus elaphus*), and pronghorn (*Antilocapra americana*) have vanished from the Greater Yellowstone Region (Berger, 2003). Mule deer have also experienced widespread declines throughout the western US in recent years

(Laundre, Hernandez, & Clark, 2006). These alarming trends stress the need for conservationists and wildlife managers to consider the ecological, economic, and cultural values that the remaining western ungulate migrations have to offer.

The management of migratory ungulates presents several unique challenges. First, migratory animals do not recognize jurisdictional borders. In each of the case studies, the animals move across a mosaic of state, federal, and privately owned land. Wildlife agencies are often faced with the dilemma of managing populations that depend upon resources entirely out of their control. Second, because none of these species are threatened or endangered, they do not receive special consideration in most instances. Finally, there is an inherent difficulty in managing populations that do not stay in one place. Separate considerations must be made for the summer, winter, and transitional grounds.

In this chapter, we will work within the frameworks of ecology, conservation, and management. We begin with an explanation of the methods we utilized to quantify and rank the identified threats. We next examine the threats to each migratory ungulate case study individually. Each threat is considered with attention to the capabilities of wildlife managers and management recommendations are included where appropriate. The chapter concludes with two sections addressing common threats that occur across our case studies.

Threat Ranking

Threat ranking is an important process because it allows managers to prioritize their work. A "threat" or "direct threat" is defined, for the purposes of this project, as any activity or process that is impeding or may impede the seasonal migration of a species. Focus is placed on threats that have their origin in human activity or are exacerbated by human involvement. Using a simple objective process to analyze the threats can help managers decide where to focus their resources. Two methods are described here to rank the threats to the Clarks Fork and Cody elk, the GTNP pronghorn and the Round Valley mule deer on each of their summer, winter and migration (transition) ranges.

The first method is an absolute ranking system adapted from a system designed by the World Wildlife Fund (WWF) (2005). Absolute threat ranking systems are advantageous because they allow comparison across threats and species and require objective values to be given to each threat.

The second method is a relative ranking system, where each threat is ranked in order of priority. In this system all of the threats within a species will be compared and ranked in order of conservation priority and feasibility based on the researcher's experience.

I. **WWF Absolute Ranking System**

The WWF system ranks threats based on Scope, Severity, and Irreversibility as described in Figure 5.1.

Box 2. Criteria for Threat Ranking Using the Absolute System

Scope – The proportion of the target that can reasonably be expected to be affected by the threat within ten years, given the continuation of current circumstances and trends. For ecosystems and ecological communities, measured as the proportion of the target's occurrence. For species, measured as the proportion of the target's population.

4 = **Very High:** The threat is likely to be pervasive in its scope, affecting the target across all or most (71-100%) of its occurrence/population.

3 = **High:** The threat is likely to be widespread in its scope, affecting the target across much (31–70%) of its occurrence/population.

2 = **Medium:** The threat is likely to be restricted in its scope, affecting the target across some (11–30%) of its occurrence/population.

1 = **Low:** The threat is likely to be very narrow in its scope, affecting the target across a small proportion (1-10%) of its occurrence/population.

Severity – Within the scope, the level of damage to the target from the threat that can reasonably be expected given the continuation of current circumstances and trends. For ecosystems and ecological communities, typically measured as the degree of destruction or degradation of the target within the scope. For species, usually measured as the degree of reduction of the target population within the scope.

4 = **Very High:** Within the scope, the threat is likely to destroy or eliminate the target, or reduce its population by 71-100% within ten years or three generations.

3 = **High:** Within the scope, the threat is likely to seriously degrade/reduce the target or reduce its population by 31-70% within ten years or three generations.

2 = **Medium:** Within the scope, the threat is likely to moderately degrade/reduce the target or reduce its population by 11-30% within ten years or three generations.

1 = **Low:** Within the scope, the threat is likely to only slightly degrade/reduce the target or reduce its population by 1-10% within ten years or three generations.

Irreversibility (Permanence) – the degree to which the effects of a threat can be reversed and the target affected by the threat restored. It is assessed for the impact of the threat on the target, not the threat itself.

4 = **Very High:** The effects of the threat cannot be reversed, it is very unlikely the target can be restored, and/or it would take more than 100 years to achieve this (e.g., wetlands converted to a shopping centre).

3 = **High:** The effects of the threat can technically be reversed and the target restored, but it is not practically affordable and/or it would take 21–100 years to achieve this (e.g., wetland converted to agriculture).

2 = **Medium**: The effects of the threat can be reversed and the target restored with a reasonable commitment of resources and/or within 6–20 years (e.g., ditching and draining of wetland)

1 = **Low:** The effects of the threat are easily reversible and the target can be easily restored at a relatively low cost and/or within 0–5 years (e.g., off-road vehicles trespassing in wetland).

Figure 5.1, WWF criteria for Threat Ranking using an Absolute System. Table from Sourcebook for WWF standards 2007.

In order to apply the WWF ranking to we adapted the definitions of scope, severity, and irreversibility to better fit migratory ungulates (2007). "Scope" in this case will refer to both the proportion of a migratory animal population and the proportion of its habitat that will be affected by the threat within 10 years on each range. For example, drought affects the entire summer range of elk and it affects all elk that summer within that range, therefore it has a scope ranking of 4. "Severity" will refer to the level of impacts to affected animals. For example, a more severe threat would have the potential to halt the migration while a less severe threat only increases the stress of the migration. Finally, "irreversibility" refers to the permanence of damage from the threat and the likelihood that impacts will occur in 10 years or 3 generations. The rankings of Scope, Severity and Irreversibility were combined using the equation:

$$\left(\frac{2(Scope + Severity) + Irreversibility}{\#\ Ranges}\right) + (\#\ Ranges - 1) = AC$$

This equation is different from the one use by the WWF, we altered the original in order to account for the multiple ranges through which migratory species move. Based on the value of combined Scope, Severity, and Irreversibility, each threat on each range was given a Classification and then an aggregate classification (AC) across ranges. The WWF system does not dictate how to assign classifications; ordinal rankings in all cases were devised by the project team.

Low	0 – 11
Medium	12 – 14
High	15 – 17
Very High	18+

Table 5.1, Value ranges for classification, and aggregate classification.

A ranking was then calculated for each threat by combining the Total for each threat on each range across the three ranges creating a ranking of Aggregate Classification.

Low	0 – 21
Medium	22 – 25
High	26 – 29
Very High	30+

Table 5.2, Value ranges for Area Threat Class.

The same Threat Classes were then used to rank the level of threat within each range for each species. The total values for scope, severity, and irreversibility were summed vertically across threats, and those values were then summed within each range to create a range-specific aggregated threat level. This was not a prescribed part of the WWF system, but was used by the researchers to determine the highest-priority ranges for conservation. The results are presented in Table 5.3 for the Clarks Fork and Cody Elk, Table 5.4 for the Round Valley mule deer, and Table 5.5 for the GTNP pronghorn.

DIRECT THREAT	TARGET: Elk Summer Range					TARGET: Elk Migration Corridor					TARGET: Elk Winter Range					THREAT RANKING	
	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA -TION	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA -TION	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA - TION	TOTAL	AGGREGATE CLASSIFICATION
Residential Development											1	3	4	12	Medium	12	Medium
Drought	4	3	1	15	High						4	2	1	13	Medium	15	High
Predation	1	1	1	5	Low											5	Low
Disease	2	3	3	13	Medium	2	3	3	13	Medium	2	3	3	13	Medium	15	High
Climate Change	1	1	4	8	Low	1	1	4	8	Low	1	1	4	8	Low	10	Low
TOTAL	8	8	9			3	4	7			8	9	12				
			Area Threat Class: Medium	25	Total Risk to Summer Range			**Area Threat Class:** Low	14	Total Risk to Migration Corridor			**Area Threat Class:** High	29	Total Risk to Winter Range		

Table 5.3, Absolute threat ranking for Clarks Fork and Cody Elk. Gray indicates the threat does not substantially affect the species on that range. Values of scope, severity, and irreversibility were identified through interviews and through a literature review. Individual threats on each range were given classifications ranges from low to very high. Low values ranged from 0 – 11, medium values ranged from 12 – 14, high values ranged from 15 – 17, and very high values were 18 and above. Threats across ranges and each range were given an Area Threat Class ranking from low to very high. Low values ranged from 0 – 21, medium values ranged from 22 – 25, high values ranged from 26 – 29, and very high values were 30 and above.

DIRECT THREAT	TARGET: Mule Deer Summer Range West of Seirra					TARGET: Mule Deer Migration Corridor and Summer range east of Seirra					TARGET: Mule Deer Winter Range					THREAT RANKING	
	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA -TION	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA -TION	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA - TION	TOTAL	AGGREGATE CLASSIFICATION
Human Activity	1	1	1	5	Low	2	2	2	10	Low	2	2	1	9	Low	10	Low
Development						3	3	4	16	High	3	2	4	14	Medium	16	High
Fire, Invasive Species, and Grazing						1	1	3	7	Low	3	3	3	15	High	12	Medium
Predation	1	1	1	5	Low	1	1	1	5	Low	1	1	1	5	Low	7	Low
Climate Change	1	1	4	8	Low	1	1	4	8	Low	1	1	4	8	Low	10	Low
TOTAL	3	3	6			8	8	14			10	9	13				
			Area Threat Class: Low	12	Total Risk to West Summer Range			**Area Threat Class:** Very High	30	Migration Corridor and East Summer			**Area Threat Class:** Very High	32	Total Risk to Winter Range		

Table 5.4, Absolute threat ranking for Round Valley mule deer. Gray indicates the threat does not substantially affect the species on that range. Values of scope, severity, and irreversibility were identified through interviews and through a literature review. Individual threats on each range were given classifications ranges from low to very high. Low values ranged from 0 – 11, medium values ranged from 12 – 14, high values ranged from 15 – 17, and very high values were 18 and above. Threats across ranges and each range were given an Area Threat Class ranking from low to very high. Low values ranged from 0 – 21, medium values ranged from 22 – 25, high values ranged from 26 – 29, and very high values were 30 and above.

DIRECT THREAT	TARGET: GTNP pronghorn Summer Grounds					TARGET: GTNP pronghorn Migration Corridor					TARGET: GTNP pronghorn Winter Range					THREAT RANKING	
	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA -TION	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA -TION	SCOPE	SEVERITY	IRREVERS - IBILITY	TOTAL	CLASSIFICA - TION	TOTAL	AGGREGATE CLASSIFICATION
Residential Development						3	4	4	18	Very High						18	Very High
Natural Gas Development						1	1	2	6	Low	3	2	2	12	Medium	10	Low
Fences						4	2	2	14	Medium	2	2	1	9	Low	12.5	Medium
Roads						3	1	2	10	Low	2	1	2	8	Low	10	Low
Climate Change	1	1	4	8	Low	1	1	4	8	Low	1	1	4	8	Low	10	Low
TOTAL	1	1	4			12	9	14			8	6	9				
			Area Threat Class: Low	6	Total Risk to Summer Range			**Area Threat Class:** Very High	35	Total Risk to Migration Corridor			**Area Threat Class:** Medium	23	Total Risk to Winter Range		

Table 5.5, Absolute threat ranking for GTNP pronghorn. Gray indicates the threat does not substantially affect the species on that range. Values of scope, severity, and irreversibility were identified through interviews and through a literature review. Individual threats on each range were given classifications ranges from low to very high. Low values ranged from 0 – 11, medium values ranged from 12 – 14, high values ranged from 15 – 17, and very high values were 18 and above. Threats across ranges and each range were given an Area Threat Class ranking from low to very high. Low values ranged from 0 – 21, medium values ranged from 22 – 25, high values ranged from 26 – 29, and very high values were 30 and above.

One shortcoming of the WWF system is that it is hard to address threats that may or may not occur in the next 10 years. For example, the possible threats stemming from both climate change and natural gas development on the winter range of the GTNP pronghorn could vary substantially over a 10 year time frame. It is possible that the animals already experience negative effects—however, we found no research drawing a direct connection. In these cases we took a cautious approach and ranked the threat based on what we knew to be happening. Natural gas development in the migration route of the GTNP pronghorn is a threat of great interest to conservation organizations: were drilling to occur, it could lead to a stoppage of the migration. However, since the current BLM Resources Management Plan states the migration corridor is off-limits to drilling, this threat received a low classification (Bureau of Land Management, 2008).

While it had shortcoming the absolute ranking system was a very valuable process for helping the project team delineate threats and, once completed, also helped identify the ranges that were most threatened. However, the problem with this threat-ranking system was that it did not take into account the users' ability to influence the event; some events which received high rankings cannot be easily influenced or altered by managers.

We did not find any examples of either WGFD or CDFG using an absolute threat ranking system, but that is likely because this system is tailored to single species conservation. State agencies already use population management goals to plan projects and allocate funds. However, this system would be very helpful for NGOs planning their involvement in a project. Because threats are ranked spatially, both by range and threat, the system clearly indicates where work is most urgently needed.

II. **Relative Ranking System**

Another method discussed by WWF is a relative ranking system. Under this system, users rank each threat against other threats to the same site or species. We created and applied a relative ranking system to get another perspective on threats to the Clarks Fork and Cody elk, GTNP pronghorn, and the Round Valley mule deer.

Each threat was given a priority ranking, with the highest priority threats receiving the largest number. For example, the elk winter range has five threats, with the residential development threat receiving the highest priority ranking of five and climate change receiving the lowest priority ranking of one. On ranges with fewer threats, fewer rankings were used. For example, the migration corridor for elk only has three threats, and the most severe threat, disease, received a ranking of three while the lowest ranked threat, climate change, received a one. With a relative ranking system, priority values cannot be compared across species. The individual priority for each threat was given a total priority value using the following equation:

$$\left(\frac{\sum individual\_priority}{\#\,ranges} \right) + (\#\,ranges - 1) = total\_priority$$

Once a total priority was established, a priority class was given. Again because values could not be compared across species standard value breaks were not used. Results from this analysis can be found in Tables 5.6-5.8.

DIRECT THREAT	Elk Summer Range PRIORITY	Elk Migration Corridor PRIORITY	Elk Winter Range PRIORITY	TOTAL PRIORITY	PRIORITY CLASS
Development			4	4	High
Drought	3		2	3.5	Medium
Predation	2			2	Low
Disease	4	2	3	5.0	High
Climate Change	1	1	1	3	Low

Table 5.6, Relative threat ranking for Clarks Fork and Cody elk. Gray indicates the threat does not affect the species on that range. Priority for each threat was identified though interviews and a literature review, and also indexed based on the ability for managers to address the threat. Threats across ranges were given Total Priority rankings against each other, and a subsequent class of priority. These priorities cannot be compared between species.

DIRECT THREAT	Mule Deer East Summer Range PRIORITY	Mule Deer Migration Corridor & West Summer Range PRIORITY	Mule Deer Winter Range PRIORITY	TOTAL PRIORITY	PRIORITY CLASS
Human Activity	3	4	3	5.3	High
Development		5	5	6	High
Fire, Invasive Species, and Grazing		3	4	4.5	Medium
Predation	2	2	2	4	Low
Climate Change	1	1	1	3	Low

Table 5.7, Relative threat ranking for Round Valley mule deer. Gray indicates the threat does not affect the species on that range. Priority for each threat was identified though interviews and a literature review, and also indexed based on the ability for managers to address the threat. Threats across ranges were given Total Priority rankings against each other, and a subsequent class of priority. These priorities cannot be compared between species.

DIRECT THREAT	Pronghorn Summer Grounds PRIORITY	Pronghorn Migration Corridor PRIORITY	Pronghorn Winter Range PRIORITY	TOTAL PRIORITY	PRIORITY CLASS
Development		5		5	High
Natural Gas Development		2	4	4	Medium
Roads		3	2	3.5	Medium
Fences		4	3	4.5	High
Climate Change	1	1	1	3	Low

Table 5.8, Relative threat ranking for GTNP pronghorn. Gray indicates the threat does not affect the species on that range. Priority for each threat was identified though interviews and a literature review, and also indexed based on the ability for managers to address the threat. Threats across ranges were given Total Priority rankings against each other, and a subsequent class of priority. These priorities cannot be compared between species.

The process of relative threat ranking was helpful because it forced the project team to decide which threats were the worst on each range. Using this system, preference was given to the threats that we felt could be most easily addressed.

This threat ranking system can be quickly and easily applied with little information, and could be very valuable in the planning process. While not as quantitative as an absolute threat raking system, a relative ranking system has the advantage of allowing the user to prioritize threats within a range.

III. **Conclusions**

Both threat ranking systems are useful for forcing users to think about the severity of each threat and for helping users see concentrations of threats either spatially across ranges or within classes by threat. Given enough time and information, an absolute threat ranking system provides users with more information and has the added value of allowing comparison between species. However, the relative threat ranking system is invaluable early in the planning process when less information is available.

Mule Deer Threats

I. **Predation**

Scientific inquiry aimed at the identification of factors affecting the viability of the migratory mule deer population has often focused on effects of predation, primarily coyotes and mountain lions. The findings of the early work have been unequivocal, with one researcher opining "[w]e could not come up with…any clear indication that predation played any role whatsoever in the dynamics of this deer population." (V. Bleich, personal communication, January 8 2009). With the role of predation on the deer's winter range largely ruled out researchers have turned their attention to the summer range, investigating predator-prey dynamics in this portion of the habitat (Ibid.). Although a causal link between summer range predation and the fitness of migrants has not yet been demonstrated, many researchers maintain it as a hypothesis to account for the drastic decrease in the percentage of the herd that completes the entire migration in recent decades[1] (Ibid.). This shift sends somewhat of a mixed message for those engaged in mule deer conservation. On one hand, the large percentage of the population that is viable without making the summer migration is encouraging in terms of the absolute persistence of the herd. Conversely, any reduction in range necessarily comes with an ultimate reduction in the absolute carrying capacity (K) of a herd (Ballard, Lutz, Keegan, Carpenter, & deVos, 2001). Therefore, inquiry into the mechanisms driving reductions in the percentage of migratory animals is a worthwhile pursuit, and there are sound theoretical grounds for investigating predators as a possible factor driving herd numbers down.

For herds that are below vegetative carrying capacity, predation has the potential to create additive mortality, as opposed to compensatory mortality (Ballard et al., 2001). The logic is simple enough: if a herd of herbivores is already limited by the amount of available forage, then any predators present are not exerting additional pressure. In essence they are operating at an ecological equilibrium, harvesting at most as many animals as would otherwise die of starvation (compensatory mortality). In practice, it is very difficult to arrive at the conclusion that a herd is limited by vegetation.[2] There is at least a significant possibility that the Round Valley herd is

[1] Vern Bleich, speaking primarily of census work conducted by Thomas Kucera and the Department of Fish and Game stated that the roughly 85% of the Round Valley herd completed the full migration in 1984, and that this number has been reduced by as much as 50% presently.

[2] Although there are no hard and fast rules, Ballard et al. 2001 gives several possible ways of assessing the likelihood of a population being at K, including low natility rates, low fawn:doe ratios, poor body condition, high utilization of available forage, and high deer densities.

currently below vegetative K, considering the precipitous decline in animals from about 6000 in 1985 to less than 1000 in 1991(Pierce, Bleich, & Bowyer, 2000). This decline was associated with a very severe drought, which significantly reduced available forage (Kucera & McCarthy, 1988). To our knowledge, no comprehensive studies have been undertaken to describe the amount of forage available to mule deer today relative to 1985. Mule deer numbers have since increased (Pierce et al., 2000)—corresponding to increases in vegetation—so new research on whether or not predators have decelerated these gains would be timely and relevant.

In recent years, many studies have cited a significant decline in mule deer populations in the Western United States and predation has often been implicated theoretically as a causal agent (Ballard et al. 2001; Bleich, Pierce, Jones, & Bowyer, 2006; Cooley et al. 2008;). The only predatory species that has been studied with sufficient rigor are the mountain lion (*Puma concolor*), an obligate carnivore. Studies investigating the predator-prey dynamics of the Round Valley mule deer herd have focused primarily on mountain lions, with some attention given to coyotes (*Canis latrans*). In addition to mountain lions and coyotes, researchers have cited black bears (*Ursus americanus*) and bobcats (*Lynx Rufus*) (V. Bleich, personal communication, January, 8, 2009). We conducted a review of the literature on the interactions of these two species and the mule deer of Round Valley failed to find any publications suggesting that these relationships have been studied. Therefore we do not address the possible predation pressure exerted by either of these species in this section.[3]

Mountain lions are the primary predators of the round valley mule deer on both their summer and winter ranges (Pierce, Bowyer, & Bleich, 2004), and mule deer are the primary food source for mountain lions (Pierce, Bleich, & Bowyer, 2000). Mountain lions are ambush hunters, often stalking their prey with the aid of vegetative cover (Pierce, et al. 2004). A general estimate for the kill rate of a mature mountain lion is roughly one large ungulate every two weeks, but this period is reduced significantly in the case of females caring for young, and can be as little as every 3 days (Nowell & Jackson 2006; Anderson & Lindzey 2003). It has been suggested by many conservationists that this generalist, sometimes apex, predator represents a keystone or umbrella species in many of the ecosystems that it inhabits (Laundre, Hernandez, & Clark, 2006). Conversely, it has been suggested that increasing mountain lion populations throughout

[3] In a review paper on deer-predator relationships published in 2001, Ballard et al. could not find one study implicating bobcats or black bears as a major source of mule deer mortality, adding support to our findings.

the American West have been a major driver in the widespread declines of mule deer in recent years (Laundre et al. 2006: Logan, Sweanor, Ruth, & Hornocker, 2003). The research conducted to date suggests that mountain lions do not play the same role in every ecosystem, as their effects on prey species and the prevalence of other predators can shift based on a variety of factors (Ballard et al. 2001).

The role of mountain lion predation in Round Valley has been well studied in recent decades. Initial investigations were aimed at understanding the role predation played on the winter range (Pierce et al. 2000). Predation by mountain lions was quickly ruled out as a major limiting factor (V. Bleich, personal communication, January 8, 2009). Much of the research that followed was an attempted to answer the question of why there appeared to be strong selection against mule deer that make the annual migration to the West Side of the Sierra Nevada, as measured by the survival of offspring (V. Bleich, personal communication, January 8, 2009). In a study beginning in 1991 Bleich et al. investigated survival rates of young mule deer in Round Valley and found 55% of the mortalities to be attributable to predation, which was lower than proportions reported for adult females elsewhere in the Sierra Nevada (Bleich, Pierce, Jones, & Bowyer, 2006). Anthropogenic causes of death appeared to fill the gap, with road-kills accounting for 27% of the total mortalities (Ibid.). The effects of predation are not limited to mortality. Predators are also capable of regulating prey populations by excluding them from high quality forage. Researchers hypothesized that a tradeoff may exist between selection of high quality forage areas (bitterbrush stands, *Pinus monophylla*) and predation risk, since these stands also provide substantial stalking cover (Pierce et al. 2004). Yet when this hypothesis was tested empirically, no such tradeoff was found (Ibid.). Mule deer did consistently select for habitats with a high proportion of bitterbrush, but the greatest proportion of mountain lion kills occurred in relatively open habitats containing predominantly desert peach (*Prunus fasciculate*) and rabbitbush (*Ambrosia deltoidea*) (Ibid.). These results indicate that mountain lion predation does not significantly limit access to high quality forage.

Although mountain lion predation does not appear to be the cause of the reduction in the proportion of animals making the annual migration, it is also important to look into what possible implications the complete cessation of migration would have for predation. Currently, "populations of mountain lions that feed on migratory mule deer…exhibit seasonal movements, particularly elevational shifts, with those primary prey" (Pierce, Bleich, Wehausen, & Bowyer, 1999, p.986). Interestingly enough, a larger proportion of mountain lions retain home ranges on mule deer winter range than those who migrate (Ibid.). This observation provides support for a high degree of behavioral plasticity in mountain lions in response to changing densities of prey. Contrary to the general rule that nomadism acts as a buffer against predation (Skogland 1991), mule deer are neither escaping predation nor increasing their exposure to it by making this migration. Because the mountain lion is an obligate carnivore and preys predominantly upon mule deer, we can predict that kill rates per animal would remain fairly consistent regardless of the prey density (except in the case of females with kittens) (Ballard 2001). In practical terms this means that the predation pressure exerted by mountain lions on mule deer will remain a function of the number of mountain lions present within the range of the mule deer. This highlights the need to continue to monitor mountain lion populations. Because mountain lion predation does not appear to be a limiting factor for the Round Valley mule deer, no other specific management actions should be taken at this time.

Management recommendations

Mountain lion predation pressure has been studied in depth on both the summer and winter ranges of the Round Valley mule deer. Because research has generally indicated mountain lion predation is not a significant limiting factor for the herd, no invasive management actions should be taken at this time. Further research may provide wildlife managers with more insight into these dynamics. Specifically researchers should:

- Monitor predator populations and model impacts on mule deer population.
- Study predation pressure exerted on mule deer from coyotes and black bears.

II. **Development**

Development acts generally to reduce the fitness of mule deer through the generation of habitat loss, habitat fragmentation and physical barriers to movement, and disturbances associated with human activity (Kucera & McCarthy, 1988, Lutz et al., 2003). Land and wildlife managers essentially agree that human development represents the greatest immediate threat to the continued viability of this mule deer migration route (T. Kucera personal communication, January, 2009; S. Nelson, personal communication, January, 23, 2009; K. Ferrell-Ingram, January, 14, 2009). In addition to the instant effect of habitat loss development sets in motion what are best described as a series of cascading events, each creating additional sources of stress for the animals. Karen Ferrell-Ingram, the Executive Director of the Eastern Sierra Land Trust succinctly encapsulates this phenomenon in her description of the effects of development as "everything that comes along with fragmentation; increased traffic, so you've got more collisions with deer; increased dogs and pets that harass deer; increased weeds and exotic plants that come in with subdivision…and more roads and more pavement" (K. Ferrell-Ingram, personal communication, January, 14 2009).

Of particular concern to the round valley mule deer is the potential for future development near Swall Meadows, at the 1-mile wide migration bottleneck, and near Mammoth Lakes within the spring holding area for those deer migrating north (Kucera & McCarthy, 1988).[4] Although this area provides "no resource other than a travel opportunity" (Ibid.), further development could have deleterious effects on the continued viability of the migration. There is a similar degree of development within the winter and the migration corridor, while much of the summer range lies within USFS and NPS administered land. Aside from private development and recreational use within the winter range, there is only light livestock use of the area—most grazing of livestock in Round Valley occurs when deer are not present. In this section, we present a review of the effects of human development on mule deer and arrive at implications for the optimal management of development in the summer and winter ranges, as well as along the migration route.

While no precise methodology has been proposed to predict the consequences of development on the mule deer (Kucera & McCarthy, 1988), several considerations are central to a reasonable estimate. Of primary importance is an understanding of just how much displacement will result from a given amount of human development. In a recent study of radio-collared mule deer, researchers compared winter habitat selection before and during the development of a natural gas field. Sawyer et al. found that deer use of developed areas dropped progressively over a three year period (Sawyer, Nielson, Lindzey, & McDonald, 2006). Further, in each year of the three year study, deer used habitats that were further away from the nearest well pads (2.7km, 3.1km, and 3.7km respectively). Notably, habitats that were considered "low use" prior to natural gas development, presumably due to their inferior suitability, became highly utilized by year three (Sawyer et al., 2006). These trends provide strong evidence against

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[4] DFG studied a proposed development in 2003-2004 involving a subdivision and LADWP in the winter range but that might be near Swall Meadows – see DFG; Rimrock Ranch proposed development in 2000 according to Linkages report.

significant habituation to human development. The reduction in suitable winter range also lead to greater deer density on the utilized fragments. Researchers generally agree that there are substantial negative effects associated with such an increase in density, including lowered juvenile survival, lowered reproductive rates of young females, and in extreme cases, lowered fecundity of adults of prime age (Gaillard, Festa-Bianchet,mYoccoz, Loison, & Toigo, 2000).

For land managers, it is therefore important to take into account the “area of effect” for a given development project in addition to its physical footprint (Lutz et al., 2003). If the maintenance of critical habitat is considered a high priority, liberal buffer zones must be left between development and habitat. These findings also have noteworthy implications for the efficacy of habitat restoration projects. Lutz et al. recommend that habitat restoration projects not be conducted in close proximity to areas of intense human development or activity (Ibid.).

Development necessitates the construction of roadways, which have been shown to have marked effects on habitat utilization for mule deer (Rost & Bailey 1979; Lutz et al. 2003; Sawyer et al. 2006). Traditionally researchers sought to confirm the hypothesis that deer distribution in relation to roads was primarily a function of the average road density of a given area (Lutz et al., 2003). This viewpoint has given way to a more multi-faceted explanation involving “road class (primary vs. secondary), ecological characteristics, degree and frequency of use, spatial distribution, and presence of other ungulate species” (Ibid., p. 35-36). Because taking all of these characteristics into account can be an arduous task, the more tractable heuristic of distance to the nearest road generally serves as a reasonable proxy for the likelihood of mule deer habitat utilization (Johnson, Kern, Wisdom, Findholt, & Kie, 2000). A study conducted to ascertain the area of effect for roads concluded that deer were 3.3 times more likely to utilize habitat 300-400m away from a road than habitat within 100m of a road (Rost & Bailey, 1979). Interestingly, researchers found no difference in this effect between road types (Interstate roads, other paved roads, and gravel roads). The results of this study should not be taken to buttress the claim that highways exert no greater effect on mule deer than do gravel roads, but rather to provide evidence that a mule deer perceive roads as a general predation risk (Gavin & Komers 2006). The practical implication of this result is that managers must not overlook any road, no matter how small, when estimating the amount of habitat available to mule deer.

Roads additionally create impediments to migration and deer movement in general. While deer would prefer to keep roads at a distance, this is practically impossible for migratory individuals. Because the animals must traverse roads, managers must ensure that optimal crossing opportunities are available mule deer to minimize stress and vehicle collisions, and to provide connectivity. In a study of wildlife use of highway undercrossings, Ng found that mule deer preferred to use large spanning bridge underpasses with significant natural habitat within a 250m semi-circle around both ends of the passage (Ng., Dole, Sauvajot, Riley, & Valone 2004). Mule deer never used drainage culverts and rarely used square culvert tunnels to cross roads (Ibid.). If roadway undercrossings are constructed to the proper specifications[5], deer are much more likely to utilize these structures to traverse these migratory impediments.

Management recommendations

Mono County planners have generally been very receptive to input from wildlife managers. The California Department of Fish and Game submits mitigation strategies whenever new development proposals are made within mule deer range and the migration corridor. Specifically, wildlife managers encourage the following:

- Take into account the "area of effect" of a given project (including roadways) in addition to its physical footprint.
- Developments should be "clustered" rather than sprawled.
- Preferentially select habitat restoration projects away from developed areas (at least 3.5km) to achieve greater deer use of restored habitat parcels.
- Underpasses
    - Provide deer with underpasses of at least 45 meters in width and 5 meters in height.
    - Conduct habitat restoration projects near the entrances of the structures.
    - Construct wildlife-proof fencing to funnel the animals to the passages.
- Utilize wildlife friendly fences.
- Investigate the area of influence for a variety of anthropogenic features with varying levels of activity to attempt to arrive at general principles.
- Monitor deer population demographics, with especial attention to fawn: doe ratios and fawn survival to ascertain the effects of range restrictions.

III. **Human Activity**

In addition to physical anthropogenic structures, associated activity can significantly affect the behavior, and therefore the fitness of mule deer. Human recreational activities, especially those associated with Mammoth Mountain create substantial sources of stress for the Round Valley Herd. While there has been some disagreement within the management

[5] Here proper specifications means passages that are at least 45 meters in width and 5 meters in height.

community as to the severity of the stress associated with human recreation, there is reason to believe that it may be substantial.

During the period of coincidence of human recreational activity and deer migration, vehicle kills are not uncommon (Bleich et al., 2006). Wildlife managers generally agree that vehicular traffic represents a substantial threat to the migratory mule deer population. There is much less agreement within the management community about the extent of stress on the mule deer herd resulting from "lower impact" recreation, such as hiking, rock climbing, etc.

Human activity threatens the viability of the migratory mule deer population through the direct mortality associated with vehicle collisions and disturbances associated with recreational use of deer summer range and along the migration corridor. Managers and conservationists have noted that mortalities due to vehicle collision appear to be rising (Anonymous California biologist, personal communication, January 8, 2009). These assertions appear to be in line with the findings of a recent research project in which 27% of deaths among young mule deer were attributed to vehicle collisions, an increase of 23% reported in 1998 (Bleich et al., 2006).[6] In the previous section on human development roads were determined to provide a deterrent effect to mule deer. So why then are so many mule deer falling victim to vehicle collisions? There are two answers to this apparent paradox. The first is that in order to complete their migration, it is necessary for the deer to cross several roads. This is especially true in the area surrounding Mammoth Mountain (B. Tillemans, personal communication, January, 12, 2009). The second reason is that in cases of habitat restriction, food sources may draw deer closer to roads (Lutz et al. 2003). For this reason, researchers have suggested seeding unpalatable plant species in highway right-of-ways (ROWs) to reduce vehicle collisions (Lutz et al. 2003).

In addition to the direct mortality associated with vehicle collisions, the mere presence of humans engaged in recreational activity may exert considerable stress on the mule deer of Round Valley. It is for this reason that the town of Mammoth Lakes poses a threat to viability of the mule deer migration. The human impact footprint of the town of Mammoth Lakes—including both recreation from residents and tourists around the town and the heavy traffic flow in and out of town (particularly in connection with the skiing industry)—is larger than the physical

[6] It is worth noting here that the studies that arrived at these estimates were not completely alike. The 2006 study focused on young mule deer, while the 1998 estimate did not focus on a specific age class. Whether age plays a significant role in this apparent disparity has not been investigated to date. It seems intuitive that younger deer may be more likely to be involved in vehicle collisions, owing to their relative inexperience with roads.

footprint of the infrastructure itself (S. Nelson, personal communication, January 23, 2009). This assertion is evidence by the high proportion of vacation homes in Mono County, upwards of 65% (S. Burns, personal communication, January, 15, 2009). In an attempt to quantify the effects on mule deer of pedestrians and snowmobile-users, Freddy recorded the responses of deer to these two disturbances. The duration and intensity of these responses were then used to calculate energy expenditure. They found that the affect of a single disturbance trial could account for 0.2-5.0% of their daily metabolizable energy intake for deer (Freddy, Bronaugh, & Fowler, 1986). Of additional interest is their finding that deer were effected for longer durations by pedestrians, perhaps owing to the prolonged exposure to this slower-moving disturbance. As the booming tourism industry in the Mammoth Mountain continues to grow, deer will be increasingly exposed to humans. Research is desperately needed to understand whether or not deer readily habituate to various types of human recreation. Because it has been documented that migratory mule deer are more sensitive to human disturbances (Nicholson, Bowyer, & Kie, 1997), management principles derived from non-migratory populations cannot always be directly applied to migrants.

Management recommendations

Wildlife managers have few opportunities to directly influence human activity. To the extent possible, human recreational activity should be limited in critical habitat areas along the migration corridor at times when mule deer are present. The identification of high mortality roadway sites should be a major research focus. These sites can then be selected for appropriate mitigation measures such as seeding unpalatable species in ROWs, augmenting ROW fences, and creating appropriate crossing structures. Additional research efforts should be undertaken to elucidate the propensity of mule deer to habituate to the presence of various types of human activity.

IV. **Fire, Cheatgrass, and Livestock**

An increasing threat to the Round Valley mule deer is the invasion of Cheatgrass (*Bromus tectorum*) onto the scrubland ecosystems that make up their winter range. Cheatgrass is a common ruderal invasive weed throughout the western United States, and is known to increases fire frequency by increasing the fine fuels that carry fire (Keeley & McGinnis, 2007). Karen Ferrell-Ingram, Executive Director for the Eastern Sierra Land Trust states, "The main weed that comes into this migration corridor that is a problem is [Cheatgrass] *Bromus tectorum* " (personal communication, January 14 2009). Ferrell-Ingram goes on to describe the community changes brought on by cheatgrass: "it really changes in the fire frequency. We are faced with more frequent fires, and the plant communities that the deer and other wildlife depend on are not adapted to that kind of fire frequency. The bitterbrush (*Purshia tridentate*)… that's their [the deer's] main food for the fall and winter is not as well adapted to fire and so we've lost a lot of bitterbrush from fire within the corridor." Vern Bleich a retired CDFG employee and former director of the Round Valley Mule deer project confirms that "there have been 2 major fires on the round valley winter range itself…those were accidental starts…if fire destroys a large portion or in fact, any of the mature bitterbrush on the range it could be many decades before it is reestablished. Bitterbrush is a very important winter food source [for the deer]" (personal communication, January 8, 2009).

The availability of bitterbrush is effected not only be fire but also by livestock overgrazing. Both of these factors are confirmed in a report conducted by CDFG in conjunction with USFS and BLM on Deer populations and habitat. According to that report, fire management is an issue for deer in Round Valley because successional changes following a fire are slow in the harsh environment, which reduces the availability of bitterbrush. The report recommends that the agencies consider buying more land to increase the size of the winter range. On the summer range for the Round Valley deer herd livestock grazing varies from none in remote areas to heavy in easily accessible areas east of the Sierra crest (Kucera 1992, 1988). Livestock overgrazing on public lands and a lack of fire management are the key threats in the summer range according to the 3-agency report. The report also identifies portions of the larger area of Eastern and South Sierra where there is a lack of forage for deer as a priority for management efforts (Loft, et al. 1998).

Lack of forage availability is a result of the ecosystem changes brought about by Cheatgrass invasion in the western slopes of the Sierra Nevada (Keeley, 2006). In order to understand these ecosystem changes this report will discuss the basic life history of both cheatgrass, and bitterbrush, also called antelope bitterbrush. Native to Eurasia and the Middle East (Keeley & McGinnis, 2007) cheatgrass is a winter annual. Experiments have shown that temperature and photoperiod greatly affect production of panicles in all species of the genus *Bromus* (Finnerty & Klingman, 1962). Along with moisture, soil fertility, and light these factors are the strongest influencers of vernalization (Finnerty & Klingman, 1962). Knowledge of influencers of vernalization is important because some studies have shown that control of

Bromus can be achieved by prevention of seed production for two years, because after two years few viable seeds remain (Finnerty & Klingman, 1962).

Antelope bitterbrush (*Purshia tridentate*) exists at elevations between 900 and 2,700 m (3,000 – 9,000 ft) on sedimentary and volcanic soils that are deep and well drained (Hall, 2000). Bitterbrush is most commonly found on coarse or sandy soils that are neutral to slightly acidic. Producing roots up to 20 feet deep this species does best on alluvial deposits of granitic origin (Hall, 2000). Bitterbrush is most frequently found associated with big sagebrush, rubber rabbitbrush, and curl leaf mountain mahogany in sands that may have crown cover approaching 90% or more (Hall, 2000).

The winter habitat that is of interest for round valley mule deer is a shrublands community in the Sierra Nevada. Shrublands with a crown cover approaching 90% or above are described as closed-canopy. Undisturbed closed-canopy shrublands are relativity immune to serious invasion, and invaded landscapes are commonly those that have been converted from closed-canopy woody vegetation to open herbaceous communities (Keeley, 2002). Cheatgrass thrives on disturbance either from fire or livestock grazing (Brooks, et al., 2004). Fire, in this landscape, occurs either through intentional starts either as part of management interventions such as prescribed fire or else accidental and natural starts by lightning and human activity. It has been the standard practice in management literature to view prescribed burning in sagebrush ecosystems as a highly effective and economic method of improving rangelands for livestock grazing and reduction of fire hazards to human developments (Keeley, 2006). Livestock brought overland from Mexico likely contributed to the initial introduction and establishment and spread of invasive species in this region (Heady, Bartolome, Pitt, Savelle, & Stroud, 1992). Rangeland management through the use of fire to open closed-canopy shrublands has lead to substantial cheatgrass invasion (Baker, 2006). Shrublands in California have experienced an increase in fire frequency during the 20th century and this increase has likely favored invasion by non-native plants such as cheatgrass (Keeley & Stephenson, 1999). Plant communities are adapted to specific fire regimens of both intensity and frequency, as well as season; alteration of the fire regime makes plants communities more vulnerable to alien competition (Keeley, 1986). In general herbaceous annuals are more resilient to higher fire frequencies then woody growth forms (Keeley & Fotheringham, 2001).

Cheatgrass thrives on disturbance; therefore benefits from both fire and grazing quickly form a positive feedback loop in which the invasion increases fuel-bed flammability and therefore increases the fire frequency (Brooks, et al., 2004). Furthering the positive feedback loop once cheatgrass has invaded the landscape it decreases the fire return time, effectively increasing disturbance frequency to a point where native shrubs, such as bitterbrush and sagebrush, cannot recover (Baker, 2006). Larger and higher intensity cheatgrass fires leave successively smaller unburned patches that are more vulnerable to cheatgreass invasion strengthening the positive feedback loop (Knick & Rotenberry, 1997).

This increased fire return time has decreased the availability of bitterbrush, an important winter food source for mule deer. Winter malnutrition is a common cause of mortality for mule deer—particularly fawns, with nutritionally stressed fawns are more susceptible to other causes of mortality (Bishop, Garton, & Unsworth, 2001). Bitterbrush is considered an important shrub to wintering mule deer because of its palatability, ubiquity, relative quality, lack of essential oils, and its persistence later into the winter when other forage is dormant (Bishop, et al., 2001). Some studies have found that range fires not only decrease the amount of available bitterbrush but that increased foraging on surviving bitterbrush also decreased the nutritional quality of that forage (Bishop, et al., 2001).

Bitterbrush loss is further exacerbated when there is continued grazing after cheatgrass invasion (Hall 2000). Bitterbrush only produces seeds and flowers on stems and leaders at least 2 years of age, therefore if heavy grazing has removed those stems no reproduction can take place. Larger bitterbrush plants are highly palatable to cattle, domestic sheep, and mule deer and hold protein later in the season when grasses are dry or lower in protein (Hall 2000). While domestic grazing can improve bitterbrush stands by reducing competition from grasses early in the growing season livestock must be removed before mid-summer. As the season progresses to mid-summer and fall, overgrazing by livestock can occur, especially as other plants become less palatable (Hall 2000).

Loss of bitterbrush is a huge problem because it is the primary winter food for mule deer and because it has negative ecosystem impacts. Bitterbrush is also a nitrogen fixer and therefore adds to site productivity and benefits the entire plant community (Hall 2000).

Management recommendations

As with all invasive species the best management strategy for cheatgrass is to prevent invasion and if invasion does occur treatment should begin immediately. However once invasion has occurred and the positive feedback loop of the grassland fire regime is established restoration to a shrubland ecosystem is difficult. Shrubland ecosystems provide few options for fuel reductions because mechanical treatments are unlikely to provide a commercial profit and are thus expensive (Keeley, 2006).

The use of prescribed fire for thinning and reduction in fire intensity is inappropriate as it does not restore a mosaic thought to be important for wildlife (Baker, 2006) and carries huge risks in such a dry ecosystem.

Control of bitterbrush should focus on reducing disturbance and therefore increasing the chances of bitterbrush re-establishment. Reduction in disturbance can be achieved by concentrating livestock grazing in the spring and early summer and not allowing grazing in the fall. Fire prevention and invasive treatment should be concentrated on the least invaded areas Intentional fire suppression is appropriate and should ideally be coupled with bitterbrush re-seeding after fires as described in (Hall, 2000). A partial summery of his recommendations for bitterbrush reseeding includes:

- State fish and game should maintain of a supply of viable bitterbrush seed
- Post fire reseeding is best done with a seed drill and should focus on sites that have historically supported bitterbrush
- Re-seeding poorly germinated sites after one year
- Fencing of young bitterbrush plants to prevent overgrazing

Pronghorn Threats

I. Fencing

Scientists and conservationists from both governmental and non-governmental organizations in Sublette County consistently cite fences, specifically “non-wildlife-friendly fences” as a major impediment to the pronghorn migration (Wyoming Game and Fish biologist, personal communication, May 2, 2008; C. Mlodik, personal communication, May 10, 2008). While some scientific studies have been conducted specifically testing hypotheses of the ability and willingness of pronghorn to cross certain types of fences, there is too little information or this sort available to draw sweeping conclusions. Therefore, where appropriate, our review of the scientific literature is supplemented by anecdotal accounts obtained from experts in the field of wildlife management such as Wyoming Game and Fish biologists. In the case of pronghorn fence crossing, the value of such "anecdotal" accounts should not be underestimated. Biologists at the Department of Game and Fish are aware of each fence the herd encounters along its semi-annual migration through Sublette County and Bridger Teton National Forest (BTNF) to Grand Teton National Park (GTNP). Because these managers work closely with ranchers and other residents to ensure the continued viability of the migration, they are privy to numerous accounts of the fence crossing dynamics of the pronghorn.

A report released in 2000 found at least 47 fences perpendicular to the current migration route (Sawyer & Lindzey, 2000). Wyoming is a "fence out state," meaning that each private land owner must erect fences surrounding portions of his own land that he wishes to keep off limits to wildlife and the livestock of others. This policy leads to a proliferation of otherwise unnecessary fences. While there are several "wildlife friendly" fencing options, replacing or retrofitting fencing is expensive and time intensive for landowners to undertake (J. Vana, personal communication, May 4, 2008). With increased residential home production,[7] more fences and other elements of the human settlements can induce stress to migrating pronghorn (Berger, Berger, & Beckmann, 2006) and decrease foraging efficiency (Beckmann, Berger, & Berger, 2008). Fencing on public lands and along roadways, as well as traffic itself, provides obstacles to pronghorn as they migrate. Several fences of particular concern are located along Highway 191, a well-traveled thoroughfare, which substantially contributes to the Trapper's Point bottleneck. This area of the migration has been described as a "gauntlet" by researcher Joel Berger (Moen, 2008).

There are three characteristics of fences that affect the ability and willingness of pronghorn to cross. Because pronghorn have "adapted over the millennia to open landscapes without vertical barriers," they are considered less likely to jump fences than other American ungulates such as mule deer and elk (Autenrieth et al. 2006). A review of the available literature reveals that pronghorn are much more likely to cross under fences than over them (Sawyer, Lindzey, & McWhirter, 2005; Paige, 2008). Accordingly, the first important fencing characteristic is the height and composition of the lowest wire. Pronghorn primarily cross fences by crawling under them, necessitating a smooth bottom wire of no less than 15-18 inches (Karhu

[7] More specific information on housing and ranch development will be provided in the section on anthropogenic development to follow.

2004; Autenrieth et al. 2006). Pronghorn are capable of crawling under fences with barbed wire, but these fences pose an increased risk of injury and entanglement. The minimum bottom wire height requirement should be understood as adequate only in areas not experiencing significant accumulation of snow while pronghorn are present (Karhu, 2004). If the accumulation of snow results in passages of less than 15-18 inches, crawling under them can be impossible.[8] In the case of electric fences, the bottom wire should be both smooth and grounded to allow for pronghorn passage (Ibid.).

The evolutionary adaptation of pronghorn to open landscapes means fence transparency must be taken into consideration. Pronghorn are much more likely to attempt to cross an impediment if they have a relatively unobstructed view of the landscape on the other side (Sawyer & Rudd, 2005). Whereas a high degree of fence transparency encourages pronghorn crossing attempts, it can also have significant negative effects. In the case of newly constructed fences, a high transparency creates a risk of ensnarement to pronghorn that either fail to correctly estimate the height of the top wire (in the case of jumping) or fail to notice the fence entirely (Autenrieth et al., 2006). A simple solution to this problem is to flag relatively transparent sections of all newly constructed fences (Ibid.). For the construction of electric fences in areas that receive significant snowfall, the top "live" wire, should not be white, to ensure ample contrast to the snow-covered landscape. Lastly, the inclusion of stays at every 6-8 feet of wire fencing will both increase visibility and decrease the probability of ensnarement should pronghorn attempt to jump a fence (Ibid.).

The final characteristic of fence design that should be considered for pronghorn crossing is fence depth.[9] While fence depth is not at all an issue for the wire fences typically used to contain sheep and cattle, it is a significant consideration for "buck-and-pole" style fences. The addition of the depth element in buck-and-pole fences creates a situation discourages crossing attempts and makes crossing more technically difficult for pronghorn. In a study of buck-and-pole fence crossing by pronghorn, Scott found that some pronghorn became temporarily trapped inside these fences (Scott, 1992). These delays are likely to be associated with increased stress

[8] Although it may be tempting to conclude that snow accumulation would effectively shorten a fence, making vaulting a more viable option, snow "does not provide a solid enough surface for a launching effort" (Autenrieth et al., 2006, Section 8, p.2). In short, experts generally agree that the presence of snow only exacerbates pronghorn fence negotiation problems.

[9] Here, the word 'depth' refers to the dimension of a fence traveled by an ungulate making a perpendicular crossing.

and vulnerability to predators. Additionally, pronghorn were significantly less likely to attempt to cross the asymmetrical buck-and-pole fence on the on the side with three additional rails (Ibid.). Substantial herd and individual movement problems could result from fences that inhibit crossing differently. Depth issues also come in to play when considering the installation of cattle guards to facilitate pronghorn crossing. Cattle guards less than six feet in depth have been demonstrated to contain cattle while allowing free passage to pronghorn (Mapston, Zobell, Winter, & Dooley, 1970).

In areas of significant snow accumulation, "let-down" or "drop" fences are often recommended (Karhu, 2004). These fences are constructed so that large portions can be folded to the ground in a matter of minutes. In theory, a properly constructed drop fence solves the problem of significant or unpredictable snow accumulation, yet nearly all of our interviewees had reservations concerning the widespread implementation of drop fences (Wyoming Game and Fish biologist**,** personal communication, May 4, 2008). If private landowners install drop fences, it is their responsibility to let them down at the appropriate times. Because managerial agencies and NGOs lack both the manpower and information to oversee and assist land owners in this task, there is well-founded skepticism towards the use of drop fences to maintain migratory corridors.

Management recommendations

Wildlife managers can work with public and private landowners to ascertain the locations fences act as significant migratory impediments to pronghorn. If landowners are cooperative and there is adequate funding, state Game and Fish agencies can provide technical support in the replacement of fencing with more wildlife friendly alternatives. Managers should be particularly attentive to the locations of drop fences. These fences should be let down well in advance of the arrival of migratory pronghorn.

- Build fences intended to allow pronghorn to pass to wildlife friendly specifications. For detailed information on fencing specifications and construction plans, contact Wyoming Department of Game and Fish. For a thorough literature review on wildlife friendly fencing specifications see Sheldon, D. P. (2005). *Pronghorn movement and distribution patterns in relation to roads and fences in southwestern Wyoming*, University of Wyoming, Department of Zoology and Physiology. This document is retrievable at the University of Wyoming's website, www.uwyo.edu.
- Flag all newly constructed fences with colors that contrast well with surroundings. Specifically do not use white flags in areas in which snow accumulation occurs.
- If sheep tight fences must be used, install antelope passes.

- Continue to collect information (type, location, condition, etc) on fences perpendicular to the migration route, within critical range, and on staging grounds.

II. **Roads**

The stress exerted on migratory pronghorn from roadways comes primarily in three forms: "1) ungulate-vehicle collisions, 2) reduced habitat/resource selection, and 3) decreased movement across roadways leading to habitat fragmentation and potentially genetic isolation" (Gagnon, Schweinsburg, & Dodd, 2007). While these concerns are significant from an ecological standpoint, the decreased fitness and mortality of ungulates is largely immaterial to decisions concerning the construction of roadways. As of today, no federal law is in existence requiring the consideration of wildlife passage into highway construction and improvement projects (Humane Society of the United States, 2009, para 10). Therefore the most important information to obtain about roadways is how they can be augmented or supplemented to better facilitate ungulate passage. In a study of wildlife crossing additions to highway projects, Bank et al. found these structures typically only resulted in a 7-8% increase in the total cost of the project (Bank et al. 2002). Because the inclusion of wildlife crossing modifications to new and existing highway projects is a politically and economically tractable method to reduce some the wildlife problems associated with roads, the primary aim of this section is to provide the reader with management alternatives aimed at making the inevitable more amenable to migrating pronghorn.

A. **Vehicle collisions**

No studies have been conducted specifically addressing the prevalence of vehicle collisions with this herd of migratory pronghorn. While the Wyoming Department of Transportation (WYDOT) does collect data on road mortalities opportunistically[10], there has not been a systematic compilation or analysis of such data to date. In a review of the literature on ungulate vehicle collisions, researchers were unable to find any studies directly testing hypotheses related to pronghorn-vehicle collisions (Gagnon et al., 2007). Because pronghorn negotiate right-of-way (ROW) fences in a different manner than every other ungulate in the western US, utilizing the results of studies involving other migratory ungulate species to arrive estimations of pronghorn-vehicle collisions would be dubious.

[10] The Wyoming Department of Transportation makes note of each road mortality reported or witnessed in this area, but this data may not be representative of actual mortality rates as this process is quite haphazard.

Although there is little empirical documentation, several Wyoming scientists cited vehicle collisions as a significant threat to the pronghorn migration, especially around the Trapper's Point bottleneck (Wyoming Game and Fish biologist, personal communication, May 4, 2008). The widespread perception of vehicle collisions as a significant threat is further evidenced by the installation of a $900,000 motion and seismic detection system, lining roughly a mile of highway 191. The ultimate decision to implement this system was made by WYDOT and the Bureau of Land Management (BLM) based on the recommendations of the Trapper's Point Working Group.[11] The intended purpose of this device is to provide motorists with a warning signal (signs with flashing lights) when ungulates are about to cross the road ahead. This device was the first of its kind at the time of installation, was intended to be largely 'pilot' program, and WYDOT is currently conducting a study to try to gauge the effectiveness of this tool. While the results of this study have yet to be released, several scientists and conservationists have voiced their doubts as to the efficacy of this device, explaining that they have regularly observed the system give both false positive and false negative indications of the presence of ungulates[12] (Wyoming Game and Fish biologist, personal communication May 4, 2008; Anonymous Wyoming conservationist, personal communication, May 5, 2008)

The commonly held belief that this project has been a near-complete failure has resulted in a significant loss of confidence in the decision-making processes of these agencies among the conservation community (Anonymous Wyoming conservationist, personal communication, May 5, 2008). These events highlight the need to more rigorously study rates of pronghorn road mortality. Wildlife managers should begin by identifying areas of high ungulate use. These mortality rates associated with these areas should then be compared with one another to elucidate the underlying factors effecting ungulate mortality rates.

B. **Reduced habitat/resource selection**

Roads and associated infrastructure directly reduce the amount of habitat and migratory land available to pronghorn through the physical degradation and transformation of the landscape. Yet species with vast ranges, like the pronghorn, are unlikely to be greatly affected by

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[11] Trapper's Point Working Group was a collaborative effort between public and private partners focusing on conservation efforts in and around Trapper's Point. Of specific concern was proposed gas development on BLM lands in and around the Trapper's Point Area.

[12] Here the term 'false positive' refers to a warning signal when ungulates are not present, and the term 'false negative' refers to the absence of a warning signal with ungulates are present.

such inconsequential losses of habitat. In addition to direct habitat loss, roads influence pronghorn habitat selection, leading to reductions in use of otherwise suitable habitat.

Gavin and Komers state "[t]he risk-disturbance hypothesis proposes that organisms respond to generalized threat stimuli; therefore, human disturbances that elicit these behaviors will cause individuals to behave similarly to avoid [sic] a natural predator" (Gavin & Komers, 2006). In ungulates, vigilance is defined as the raising of the head to inspect surroundings while foraging (Fortin, Boyce, Merrill, & Fryxell, 2004). This behavior is additionally defined by its exclusion of the possibility of simultaneously foraging (Ibid.), chewing, or walking (Berger, Daneke, Johnson, & Berwick, 1983). While few studies have quantified the costs of increased vigilance in ungulates, Fortin et al. found that significant decreases in bite rate, a commonly used measure of food intake for ungulates, was associated with increased vigilance (Fortin et al. 2004). Available theoretical and empirical evidence generally supports the proposition that reduced forage intake can be inferred from observations of increased vigilance. A study in Alberta found pronghorn within 300 meters of roads were significantly more vigilant than those 301-1000 meters from roads (Gavin & Komers 2006). Moreover, the pronghorn observed within close proximity to roads exhibited increased vigilance independent of the level of traffic, suggesting that the roads themselves can be perceived as a significant threat (Ibid.). In contradiction, another recent study of pronghorn in the PAPA and Jonah Field found that foraging behavior was unaffected by proximity to roads, but instead associated with traffic levels and proximity to fences (Beckmann et al. 2008). This apparent paradox may be explained in terms of the rapidity of the increases in traffic intensity (Ibid.). The animals may be able to habituate to the presence of roads, but unable to adapt as quickly to the more rapid increases in traffic. Because there are several major roadways in the migration corridor, the pronghorn may spend a significant proportion of their migration in close proximity to roads. Though the information on foraging disruption may be somewhat equivocal at this point, it is known that roads, fences, and traffic all possess the potential to reduce the foraging rates of pronghorn. Accordingly, the potential effects of each of these elements should be considered when assessing the potential harm to pronghorn of any road construction project.

C. **Decreased movement**

Roads themselves have been shown to decrease the daily movements of pronghorn (Bruns, 1977). Many roadways are associated with ROW fences (Sawyer & Rudd 2005) which, as mentioned earlier, pose a significant threat to migratory pronghorn. Additional precautions must me made when designing ROW fencing associated with high-traffic roads. ROW fences can be effectively utilized to either prohibit the pronghorn from crossing a road or facilitate their passage, if the proper considerations are made. It is much easier to exclude pronghorn from stretches of highway than it is to encourage highway crossing. The fence must be made highly visible, perhaps utilizing a top rail of wood (Wyoming Game and Fish biologist, personal communication, May 4, 2008) and must include a bottom wire that is considerably less than 16" off the ground.[13] Pronghorn-tight fences must be vigilantly maintained. If portions of otherwise pronghorn tight fence become degraded such that pronghorn can pass and become trapped, the results could be disastrous. Because a large percentage of highway ROW fences are restrictive of wildlife movements, maintaining them is no small task.

ROW fences intended to allow pronghorn to pass must be built to strictest wildlife friendly specifications to prevent pronghorn from becoming trapped state right of ways (Karhu 2006). Pronghorn will often slip under one roadway fence with the intention of traversing the road, become spooked by traffic, and proceed to run back and forth across the roadway (Wyoming Game and Fish biologist, personal communication, May 4, 2008). This has the twin effects of multiplying the chance of a vehicle collision and increasing the stress experienced by the animal. To avoid the undesirable situation in which an antelope is effectively trapped on the roadway, ROW fences should generally be built far enough from the highway so as to give the pronghorn an area of safety that they may retreat to in the event that they are unable to successfully traverse both fences.

While wildlife-friendly ROW fences may be acceptable for pronghorn passage mechanisms in areas of moderate ungulate abundance or with moderate traffic levels, some areas pose too great a risk to allow ungulates to cross directly roads. Recently, Sawyer and Rudd conducted a review of the information available for assessing the effectiveness of underpasses and overpasses to facilitate pronghorn roadway crossing (Sawyer & Rudd 2005).[14] They found very little empirical evidence for pronghorn use of underpasses. Only one observational study documented pronghorn using a wildlife underpass,[15] even then not in large numbers[16] (Plumb

[13] Sawyer and Rudd suggest that a 10" bottom wire should sufficiently prevent the passage of pronghorn.
[14] This document is publicly available through the Wyoming Game and Fish Website at http://gf.state.wy.us/downloads/pdf/pronghorn_report_final.pdf
[15] Interestingly enough, most successful pronghorn crossings occurred in the presence of mule deer.

2003). While there is very little evidence of underpass use, underpasses may still be effective if they are designed to address the need for the pronghorn to have an unobstructed view of the landscape on the other side of the underpass (Foster & Humphrey 1995; Sawyer & Rudd 2005). Further, ideal "[h]abitat surrounding a pronghorn crossing structure should consist of native grass or shrub vegetation and gentle topography" (Sawyer & Rudd 2005). Constructing underpasses to these specifications requires large initial investments and moderate maintenance costs (Ibid.). The benefits conferred to pronghorn and other ungulate species,[17] and the reduction in property damage rates make the construction of underpasses economically defensible (Mastro, Conover, & Frey, 2008). The cost of an underpass built to the specifications that would theoretically promote pronghorn crossing of a two-lane highway could cost anywhere from 1-2 million dollars[18] (Sawyer & Rudd 2005). Cost-benefit analyses should include both the expected value of property damage reduction as well as the existence and use values of the animals that are saved in the process.

Overpasses are much more costly and have been tested even less than underpasses. As of 2005 not a single overpass in the intermountain west had been designed for ungulates (Sawyer & Rudd 2005). The only studies on ungulate use of overpasses have come from Canada and Europe, and generally fail to demonstrate that these more costly structures are superior to grade level crossing structures (Corlatti, Hacklander, & Frey-Roos, accepted 2008). The authors of a recent review found no reason to believe that pronghorn would be more likely to traverse an overpass than an underpass (Sawyer & Rudd 2005). Current estimates of the costs of building an overpass in Wyoming are 3.5-5 million dollars. This figure is for a wildlife overpass of roughly 33 meters in width, which is substantially smaller than the recommended minimum specifications for large animals 40-50 meters (vanWieren & Worm, 2001). It is reasonable to assume that an overpass built to the minimum specifications would cost considerably more. While cost considerations seem to weigh heavily in favor of underpasses, there may be situations in which landscape characteristics strongly favor the construction of an overpass.

D. **Management recommendations**

While wildlife managers have no control over the location decisions for roadway construction projects, they can work with transportation departments to mitigate the negative

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[16] 70 of the 89 pronghorn that approached the underpass eventually successfully crossed.
[17] Mule Deer are known to use underpasses frequently (Plumb, 2003; Reed, Woodward, & Pojar, 1975).
[18] Cost estimate is presented in U.S. dollars (2005).

effects of roadways on migratory ungulates. Possible management actions and further research opportunities include:

- To the extent possible, construct roads as far from critical habitat and migration corridors as possible.
- The maintenance of ROW fences intended to prohibit pronghorn from crossing high traffic roads should be built to the proper specifications and vigilantly maintained. Periodically wildlife friendly fences or antelope passes should be included to allow for movement across the road.
- Wildlife friendly ROW fences should be constructed a greater distance from roads in areas of higher vehicle and ungulate traffic. These areas should also be sufficiently broad to allow for nervous behavior and disorientation of crossing animals.
- If wildlife underpasses are to be utilized, they should be built the specifications outlined in http://gf.state.wy.us/downloads/pdf/pronghorn_report_final.pdf
- Conduct studies to ascertain the frequency of pronghorn roadway deaths and identify high mortality sites.
- Systematically investigate the areas of influences for various types of roads and levels of traffic.
- Empirical studies of the relative merits of highway underpasses and overpasses should be conducted. Because overpasses are extremely costly, those that are constructed should be monitored intensively to begin to understand their effectiveness.

II. **Development**

Development acts generally to reduce the fitness of pronghorn through habitat loss, habitat fragmentation and physical barriers to movement, and disturbances associated with activity of humans and domesticated and livestock animals (Yoakum, 2004; Berger et al. 2006). While the development of private and public lands may entail very different projects, they are most appropriately viewed as a common threat to the continued viability of the pronghorn migration (Yoakum, 2004; Gavin & Komers, 2006). Virtually all human infrastructure and activity can in theory be managed optimally by a common set of rules. The goals of this section are to first provide the reader with a summary of the state of human development within the migration corridor and winter grounds, and then to summarize conservation strategies that can minimize the negative impacts of human development on pronghorn antelope.

A. **Residential development**

The populations of Sublette and Teton Counties have grown significantly over the past two decades with Sublette County in particular experiencing record levels of growth. The population of Sublette County is estimated to have expanded by an additional 23%-60% every year from 2000 to 2007, with the rate of change continually increasing each year. (Jacquet, n.d.).

Sublette County's Socioeconomic Analyst Jeffrey Jacquet reports that the County Assessor's Office counted 637 single family homes constructed between 2000 and 2005, 488 of which were in rural northern Sublette County or Pinedale (2007). The Sonoran Institute reports that in the period from 2000 to 2004, 40% of the new houses were built within 2 miles of, or within, Pinedale and 44% were built in rural Sublette County areas (Carpenter, n.d.). The numbers of new houses built also climbed every year (Jacquet, 2007).

Current housing subdivisions, where parcels are less than 30 acres, are concentrated at the southern end of the migration route, west of Pinedale at the intersection of US-191 and WY-352 at Trappers Point, and in the middle of the route before it enters BTNF near White Point Road. These two areas are often referred to as two major "bottlenecks" for the pronghorn as they exist at sections of the route that are already narrowed by topographic features.

B. **Natural gas development**

Natural gas exploration and development, one of the main factors contributing to the human population increase in Sublette, is relatively recent in Sublette County and has steadily increased from 1995 to 2005 (Jacquet, 2006, p. 20). Because it is estimated that 25-30 trillion feet of cubic gas may exist in Southwestern Wyoming, the extraction activities will continue to intensify in the foreseeable future (Berger 2006, p. 10). Much of pronghorn winter range, south and southwest of the identified corridor, lies in two distinct areas of natural gas exploration, the Jonah Field and the Pinedale Anticline Project Area (PAPA) (Berger, et al. 2006).[19] The PAPA, in an area referred to as the Mesa, is a narrow swath that stretches diagonally northwest to southeast from just outside Pinedale to approximately 70 miles north of the incorporated town of Rock Springs, located on U.S. Interstate 80. The Jonah Field is a dense production site, located 35 miles south of Pinedale. Both the Jonah field and the PAPA gas reserves are classified as "tight sand reservoirs"[20] necessitating "substantially larger workforce requirements over a longer period of time as compared to conventional on-shore fields" (Sublette County Socioeconomics, 2009, para 1).

In January of 2008, the Jonah field and the PAPA had 15 and 28 active rigs respectively (Sublette County Socioeconomics, 2009a, para 2). Although these numbers seem low, the extent of development is more accurately portrayed through the conservative estimate of 685 and 200

[19] Both administered by the Bureau of Land Management (BLM)
[20] For a thorough discussion "tight sand reserves" refer to the following pdf file, available at <http://sublette-se.org/files/tight_gas.pdf>

total gas pads[21] in the Jonah and PAPA respectively (Berger et al., 2006). This estimate was made in 2005, and given the substantial increase in the number of active rigs between the time the estimate was made and the present (Sublette County Socioeconomics, 2009) it is reasonable to assume that there has been a substantial increase in the number of gas pads present. The average area of a gas pad is roughly 19,600 m^2, resulting in over 17 km^2 of direct loss of (often valuable) habitat from the creation of gas pads alone (Berger et al., 2006). During periods of significant snow accumulation, sagebrush is the life-sustaining species of forage (Yoakum, 2004a). This species takes a minimum of 15-20 years to reestablish in areas that have been cleared (Wyoming Game and Fish biologist**,** personal communication, May 4, 2008). Finally, the infrastructure necessary to operate active rigs as well as the activity and noise produced must be taken into account to accurately calculate their aggregate disturbance effects.

Development and land use practices have been cited as the "most ubiquitous factor[s] affecting the welfare of pronghorn during the last 150 years" (Yoakum 2004, p. 434). Yoakum has theorized that the cumulative effects of human development have reduced pronghorn numbers in the West to "1 pronghorn for perhaps every 30 or 40 when Lewis and Clark crossed the continent in 1804-1806." (Yoakum 2004, p. 434). Of course not every instance of development poses an equal threat to the viability of the GTNP pronghorn. These animals are primarily limited by the availability of winter forage and a relatively unobstructed path between their summer and winter grounds (Wyoming Game and Fish biologist, personal communication, May 4, 2008). Human structures within the migration route itself or on critical winter range pose the greatest threat.

Despite the recent spike in human development, the pronghorn migration corridor remains quite functional today (Wyoming Game and Fish biologist, personal communication, May, 4 2008). Even with the proliferation of fences and roads and the anthropogenic additions to already critically narrow migration bottlenecks, these animals manage to find their way through this matrix with remarkable consistency. In the last 50 years, only once have pronghorn failed to arrive at Grand Teton National Park (C. Schniebeck, personal communication, , May 10, 2008**)**. There is evidence of the herds' ability to shift their routes in response to human development. As Pinedale has expanded to the West, the pronghorn have shifted their path in lock step. The West

[21] Researchers defined a "gas pad" as an area with cleared vegetation, association with a water pond, and a visible road to the pad.

Pinedale portion of the migration continues to function today, but with considerably more difficulty than even 10 years ago (Wyoming Game and Fish biologist, personal communication, May 4, 2008). While evidence for behavioral plasticity is encouraging, human development need not stop the migration entirely to negatively impact the pronghorn. Pronghorn that spend a greater amounts time in the presence of humans and human development may be under greater amounts of stress that can lead to reduced female condition, fecundity, and ultimately population size (Berger et al. 2006). To ascertain whether or not the pronghorn are experiencing heightened levels of stress during this portion of their migration, fecal samples can be colleted and tested for cortisol (a stress hormone). This practice is widely accepted be they scientific community as indicative of physiological stress and body condition (Creel et al., 2002). Heightened physiological stress can be costly to pronghorn, resulting in reductions in survival, reproduction, and immune function (Sapolsky 2002).

When attempting to assess the functional width of the migration corridor, it is important to understand the interplay of topographic elements, human infrastructure, and human activity. A thorough understanding of an anthropogenic feature's "area of influence" is absolutely essential. In a study conducted in a state park, researchers found that pronghorn showed a 70% chance of flushing, an avoidance behavior, when visitors passed on nature trails within 100 meters of the animals (Fairbanks & Tullous, 2002). In this instance, the area of effect or effective width of the 3 meter wide nature trail was just over 200 meters. Further, pronghorn showed no indication of habituation to recreational users of the nature trails over the three years that the study was conducted. For certain features, like nature trails, effective width is not a static measure; it is a function of infrastructure and activity. In the absence of activity, a nature trail may have an effective width of 0 m. But this is not the case for all anthropogenic features. Another study found the effective width of a highway to be at least 600 m, regardless of the level of traffic (Gavin & Komers, 2006). These two studies differed in the quantification of the area of influence. Fairbanks used flushing to measure the area of influence while Gavin & Komers used vigilance. Undoubtedly flushing is a more robust measure, while vigilance is much more conservative estimate. A comprehensive measurement of the effects of anthropogenic features and activity on pronghorn should include both of these measures (Berger, 1983). Finally, there is at least one study finding human disturbance attractive to pronghorn. In a study of pronghorn use of military testing sites in Arizona, researchers showed that pronghorn were attracted to mock airfields, bomb craters, and even roads, presumably because these disturbances acted on the whole to create more favorable forage (Krauseman et al., 2005). These findings highlight the need for more observational and experimental inquiries into how pronghorn perceive various features along the migration corridor.

Even with a fully functional migration route and plentiful summer grounds, to maintain their current numbers pronghorn are dependant on their wintering grounds in the PAPA. In essence the population carrying capacity each herd of pronghorn is largely dependant on the amount of available winter forage (Yoakum, 2004a). In the winter, pronghorn move to areas of lower elevation primarily in pursuit of available forage (Ibid.). Snow depth is ultimately what limits the availability of succulent forbs, the preferred forage of the pronghorn (Ibid.; Berger et al., 2006). Snow cover of 6 inches or less greatly reduces the amount of forbs available to the pronghorn, and when snow depth approaches 10 inches, pronghorn rely entirely on sagebrush and similar shrubs (Yoakum, 2004a, p. 434). Even with this dietary alteration, forage can be extremely limited (Wyoming Game and Fish biologist, personal communication, May 4, 2008), and for this reason the maintenance of suitable winter grounds must be considered a top priority in any comprehensive pronghorn management plan. As mentioned above, the primary human activity impacting the winter range of the GTNP pronghorn is oil and gas development. This section will focus specifically on the research to date on the impacts of oil and gas development on pronghorn.

In 2005, the Shell Exploration and Production Company (Shell), Ultra Petroleum (Ultra), and Anschutz Petroleum (Anschutz) commissioned the Wildlife Conservation Society (WCS). To conduct a comprehensive 5 year study on the effects of energy development on the pronghorn of the Upper Green River Basin. To date, year summaries 1-3 have been published.[22][23] Below we highlight and discuss the most salient findings of this study to date.

The first year of study primarily revealed that pronghorn are significantly affected by the fragmentation of suitable habitat into smaller fragments. Berger reported, "[w]hen holding snow depth constant at 6 cm, the probability of an animal using a 40-acre fragment is less than 2%; for a 100-acre parcel, the probability is only 6.7%, however, this increases to 49.2% for 600-acre fragments and 70.8% when fragment size equals or exceeds 1,000 acres." This non-linear

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[22] These documents are available to the public for download at: http://www.wcs.org/yellowstone.
[23] Although these reports have not been peer reviewed, they have been conducted by experts in the field and have implemented widely practiced and rigorous techniques of data collection and analysis.

relationship between parcel size and probability of use has considerable impact for land managers. These findings support the assertion that 600 acres should be considered a reasonable minimum parcel size. If developers are able to concentrate their infrastructure so that fragments of this size and larger remain intact, it will result in much more effective range conservation.

Consistent with earlier findings (Yoakum, 2004a), researchers found that snow depth played a prominent role in habitat selection, with around 8 inches representing a threshold for suitability. Most importantly, even in cases where smaller habitat patches contained less snow cover, pronghorn did not select them with greater frequency.

Finally, researchers compared several measurements of body condition between the pronghorn that inhabited the gas fields and those utilizing winter range entirely outside of the developed areas. They found no differences between these two groups in terms of "body mass…, mineral deficiencies, disease prevalence, organophosphate concentrations, PCB levels, or stress hormones." (Berger et al., 2006). Because these parcels appear to provide the pronghorn with similarly suitable resources and do not appear to raise stress levels, the reduced use can only be explained in terms of individual differences in habituation. Whether the observation of conspecifics utilizing smaller patches will lead to a more generalized use of these areas remains to be seen.[24]

The results above were generally replicated in the second year publication, adding further weight to the original findings. Additionally researchers concluded "[p]ronghorn rely disproportionately on habitat within the core development areas proposed by the Bureau of Land Management relative to outlying areas of the PAPA, and depend on specific parcels of federal and state land to facilitate major movements between summer and winter ranges." (Berger, Beckmann, & Berger, 2007). It is clear that any conservation effort lacking the cooperation of these parties would be unsuccessful. Researchers projected that the "surface disturbance resulting from drilling and completion activities may result in the loss of 39.29% of habitat within the core development areas" creating the "potential for this habitat loss to result in a reduction in pronghorn numbers." (Ibid.). Because research has not yet determined the precise location (or fidelity) of the winter grounds for the GTNP pronghorn, it would be highly speculative to conclude that these projections will result in reduction of this specific population.

[24] Recall in the section on highway underpasses that pronghorn were more willing to cross in the presence of conspecifics and even heterospecifics (mule deer), suggesting that they will exhibit novel behaviors if they first observe others engaging in them.

The third year publication added very little to the previous two. Despite continued habitat loss and fragmentation, the study found no corresponding impacts on pronghorn demography, body condition, or fitness correlates (Beckmann, Berger, & Berger, 2008). Researchers highlighted the need for continued investigation into this relationship.

C. **Management recommendations**

Wildlife managers should work with land managers and landowners to ensure that the following criteria are satisfied:

- Do not reduce parcels of critical habitat to less than 600 acres. Take into account the effective sizes of roads, fences, and buildings. Recall that the effective width of a highway can be at least 600 meters.
- Even if patches are large enough, pronghorn must not be excluded from them by physical barriers or intensive human activity.
- Reduce human activity and the activity of dogs during migration periods
- Pay special attention to the management of human and livestock activity and future development in identified bottlenecks.
    - Reduce activity drastically during migration periods.
    - Open all gates, let down drop fences, and remove all other non-permanent barriers during migration periods.
- Reduce drilling activity during the months when pronghorn are present.
- Understand how human-made barriers interact with natural barriers (dense forests, high willows, rivers, streams, topographic features)

The following research suggestions will supplement what is currently known about the impacts of development on pronghorn behavior and physiology:

- Investigate the area of effect for a variety of anthropogenic features with varying levels of activity to attempt to arrive at general principles.
- Continue to monitoring pronghorn wintering in the Jonah Field and the PAPA to ensure that carrying capacity and fitness measures to not drop with continued oil and gas development.
    - Continue monitoring pronghorn population demography
    - Collect fecal samples to measure changes in corticosteroid levels (an indicator of stress).

Clarks Fork and Cody Elk Threats

Current research indicates that the population distribution of elk in the Clarks Fork herd is changing. Matthew Kauffman, Assistant Professor in the Department of Zoology and Physiology at the University of Wyoming, described the situation: “Historically, the population was 70% migratory and 30% resident, and in the last 10 years or so, there has a been a big shift in the distribution of the herd towards the east out on the foothills and on private land just north of Cody. At the same time, work that we're doing shows that now, the population is about 30% migratory and about 70% resident" (personal communication, December 12, 2008). This shift from migratory to resident elk is still being quantified and evaluated by researchers.

I. **Residential Development**

The primary long-term threat to migratory Clarks Fork and Cody elk is residential development and subdivision of larger properties that fragment the habitat. A 2005 report by the WGFD Aquatic Habitat, Terrestrial Habitat, Habitat and Access Maintenance, and Lands Administration Sections cited the RMEF Absaroka Conservation Initiative (ACI), which identified rural residential development as the main threat to elk. The Clarks Fork and Cody elk cannot survive as migratory species solely on public land and therefore the greatest threat to their persistence as a migratory population is the subdivision of private land for residential development. One study of non-migratory elk found that they require 250 acres to provide security under favorable conditions, and in less favorable conditions, even larger spaces would be required (Hillis, et al., 1991). Migratory elk have much larger habitat requirements, including summer grounds, winter grounds, and transitional/migration areas. Elk security areas are most often consist of dense forest cover with low road densities (Burcham, Edge, & Marcum, 1999). Clearly, subdivision of large tracts of public land would diminish habitat availability and decrease elk security.

For the migratory portion of the Clarks Fork elk, the threat of development is most immediate on their winter range. Lynnette Otto, a U.S. Forest Service biologist at Shoshone National Forest, described the situation, "We're [Shoshone National Forest] probably in a better position than a lot of places. We've got a lot of wilderness and we don't have a lot of roads on this forest, but the private land around this forest as you go east is developing pretty rapidly" (personal communication, January 16, 2009). Security areas for elk are defined as large patches of continuous cover that are isolated from open roads (Hillis, et al., 1991). This area is so open and elk require a level of habitat security such that these changes may be making a big difference in the way the elk are using the landscape (L. Otto, personal communication, January 16, 2009).

When elk are forced to live in an environment where their security areas are too small, they experience an increase in stress (Stankowich, 2008). Humans and their recreational activities have significant impacts on ungulate behavior. When ungulates are forced into habitats without adequate security, meaning there is little cover or the distance between quality forage and quality security habitat is too great they feel the increase in risk and flee from every disturbance at a greater distance. Elk behavioral response to predation risk is similar to their response to disturbance. If suitable habitat is nearby, elk may avoid disturbance by moving to an alternative site; however, if no suitable habitat is nearby, elk will be forced to remain despite the disturbance even when doing so can effect survival and reproductive success (Gill, Norris, & Sutherland, 2001). Elk response to disturbance coupled with the fact that humans on foot generate the highest rate of disturbance (more so than humans on horseback or bicycles etc.), means that increased development would dramatically increase the level to which elk are exposed (Stankowich, 2008). A study of elk calf response to disturbance in southeast Idaho found that the energetic costs of movement to escape unpredictable disturbance may have been detrimental to calf growth. The study suggested that prolonged, frequent, and unpredictable human disturbance could severely alter species behavior (Kuck, Hompland, & Merrill, 1985).

A study of development in the GYE found that homes built prior to 2000 occurred disproportionately in habitats important for biodiversity including potential mammal migration corridors. However the same study used predictive models to determine that home sites occurred less frequently on the flat windy sagebrush habitats that frequently make up elk winter range (Gude, Hansen, & Jones, 2007). This research could be positive for the Clarks Fork and Cody elk because the majority of their migration route is on public lands though they winter on private land that may not be immediately targeted for development. However, even if development did not occur on critical winter habitat the subsequent increase in recreational use of Shoshone National Forest would increase stress on the Clarks Fork and Cody elk.

Management strategies

Wildlife managers are not well equipped to influence the location residential development. At best they can work to advise policy makers on the most critical habitats for conservation. In order to make accurate recommendations it is important to conduct regular monitoring to know the extent of winter, summer, and transition ground habitats and identify migration corridors and likely locations of bottlenecks. In 2006 management recommendations from the WGFD for the Clarks Fork elk called for comprehensive classification/trend counts every year for the short term and every three years in the future (Wyoming Department of Game and Fish, 2006). Monitoring at this level is key for setting accurate hunting quotes and ensuring that hunting impacts the intended portions of the herd.

Policy and legal tools to shape the location and density of development on private land is discussed at length in other sections of this assessment.

II. **Drought**

Recent observations that resident elk are feeding in irrigated pastures is one explanation behind the decrease in the migratory population of the Clarks Fork elk. While there have always been resident and some migratory elk that grazed on private land, Assistant Professor in the Department of Zoology and Physiology at the University of Wyoming Dr. Matthew Kauffman confirmed, “We know resident elk are using pastures and increasingly using private land.” (personal communication, December, 12 2008). This includes irrigated pastures in the foothills outside Cody (Ibid.). Resident elk foraging in irrigated pastures is significant because this part of the GYE is experiencing a long-term drought. The hypothesis is that “the drought conditions are most pronounced at the higher elevation habitat inside the park where the migratory elk summer inside YNP. The migratory elk are being influenced by drought on their summer range much more than the resident elk are” (personal communication, December 12, 2008). Early results from the Absaroka Elk Ecology project show differential offspring production between resident and migratory elk. Resident elk appear to be producing more offspring than migratory elk, leading researches to believe that resident elk are finding better forage and consequently seeing reproductive benefits (Ibid.). Population trend counts from the WGFD confirm a trend toward poor calf productivity and survival in migratory elk that winter largely within the BTNF and off private land (Wyoming Department of Game and Fish, 2006). Higher levels of productivity and recruitment are found in resident elk who dominate private lands along the Absaroka Front (Ibid.).

Increased use of private land by elk under stress has been reported in other studies. Particularly the use of private land by elk seeking to reduce pressure from hunting, experiencing increasing population pressure, and elk searching for high quality forage (Burcham, et al., 1999). The WGFD sets hunting quotas on the Clarks Fork and Cody elk with the goal of providing 50% hunter success rate and keeping populations at sustainable levels (Wyoming Department of Game and Fish, 2006). Studies show that elk are repeatedly disturbed during the hunting season and that after each disturbance elk move to increasingly secure habitat (Burcham, et al., 1999). When public land where elk are subject to hunting pressure abuts private land where hunting pressure is greatly reduced, elk use private land as a refuge (Ibid.). This is the case with the residential portions of the Clarks Fork and Cody elk, which can use private land with reduced hunting pressure and higher quality irrigated forage as a refuge.

The WGFD created a conservation plan for the Sheridan region elk and focused in part on management of elk on private lands. In this plan they identify the problem of 'protected' elk populations that exist on private land and are insulated from hunting and the continual problem of private land owners receiving little or no monetary compensation for effectively shouldering the cost of involuntary production of elk forage (Jellison, 2002). A three-part plan was developed to help meet the needs of hunters, wildlife managers and landowners. First, with landowner permission, the WGFD and Rocky Mountain Elk Foundation (RMEF) funded and conducted prescribed burns on private land to improve forage for both elk and livestock. Next landowners involved in the project were offered the chance to establish a conservation easement with either TNC or RMEF. Finally in an attempt to meet population-control goals, hunting access onto private lands was arranged with the goal of harvesting 41 – 50 cow elk per year (Jellison, 2002).

A study of elk and agriculture in Cypress Hills, Canada validates this strategy. The study found that identifying spatial characteristics of an ungulate population and the seasonal land use choices of that elk herd was key information for identifying large congregations of elk likely to cause damage to private land. Within the spatial characteristics of an ungulate group the study found it was important to identify finer levels of spatial organization so that harvest management could then be applied more strategically to groups of animals causing the most conflict (Hegel, Gates, & Eslinger, 2009). Similar to the Sheridan region elk study understanding where species are spending their time and what types of land use choices they are making allows for both targeted harvest management and targeted management of forage to improve calf/cow ratios.

Hagel et al. found that, ultimately, conflicts between wildlife and agricultural landowners are only resolved when landowners are provided with opportunities to derive economic benefits from wildlife. The study suggests that wildlife quality on private land can be increased by providing meaningful economic benefit to the landowners (Hegel, et al., 2009). The Sheridan region elk study used this strategy by providing land owners with forage improvements for their livestock and the opportunity to benefit from a conservation easement. In return land managers received the ability to do some harvest management on private land.

Management recommendations

Wildlife managers cannot manage for a drought but can only manage the effects of drought on landowners and wildlife. Assistant Professor in the Department of Zoology and Physiology at the University of Wyoming Dr. Matthew Kauffman reported the WGFD spends a large amount of time hazing elk off private land (personal communication, December 12, 2008). However Burcham et al., working in the Sheridan region of Wyoming, found that hazing and herding elk off private land was not effective and that hunting, which likely simulates predator behavior, was the only effective means of keeping elk off private land. Specific management actions include:

- Organizing hunting on private land may help reduce foraging on irrigated fields
- Vegetation monitoring of both summer and winter forage can help managers understand where elk are feeding and if forage is being affected by drought
- Regular population monitoring helps managers understand how populations are changing in response to drought, even after 10 years of drought the Clarks Fork and Cody elk are still within population targets. It is only the percent that migrate that has changed.

III. **Predation**

Another explanation for the shift in population demography from migrants to residents, "is that there is differential predation pressure on the two segments of the herd…Both segments of the herd are exposed to wolf predation but the migratory are exposed to higher [wolf] populations and a greater number of packs" (M. Kauffman, personal communication, December 12, 2008). A recent study of another elk herd within the Greater Yellowstone Ecosystem suggests that predation by wolves triggers behavioral changes in elk that causes them to alter foraging and habitat selection (Creel, Christianson, Liley, and Winnie, 2007). In reference to Creel et al.'s conclusion that harassment by wolves causes elk to move around enough to cause reductions in pregnancy Kauffmann suggested "Most elk managers are taking that report with a grain of salt," but that in the public's mind there is some validity to "this idea that elk are being harassed by wolves and spending a lot of time on the move" (M. Kauffman, personal communication, December 12, 2008).

It is unclear if wolves are having a significant enough effect on foraging and habitat selection to produce decreased calf/cow ratios in the Clarks Fork and Cody elk. However, elk display increased vigilance when any of the following occur: wolves within 3km, a high proportion of calves and cows in the herd, and when elk are forced to forage away from protective cover (Liley & Creel, 2008). In the absence of wolves, elk make frequent adjustments to movements and foraging locations to optimize trade-offs between energy expenditure and forage quality. In the presence of wolves, elk have been shown to exhibit less complex decisions about habitat use. Thus the presence of wolves may lead to decreased fitness during the winter, when elk are already experiencing limited resources (Winnie, Christianson, Creel, & Maxwell, 2006).

Management recommendations

Just as with drought, managers cannot and should not attempt to prevent predation. Instead managers need to use monitoring to understand how increased predation pressure may be affecting the species. In the case of the Clarks Fork and Cody elk, monitoring showed that the migratory elk were experiencing a decrease in calf/cow ratio either because of the effects of the drought or because of increased predation pressure from wolves. Once the cause of decrease in migratory elk is identified, managers should adjust their habitat plan accordingly.

IV. **Disease**

Another threat to elk within the Greater Yellowstone Ecosystem is disease. The threat to Wyoming elk from brucellosis (*Brucella abortus*) has been well documented. At the end of this chapter we will also highlight the possible up and coming threat of Chronic Wasting Disease.

However the biggest current threat to the Clarks Fork and Cody elk is still brucellosis. Which is a chronic bacterial disease that effects a variety of wildlife and livestock populations causing abortions in females (Cross et al., 2007). Uninfected animals contract the disease by licking birth exudates of infected herd members (Bienen & Tabor, 2006). If brucellosis only affected wildlife, the Wyoming Game and Fish Department feels confident it could maintain successful populations, but the more pressing threat of brucellosis is the economic impact outbreaks have on cattle ranching (Cleveland, 2005). Feedgrounds were originally built to keep wildlife away from livestock but it is now likely that the same feedgrounds maintain populations at higher than natural levels and contribute to the spread of a disease that affects livestock (Cross et al., 2007). In February 2004 Wyoming lost its brucellosis-free status in the northwest corner of the state because of contact with infected elk (Ibid.). The costs associated with loss of this brucellosis-free status exceeded $5 million (Cross et al., 2007).

A strong correlation has been found between elk use of feed grounds and higher levels of brucellosis seroprevalence. Non-feed ground elk are commonly reported to have levels between

2 – 3%, with feed ground elk testing positively nearly 26% of the time (Cross, et al., 2007). In contrast to this reported trend, Doug McWhirter and Jerry Altermatt, Wyoming Game and Fish Wildlife Biologist and Game and Terrestrial Habitat Biologist, respectively, report that unpublished data from the recent research on the Clarks Fork elk has documented seroprevalence rates of 6%-13% (D. McWhirter, personal communication, January 20, 2009). In the literature, the assumption has been made that non-feedground elk acquire brucellosis from feedground elk when they commingle on the summer range. However, because brucellosis transmission between elk most likely occurs between February and June, there may be little commingling of fed and non-fed elk during the transmission period. Therefore, it is not currently known whether feedgrounds may be sustaining or increasing the transmission of brucellosis to non-fed elk through commingling on summer ranges or through infected elk "switching" winter ranges to non-fed herd units. Whether or not these hypotheses explain the higher than expected seroprevalence in the Clarks Fork elk herd is also unknown. It can be assumed, however, that landowner concerns will increase as brucellosis seroprevalence increases.

In October 2008, a moose in Star Valley, Wyoming tested positive for Chronic Wasting Disease, meaning the disease has crossed the Continental Divide into northwest Wyoming (Hatch, 2008). According to the WGFD website, deer in eastern Park county have also tested positive for CWD (Wyoming Game and Fish Department, 2009). CWD is a naturally occurring prion disease native to elk and deer in North America that is associated with overall decrease in health and a neurodegeneration that is always fatal (Williams & Young, 1982). CWD is contagious and epidemics amongst free range elk can be self-sustaining (Miller, Wild, & Williams, 1998). If a widespread outbreak of CWD were to occur, it would be devastating to the elk population and difficult to control so long as elk still congregate at feeding grounds (Bienen & Tabor, 2006).

Management recommendations

Focus first on the threats that can easily be addressed. The spread of disease is made easier by large cognations of animals. While it has not been confirmed that feedgrounds are increasing the transmission of brucellosis to non-feedground elk through commingling on the summer range or through infected elk "switching winter range to non feedground herd units. The most obvious management recommendation would be closing winter feedgrounds; however, it is not known to what degree that action would increase wildlife/livestock interaction and if it would lead to an overall decline in elk population.

Cross-Case Conclusions

I. Habitat Fragmentation

In this chapter we have presented evidence that habitat fragmentation and loss due to development is pervasive throughout much of the western U. S. In each of the case studies scientists, conservationists, and land managers consistently cited development as the most immanent threat to the viability of the migration routes of interest. Even so, the extent of the pressure exerted by development on migratory ungulate populations can easily be underestimated if researchers fail to undertake completely comprehensive impact studies. Human encroachment onto critical habitat and migratory corridors not only affects ungulates through direct losses of habitat, but additionally through reductions in use of otherwise suitable habitat parcels. In the most extreme case, intensive development can result in the complete cessation of migratory behavior, restricting formerly migratory populations entirely to their winter grounds. The tragic cases of lost long-distance migrations span continents and centuries (Berger, 2003). This document was produced with the express purpose of informing stakeholders in order to enable them to work towards the preservation of long distance ungulate migration routes in the western U.S. A primary assumption, implicit in this effort is that there is some ecological significance of this migratory behavior both for the ungulates and for the ecosystems in which they occur. The purpose of this section, therefore, is to explore the importance of migration to ungulates and the importance of migratory ungulates to ecosystems.

The preceding sections in this chapter have begun with the identification of a threat and subsequently presented the consequences for the ungulate population at current and predicted levels of this threat. Here, we take a different approach. Our analysis begins where migration ends. For the purposes of this section we hypothetically assume that whatever level of development necessary to cause complete cessation of an ungulate migration has already been reached. While the question as to the precise level of development sufficient to bring about this scenario in each of our cases is indeed an interesting one, it is beyond the purposes of this section to pursue answers to it.

A. Importance of migration to ungulates

Migration necessarily entails tradeoffs. Some of the costs of migration include bioenergetic expenditure, increased predation risk, increased chance of injury, and exposure to stressful anthropogenic stimuli (Nicholson, 1997; Dingle, 1996; Lutz, 2003). Precisely defining the benefits of migration is often a much more controversial issue. In a 2008 review of the literature, Bolger et al. propose three possible benefits conferred on migratory ungulates: "(1) Following seasonally changing food quantity, phenology, and/or accessibility (e.g. areas with abundant food in the summer and areas with low snow cover in the winter)…, (2) Gaining access to critically limiting resources that differ by location and season (e.g. water in the dry season and limiting nutrients in the wet season)…, (3) Seasonal escape from predators, parasites or insect harassment" (Bolger, 2008, p. 69). This short list can be further distilled by the conversion of these less tractable concepts into overall reproductive success (Nicholson, 1997). In other words, in order for a population of ungulates to remain wholly or partially migratory in the long run, migrants must not reproduce less than non-migrants. For both the Round Valley mule deer and the Clarks Fork and Cody elk, it appears that the costs of migration may already greatly outweigh the benefits, as evidenced by precipitous drops in the proportion of migratory animals and the relative fitness of the remaining migrants to non-migrants. As for the pronghorn, the benefits of long distance migration appear to outweigh the costs, at least for the time being. What might we expect to happen if the scale is tipped entirely in favor of a single-range life history?

In both the elk and mule deer case studies, non-migratory individuals remain on their winter grounds or in close proximity to instead of traveling to distinct summer ranges. While there has been no similar shift in summer range selection in pronghorn, it is a virtual certainty that, were their migration to cease, they would remain on their winter range. In each case winter forage is limited and substantial human encroachments have been made onto current winter range. If any of these migrations were to cease entirely, there would be a marked increase in the number and therefore density of individuals present on the winter range, resulting in reduced forage availability per capita. Not surprisingly, this would necessarily result in a reduction of vegetative carrying capacity (K) as well as an increase in density-dependant effects (Ballard, 2001). Christianson and Creel found that elk are physiologically best adapted, as measured by winter body mass, to consuming mixed diets of grass and browse (such as leaves, twigs, and shoots of young trees) (Christianson & Creel, 2009). A year-round restriction of elk to their winter grounds could lead to a reduced proportion of dietary grass relative to browse, resulting in lower quality nutritional intake. Captive elk, having been fed low quality forage in the summer and fall, exhibited delayed reproduction in the spring leading to greater mortality of calves in the winter (Cook et al. 2004). Researchers hypothesized that earlier birth provided a “head start” advantage, allowing calves more time to grow before the onset of winter (Ibid.). In mule deer, researchers found that increased density on winter ranges lead to both reductions in quality of diet and in the breadth of dietary niche, presumably because high quality forage is quickly consumed leaving homogenous lower quality forage (Nicholson et al., 2006). In pronghorn, female rank, as measured by outcomes in dominance interactions, has been shown to influence foraging behavior and therefore quality of diet (Dennehy, 2001). These findings have important implications if winter range density is to increase markedly. Increased intraspecies resource competition as a result of increased density could widen the disparity between the diet qualities of high ranked and lower ranked females, leading to decreases in parturition and fawn survival of females with lower quality diets. Similar to pronghorn, mule deer exhibit substantial negative effects associated with increases in density, including lowered juvenile survival, lowered reproductive rates of young females, and in extreme cases, lowered fecundity of prime aged adults (Gaillard et al., 2000).

In addition to the relatively predictable effects on carrying capacity and demography, the range restriction resultant from fragmentation also acts to greater avail ungulates to the deleterious effects of stochastic events. Severe drought in California in the late 1980’s reduced the population size of the Round Valley mule deer by more than 80% (Pierce, 2000). If this population had been cut off entirely from the seasonally available forage on their summer grounds, there numbers might have dropped even more severely. The Clarks fork elk have also been subjected to the long term drought of the Greater Yellowstone Ecosystem (GYE), forcing them to graze irrigated pastures. It is tempting to conclude that in this case human disturbance is acting to support the current population numbers. Yet this interaction may not have truly reached an equilibrium. As anthropogenic development intensifies, the negative effects of physiological stress will likely outweigh these short term benefits. Drought is not the only natural phenomenon likely to exert additional pressure on ungulate populations in the foreseeable future. One likely climate scenario predicts that the GYE will be much warmer and drier in the future, which could lead to increases in the magnitude and frequency of fire (Romme & Turner, 1991). While the application of global climate models to the regional (and smaller) scales necessarily entails a great deal of uncertainty, the limitation of ungulates to reduced ranges would undoubtedly further expose these populations to the harmful effect of whatever stochastic events befall them.

Finally, non-migratory ungulates may be exposed to increased predation pressure. The effects of predation have been studied thoroughly for the Round Valley mule deer, and to a lesser degree for the Clarks Fork elk. Recent research suggests that elk alter habitat selection, presumably to suboptimal strategies, in the presence of wolves (Creel et al., 2007). Ballard et al. found that a population of wolves feeding primarily on caribou (*Rangifer tarandus granti*) generally did not follow these animals in their migratory movements, but instead selected moose in the months when caribou were absent (Ballard et al., 1997). These findings are consistent with the hypothesis that migratory movements allow ungulates to temporarily escape predation pressure in some systems. Yet for at least two of the case studies (elk and mule deer), it does not appear that migratory animals are currently experiencing lower levels of predation as compared to non-migrants. Pierce found that a portion of the mountain lion population associated with the round valley mule deer undertakes seasonal movements to maintain the availability of their prey (Pierce, 1999). Thus, predation levels appear to remain relatively comparable for migratory and non-migratory mule deer. It is possible that the pronghorn gain some reduction in predation pressure by making the migration to their summer grounds. A recent study on the neonatal mortality rates of pronghorn in wolf-free and wolf-abundant sites surprisingly found greater mortality in sites containing wolves (Berger & Conner, 2008). The key to this apparent paradox lies in the ability of wolves to (apex predators) to exclude coyotes (mesopredators) (Ibid.). Because coyotes are better suited to capturing small prey, they impose greater pressure on neonatal pronghorn. Through their seasonal movements away from their wolf-free winter range to the wolf-abundant Grand Teton National Park, the pronghorn are able to increase the survival of neonates.

Although only one of our study herds appears to escape predation pressure through migration at present, further habitat fragmentation may still increase predation if any of these herds become entirely non-migratory. Predators such as wolves and mountain lions are capable of adjusting their strategies to the distribution and movements of prey species (Creel et al., 2007; Pierce, 1999). This behavioral plasticity coupled with restricted year round prey ranges might ultimately lead to more efficient predation and, therefore, further reductions in ungulate populations.

Population decline and spatial isolation, resulting directly from habitat fragmentation and amplified by stochastic events and predation pressure, may exert long-lasting effects on the genetic diversity, and therefore the adaptability of these herds. Coulon et al. found the genetic composition of a roe deer population to be influenced by barriers such as a highway, rivers, and canals (Coulon et al., 2006). If minor, ultimately passable features such as these can noticeably alter the genetic diversity of herds, there is much reason to be concerned about the large effects that would results from greater degrees of isolation. Urbanization has been show to have an exponential correlation to reductions in microsatellite variability and allelic diversity (two measures of genetic diversity) in roe deer (Wang & Schreiber, 2001). Non-linear relationships such as this suggest thresholds of fragmentation that may result in irreversible alterations of genetic diversity. If any of populations is too greatly reduced and isolated by development, genetic bottlenecks may ultimately lead to dramatic and long term reductions in their ability to adequately adapt to future challenges.

B. **Importance of migratory ungulates to ecosystems**

To this point, we have examined the value of long distance migration to ungulates. We next explore the ecological significance of migratory ungulates to the ecosystems they inhabit. Ungulates interact with other species through both top-down and bottom-up processes. As large herbivores, ungulates substantially alter plant communities in the areas they inhabit. As prey species, they provide the primarily dietary requirements for many predators such as wolves, coyotes, and mountain lions. While each of these groups of interactions may be analyzed individually, there is ultimately great difficulty in separating them entirely from one another, partially due to limitations in so-called "natural experiment" study methodology (Vavra, Parks, & Wisdom, 2007). That being said, the aim of this section is to provide the reader with an understanding of some of the roles that migratory ungulates (and ungulates generally) play in ecosystems.

The effects of ungulates on vegetative communities can be so profound that some authors have referred to them as keystone species (Kie & Lehmkuhl, 2001, p. 55). Ungulates are capable of controlling plant community diversity, nitrogen mineralization, and primary productivity (Ibid.). Moderate-intensity grazing by ungulates can enhance species diversity through reducing the proportion of preferred forage species relative to other species (Ibid.). A moderate level of grazing is consistent with estimates of wild ungulate grazing before European settlement (Vara et al. 2007). Ungulate migration was then "characterized by extensive migrations that probably exerted less long-term influence on the plant communities" (Ibid., p. 68) Migratory ungulates follow the "spatio-temporal pattern of nutrient rich forage across…ecosystem[s]," (Frank, 1998, p. 410) creating "positive feedback…on their forage by providing grazed plants extended periods to recover while soil conditions are suitable for plant growth" (Ibid.). It has been demonstrated that the complete absence of ungulate herbivory can have negative effects on ecosystems. In a 42-year long experiment, Manier and Hobbs found the complete exclusion of large herbivores to cause significant reductions in biodiversity as measured by species richness and evenness (Manier & Hobs, 2007). So great was the magnitude of this effect that the shrub cover in the protected areas was visually aberrant from that of the surrounding landscape (Ibid., p. 746). From these findings and others like them, emerges a general understating that migratory ungulates can have positive effects on plant community structure.

While short-term disturbances have demonstrable benefits to plant community diversity, the chronic high-intensity disturbance associated with dense, non-migratory herds of ungulates tends to have the opposite effect (Kie & Lehmkuhl, 2001). Ungulates feed selectively on plant species with the greatest palatability, thereby reducing the fitness of these species relative to other, less palatable species (Augustine & McNaughton, 1998). Long-term, intensive grazing can result in sizable competitive advantages conferred upon species that possess physical or chemical adaptations to reduce palatability (Kie & Lehmkuhl, 2001). Not surprisingly, many plant species labeled "invasives" utilize these strategies (Ibid.). Invasives have also taken advantage of the mobility of ungulates through two types of seed adaptations: those that facilitate endozoochory (diaspore transportation within the animal) and those that facilitate epizoochory (diaspore transportation on the outside of the animal) (Vavra et al. 2007). With these specialized modifications, invasive plants are able to disperse their diaspores over long distances, to habitat conditions that are very likely to be suitable for establishment.[25] Studies involving the collection of ungulate droppings and the germination of the seeds contained within them have confirmed the effectiveness of endozoochory as a dispersal strategy (Bartuszevige & Endress, 2008).

The final benefit of a moderate grazing regime is an increase in nitrogen mineralization. It is well established that nitrogen is a limiting resource in grasslands (Frank 1998). Urine and

[25] Vavra et al. (2007) note that because "Native ungulates and livestock have predictable patterns of habitat selection; hence, animal-dispersed seeds are likely to be spread among environmentally similar sites."

feces deposition can have profound fertilization effects, causing increases in primary productivity of plant communities (Kie & Lehmkuhl, 2001). Frank found a strong positive correlation ($r^2 = 0.82$ $P < 0.0004$) between plant consumption by elk and bison (*Bison bison*) during the growing season and mean above-ground plant production at winter, transitional, and summer ranges (Frank, 1998). This study also compared the mineralization of grazed sites to that of fenced sites, finding that grazed sites exhibited significantly higher net annual mineralization. Frank replicated these results in a more recent study, and additionally found that migratory ungulate grazing elevated nitrogen mineralization rates in relation to phosphorus mineralization rates, which is assumed to be of benefit to nitrogen limited systems (Frank 2007). While there is a benefit to seasonal grazing, more intensive grazing can lower net nitrogen mineralization. This is especially true in the case of forests. Pastor et al. found that heavy moose browsing of a boreal forest leads to the decline of several highly preferred tree species that produced labile litter (Pastor et al., 1993).

Ungulate herbivory can have profound effects on plant communities. These effects can be both negative and positive. While these interactions are best studied on a case-by-case basis, the general pattern that emerges suggests that maintenance of ungulate migrations, and the associated moderately intensity disturbance regimes are of much greater benefit to plant communities than the effects of dense, non-migratory herds.

On the other side of this equation is the ecological role ungulates play as the primary prey species for many apex and mesopredators. While predator-prey dynamics remains a very hot topic in the ungulate conservation literature, few researchers have looked at the function of ungulates in the maintenance of predator populations. Instead, most studies have taken the opposite approach, gaining an understanding of how predators influence ungulate demography and behavior. Although there is a paucity of empirical studies directly addressing the bottom-up effects of ungulates on predators, a few important points can be made. As mentioned earlier in this section, the findings of Ballard and Pierce suggest a considerable amount of behavioral plasticity in the predatory strategies of both wolves and mountain lions (Ballard et al., 1997; Pierce, 1999). Because predators will follow migratory ungulate populations, their presence in certain ecosystems is completely dependant upon the ungulates that migrate. This certainly appears to be the case for the Round Valley mule deer. Additionally, if ungulate populations are to shrink and become further isolated, we would expect to see a decrease in obligate carnivores (e.g. mountain lions) relative to facultative carnivores (e.g. coyotes). Attempting to draw any conclusions about the ultimate effects of this shift would more highly speculative. Much research is needed to better understand the distribution and abundance of predators in relation to ungulate populations.

This section has presented information on the importance of migration to ungulates and the importance of migratory ungulates to ecosystems. While it is not intended to be an exhaustive review, most of the major points have been addressed. If habitat fragmentation is allowed to proceed to the point where ungulate migrations are cut off entirely, we can expect to see decreases in ungulate populations, decreases in plant community diversity and productivity, and decreases in predator abundance and distribution. It is therefore imperative to maintain connectivity between ungulate summer and winter ranges through the conservation of migratory corridors.

Climate Change

The most immediate threat to the continued migration of the GTNP pronghorn, Round Valley mule deer, and Clarks Fork and Cody elk is development of human settlements that physically blocks their route or erodes critical habitat. However, in the coming years the effects of climate change could pose an even greater threat. Evidence from the Holocene indicates that alterations in temperature and precipitation bring about changes in the vegetative communities, and that these changes can also give rise to changes in the frequency and intensity of disturbances such as fire (Whitlock, Shafer, & Marlon, 2003). The threats section of our study outlines the significance of fire in the case of the Round Valley mule deer. Changes in fire regime could also have significant effects for elk and pronghorn. Keane et al. found that some of the predicted climate change scenarios would cause major shifts in landscape vegetation and that this change would be exacerbated if vegetation changes led to subsequent changes in future fire regimes (Keane, Holsinger, Parsons, & Gray, 2008). Their study indicated that changes in fire regime could be as important or more important than the changes in vegetation composition caused solely by changes in temperature, precipitation, CO_2 etc. (Keane, et al., 2008).

One possible climate change scenario for the western United States is a significant increase in summer temperature without an increase in precipitation (Whitlock, et al.,2003). This scenario would increase summer drought stress on vegetation in the GYE. If this stress was significant, it could create conditions that would decrease the fire return time (Ibid.). Under another scenario, summer temperatures could increase and be accompanied by an increase in precipitation. In this case the subsequent increase in evapotraspiration could still lead to increased drought stress that would decrease the fire return time (Ibid.). Of significance to the mule deer case study is the conclusion by researchers in Oregon that increased winter precipitation combined with summer drought leads to increases in annual *B. tectorum*. This is of concern particularly if regional temperature increases lead to worsening of the existing grassland fire positive feedback loop (Bates, Svejcar, Miller, & Angell, 2006). If fire frequency increased in the Serria Navada mountains of Californa it could exacerbate the current decline in bitterbrush, an important winter forage for the Round Valley mule deer. As described in the Fire, Cheatgrass and Livestock threat of the Round Valley mule deer.

All three of the migratory ungulates in this study rely on long-lived shrub species for winter forage, and these long-lived species with slow reproductive cycles will be slowest to adapt to habitat changes resulting from climate change effects (Romme & Turner, 1991). However, a warming climate that leads to decreased food stress over winter could reduce the congregation of elk on the winter range and at winter feed grounds, reducing the risk of disease transmission (Cross, et al., 2007a). The myriad of different scenarios makes climate change a difficult issue for managers to address. They cannot directly tackle the problem and prevent changes in climate but can only attempt to predict the changes and adapt to them accordingly.

Climate change is a transient threat because, as global warming continues to alter the climate, interactions at all levels will become more complex and vegetation and fire regimes will continue to change. The transient nature of climate change increases the difficulty managers experience in developing appropriate responses to vegetation and to fire regimes (Whitlock, et al., 2003). For example, the lower elevation sagebrush-grasslands that all three of these species rely on for winter forage are likely to show more rapid changes in productivity and composition in response to climate change (Romme & Turner, 1991).

The nature of migration then requires that management be planned at the ecosystem level, but the transient nature of climate change means that managers must create plans adaptive enough to incorporate environmental changes. Managers must consider that there is not a consistent fire return time over geologic history and that past climate change has greatly altered vegetation communities and fire return times (Whitlock, et al., 2003). Therefore, addressing this threat requires long-term monitoring in order to understand the complex changes that will occur and determine the success and consequences of all management actions (Whitlock, et al., 2003). Monitoring must be paired with research directed at understanding the responses of species to disturbances and changes in disturbance frequency (Romme & Turner, 1991).

Adaptive Management

The most immediate threat to the continued migration of the GTNP pronghorn, Round Valley mule deer, and Clarks Fork and Cody elk is the development of human settlements that block migration routes or encroach on critical habitat. Development of lands on critical habitat and migratory corridors not only affects ungulates through direct losses of habitat, but additionally through the fragmentation of habitat into smaller parcels that animals will be less likely to use. Developments present both continuous and variable disturbance regimes, making their effects on ungulates difficult to quantify. There is additional complexity arising out of the disparity between the small scale on which wildlife managers operate and the much larger scale of development. These concerns result in considerable uncertainty of the effectiveness of locally applied wildlife management actions.

The biggest collective future threat to the GTNP pronghorn, Round Valley mule deer, and Clarks Fork and Cody elk are the effects of human induced climate change on habitat. Evidence from climate change during the Holocene indicates that changes in temperature and precipitation bring about changes in vegetative communities, and that these changes can also give rise to changes in the frequency and intensity of disturbances such as fire (Whitlock, Shafer, & Marlon, 2003). Management surrounding the threat of climate change is difficult because there is uncertainty regarding the magnitude, severity, and long-term implications climate change will have on habitat (Arvai, et al., 2006). This uncertainty is further enhanced by the complexity and scope of the climate change threat, which affects the landscape at everything from the local to the global level (Ibid.).

Taken together, these threats work to both shift and halt existing long-distance migrations. In the short term the biggest risk is that development will block a migration and thereby halt the migration entirely. However, there is anecdotal evidence that the GTNP pronghorn migration has shifted westward as with the expansion Pinedale, exhibiting some degree of plasticity. Over the long-term it is thought that climate change will shift migrations both temporally and spatially. Ecosystems are not infinitely plastic; both topographic, physical barriers and limits to the flexibility of ecological interactions could lead to the complete stoppage of migration routes. While the imperviousness of physical barriers to each species is well understood, the potential for climate change to irreversibly alter the ecological conditions necessary to sustain migratory ungulates has received much less investigation. Scientists tend to wait to act until all possible research has been conducted, but managers must not fall into this trap with global climate change. Research into climate change will never be complete and will probably never be conclusive, so managers must act with the best possible information available at the time.

When managers must address an issue with imperfect information, it is necessary to implement a process that can be updated as new information becomes available. Adaptive management provides such a framework. Adaptive management can be broken into three categories: "(1) evolutionary or "trial and error," in which early choices are essentially haphazard, while later choices are made from a subset that gives better results; (2) passive adaptive, where historical data available at each time are used to construct a single best estimate or model for response, and the decision choice is based on assuming this model is correct; or (3) active adaptive, where data available at each time are used to structure a range of alternative response models, and a policy choice is made that reflects some computed balance between expected short term performance and long-term value of knowing which alternative model (if any) is correct" (Walters & Holling, 1990, p. 2060). The premise of active adaptive management is that knowledge of any system is incomplete. The system itself is a moving target, because of the impacts of management and the combined affects of continued development and climate change (Ibid.). Therefore the management actions must be active and ever changing to adapt to the changing system and goals (Ibid.).

The first step in active adaptive management is developing models built on the best available data. Through various modeling approaches, researchers are able to refine their hypotheses about the effects of possible management actions. Vegetation models can be a useful tool for wildlife managers seeking to understand how plant community composition might change under different scenarios. In order to create vegetation models, detailed information on vegetation health and community structure must be collected. These models can be compared with landscape management alternatives to help determine the best strategies for maintaining landscape integrity through climate change (Keane, Holsinger, Parsons, & Gray, 2008). Where possible, models should be supplemented with local ecological knowledge in addition to general scientific knowledge about species of interest. Irvine et al. found that the predictive capabilities of a habitat use model of red deer (*Cervus elaphus*) increase markedly with the addition of information obtained from interviews with wildlife managers (Irvine et al., 2009). Classical population modeling often involves the forecasting of future trends based on knowledge of historical population fluctuations. Forecasting models are only valid if the ecological processes generating historical data remain unaltered in future (Kshatriya, Cosner, & Van Jaarsveld, 2001). Kshatriya et al. proposed an innovative approach to population modeling, whereby researchers can estimate population “floors” and “ceilings” (Ibid.). This information can act as an early warning system to alert wildlife managers when the assumptions of classical forecasting models may no longer be valid (Ibid.). Utilizing this approach in conjunction with classical modeling techniques can allow managers to rapidly adjust their population models to better fit true ecological conditions.

Up-to-date knowledge of ecological conditions is only attainable through regular monitoring. Ecological indicators provide more information than simple population censuses because they allow for an understanding of how ungulate populations interact with other biota and anthropogenic disturbances. An ecological indicator should meet the following criteria: “be easily measured, be sensitive to stresses on the system, respond to stress in a predictable manner, be anticipatory, predict changes that can be averted by management actions, be integrative, have a known response to disturbances, anthropogenic stresses, and changes over time, and have low variability in response” (Dale & Beyeler, 2001, p.3). The Wildlife and Energy Development study of pronghorn provides a prime example of the use of ecological indicators to assess the effects of anthropogenic disturbance on a migratory ungulate population. Researchers took measurements such as distribution, abundance, survival, body condition, and fecal corticosteroid levels to assess the impacts of development on wildlife (Berger, Berger, & Beckmann, 2006). This study has not yet found that oil and gas development has major effects on the physical condition of the pronghorn. In order to better understand the relationship between ungulate density and plant community structure, this study could have included a browsing index or other measure of vegetative condition (Morellet et al., 2007). Perhaps with the addition information assessing the impacts of browsing on sagebrush, a more comprehensive representation of pronghorn-disturbance dynamics will result.

Monitoring of ecological indicators will play a key role in the management of climate change. All three of the migratory ungulates in this study rely on long lived shrub species for winter forage, and it is these long lived species, with slow reproductive cycles that will be slowest to adapt to habitat changes resulting from climate change (Romme & Turner, 1991). It is important to design long-term measurement systems that are sensitive to early indicators of ecological change. The obvious choice in the Greater Yellowstone Ecosystem (GYE) is to focus monitoring efforts along the upper and lower timberline. Timberline monitoring must be conducted in such a way that observed changes can be attributed to either climate changes or local variability (Ibid.). In both the GYE and in the Sierra Nevada mountains, fire is an important shaper of ecosystems. Changes in both fire frequency and severity can be another important indicator of climate change. Monitoring of changes in disturbance frequency coupled with research directed at the underlying mechanisms of that change is of the utmost importance (Ibid.). Large-scale climate indicators such as landscape scale fires and timberline changes do not follow state boundaries.

Traditionally states have collected their own management data, often breaking species into discreet "herd units" or "hunt units," and collecting management information independent of nearby states. These individualized approaches have lead to a wide variety of methods, making comparisons across regions difficult and reducing the flow of information between agencies. The Western Association of Fish and Wildlife Agencies, in their 2004 Mule Deer Conservation plan identifies difficulty in securing "timely data to summarize population sizes" as a challenge (Mule Deer Working Group, 2004, p. 4). They recommend "more standardized approaches to mule deer data gathering…to help alleviate this problem" (Ibid.). Toward this goal the plan creates objectives centered around improving interagency communication, standardizing methodologies, and conducting a gap analysis on information needs on mule deer populations and habitats at the ecoregion level (Ibid.).

While the standardization of methodology and information-sharing across scales as large as ecoregions allows wildlife managers to gain a better understanding of pervasive threats such as climate change, adaptive management can also be useful on much smaller scales. A prime example for the need to utilize adaptive management at a local scale can be found in the literature on the ungulate habituation. Ungulates exhibit interspecies and intraspecies differences in the degree of habituation to anthropogenic disturbances. In a mule deer habitat selection study conducted during the initial development of a natural gas field, Sawyer found little evidence for habituation. In each year of his three year study, deer used habitats that were further away from the nearest well pads (2.7km, 3.1km, and 3.7km respectively) (Sawyer, Nielson, Lindzey, & McDonald, 2006). Notably, habitats that were considered "low use" prior to natural gas development, due to their inferior quality, became highly utilized by year three (Ibid.). In a study of female mule deer habitat use in the vicinity of an aqueduct system and residential developments, Tull & Krausman predicted that deer would select habitats with low levels of human activity and infrastructure (Tull & Krausman 2007). Researchers found no support for this hypothesis, as mule deer selected habitat areas closely associated with urban developments (Ibid.). The provision of free-standing water sources associated with residential developments was ruled out as an explanation, because the study area contained abundantly available water both near and further away from urban areas (Ibid.).

Thompson & Henderson examined habituation in elk as and adaptive strategy to maximize reproductive success and predicted that habitation will become more widespread throughout the western US (Thompson & Henderson, 1998). Specifically they suggested that elk habituation will increase if the following criteria are satisfied: "(1) elk population density is high, (2) elk recognize and use areas of human presence as a sanctuary from hunting, (3) the area of human presence is elk winter range, and (4) human activities are consistent and predictable." (Ibid., p. 481). The interactions between ungulates and anthropogenic features are highly dynamic. Ungulates exhibit considerable variation in habituation spatially and temporally. The Cody elk in population in our study does not currently exhibit a high level of habituation, but only careful monitoring and natural experiments will allow wildlife managers to know if and when they become more highly habituated. If wildlife managers do not continually update their habitat use models as new information becomes available, the risk of making poor conservation decisions is heightened substantially.

In order to optimally manage ungulate populations, many types of data must be combined into a coherent model to guide decision-making processes. A thorough model for a goal as ostensibly simple as setting harvest levels for a managed elk population included such information as "plant species composition; plant production; shrub height and cover; historical climate; historical animal numbers; soils maps; field soil survey data for texture, depths, and nitrogen levels; maps for vegetation, topography, hydrology, animal ranges, and land ownership; satellite imagery for NDVI data; and many literature-derived parameters from fields of study such as animal energetics and plant physiology." (Weisberg, Hobbs, Ellis, & Coughenour, 2002, p. 195). Each type of data tells a piece of the story of how an ungulate population is interacting with its ecosystem. Adaptive management provides a framework through which these data can be packaged together into more tractable output for wildlife managers. Few long term examples of adaptive management exist however some projects beginning in the 1990's and early 2000's are beginning to show results, the reintroduction of wolves to Yellowstone National Park is a prime example. The original reintroduction models were built to predict experimental wolf recovery, and management actions were undertaken based in part on the model predictions (Varley & Boyce, 2006). Varley and Boyce have now gone back and updated the WOLF5 model to WOLF6 and evaluated the success of the new model (Ibid.). Currently the adaptive management aspects of wolf reintroduction to YNP can be viewed as a success (Griffith, Scott, Carpenter, & Reed, 1989).

The successful example of wolf reintroduction and others like it elucidate the potential uses of adaptive management in situations of ecological uncertainty. It is encouraging that wildlife managers in each of our case studies are utilizing some forms of adaptive management. Simple population models, solely utilizing population demography measures to set hunt quotas, can be built upon with additional ecological indicators to provide wildlife managers with a more comprehensive view of the ecology of ungulates. If researchers continue to monitor habitat use in developed areas, they will be better able to estimate the effects of anthropogenic infrastructure on migratory populations and spot potential future migratory bottlenecks. Vegetation monitoring and modeling will allow researchers to refine their predictions of the impacts of climate change on these ungulate migrations. In order to address the unprecedented uncertainty brought about by climate change and development, researchers and wildlife managers must increasingly rely upon adaptive management approaches.

Section IV

Cross-Case Analysis of Conservation Strategies

In Chapter 5 we discuss in detail the threats faced by each migrating ungulate herd that we examined; we turn now to identifying and examining those groups who can act to address the threats and to the challenges they face in doing so. Chapter 6 focuses on conservation strategies employed by governmental entities that have responsibility to regulate land use on the habitat through which the ungulates migrate, i.e., land use planners and managers. It also identifies management challenges for habitat-based threats within the context of the legal framework land use planners and managers operate within. The subsequent chapter, Chapter 7, examines the strategies employed by governmental entities that have responsibility to manage the ungulate populations themselves, the wildlife managers, and will identify management challenges within the context of examining the most effective efforts for ensuring population viability. Chapter 8 looks at the strategies non-governmental organizations have employed to ensure threats to the migrating ungulate species are addressed, and to the challenges they encounter, within the context of the different functions non-governmental organizations can serve in providing for habitat and wildlife conservation. The final chapter in this section, Chapter 9, examines, in particular, the varying communication strategies used by entities falling within all of these groups and will provide specific guidance on how these entities can use communication to improve the success of other strategies.

Chapter 6
Flexibility within Legal Frameworks for Land Use Regulation

Introduction

Because of our focus on threats to the seasonal ranges and travel corridors of migrating ungulates, land use planners and managers play a central role in potentially acting to directly address these current or future threats. While, as further discussed in Chapter 7, they often collaborate with wildlife managers to identify threats to wildlife and biological objectives supportive of wildlife populations, the decision if and how to implement these objectives lies with those who regulate land use. These regulators are governmental entities on municipal, county, state, and federal levels. They include both local planning bodies that provide coordinated oversight for a collection of private lands and set limits on the development of individual parcels, such as county planning departments, as well as managers of public lands, such as the U.S. Forest Service and Bureau of Land Management.

The array of land use planners and managers with jurisdictions within the seasonal ranges and migration corridors for each of the ungulate herds we examined is identified below, followed by a discussion of the authority of each entity to address threats to migrating ungulate populations and a comparison of specific actions taken by similar land use planners and managers across case studies. Because the authority given to each governmental entity is provided through a legal framework of legislation, and any subsequent judicial interpretations of that legislation, there is often a real but amorphous amount of space in which land use planners and managers can decide if, and how, to act to address migrating ungulates. Exploring authority versus action as grounded in the existing decision-making contexts for each entity (e.g., political climate, resource constraints, and individual decision-maker perspectives) in three case study settings in two states will illuminate how much flexibility each entity has, revealing management challenges for addressing habitat-based threats to migrating ungulates. While this exploration will be specific to our case studies in Wyoming and California, similar legal frameworks and governmental entities are found in other rural Western areas where ungulates migrate, so the management challenges identified here may be helpful to those interested in ungulate migration elsewhere.[1]

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[1] As identified by Joel Berger, almost all of the long-distance migrations in the US occur in Western states, including Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and

I. **The Land Use Planners and Managers**

As is illustrated by the maps of land ownership for each of our three case studies (see Maps 2.1, 3.1, and 4.1), the migrating mule deer, pronghorn, and elk herds we examined move over a patchwork of private and public lands. Although the counties in which the ungulates migrate are largely publicly owned,[2] the ungulates winter and travel in lower-elevation and riparian lands that are often privately owned because these low lands are similarly attractive for human settlement (see elevation and land ownership maps). The result is that a mix of municipal, county, state, and federal planners and managers has authority to regulate land use on the habitat within each ungulate's migration route and seasonal ranges.

Maps 2.1, 3.1, and 4.1, included in our case study narratives, help to identify the governmental entities with jurisdiction within the lands used by each migrating ungulate herd. For Round Valley mule deer, local planning bodies, who regulate land use on private lands, include Inyo and Mono Counties and the incorporated town of Mammoth Lakes; public land managers include the U.S. Forest Service (USFS), Bureau of Land Management (BLM), and National Park Service (NPS), and the Los Angeles Department of Water and Power (LADWP).[3] For Grand Teton National Park pronghorn, local planning bodies include Sublette and Teton Counties, and public land managers include USFS, BLM, NPS, and the Wyoming Office of State Lands and Investments (WY OSLI). For Clarks Fork and Cody elk, Park County is the local planning body and public land managers include USFS, BLM, NPS, and WY OSLI. As indicated in the section on public lands below, NPS is not discussed in the remainder of this paper because the location of their land holdings are within summer ranges where the threats to migrating ungulates are essentially limited to those not directly associated with land managers' authority. The areas used by the migrating ungulates also includes a few small additional parcels that are

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Wyoming (Berger, 2003). Additionally, while state, county, and municipal laws will vary across locations, and the regional conservation strategies of federal agencies may differ, the legislation and regulations that direct these major federal agencies, who own large tracts of land n the West, remains the same.

[2] This is a distinguishing quality of many Western counties versus their Eastern counterparts. 1.7% of Inyo County (M. Conklin, personal communication, March 27, 2009) and 6 % of Mono County is privately owned (Mono County, 1992); 20% of Sublette (Green River Valley Land Trust, n.d.) and 97% of Teton County (Brown, 2004); and 17% of Park County (Wyoming State Water Plan, 2003).

[3] Although LADWP has oversight of land owned by the city of Los Angeles and operates as a private property owner within both Mono and Inyo Counties, LADWP is analyzed as a public lands manager in this chapter. This choice was made because LADWP lands have a minimal level of residential development on them and LADWP manages lands under its jurisdiction similar to a public land manager, maintaining a goal of keeping approximately 75% open to the public for recreational use and operating a program of grazing leases (B. Tillemans, personal communication, March 24, 2009; LA Department of Water and Power, n.d.b). Additionally, the threats to migrating ungulates on these lands are more similar to those on other public lands than on other privately-owned lands.

managed by other public land managers;[4] however, this chapter concentrates on those land use planners and managers with more sizeable jurisdictions whose authority reaches nearly all of the relevant land.

II. Authority: Legal Frameworks for Land Use Regulation

Because each land use planner and manager must participate in addressing the identified threats faced by migrating ungulates if viable migration routes are to exist in the future, it is important for those interested in conserving these routes to recognize the limits and opportunities for action that are created by the assortment of legal frameworks under which land use planners and managers operate. Legal framework, as used here, refers to the body of laws giving each governmental entity its authority: state and federal constitutions, state and federal legislative statutes, and federal agency-created, codified rules that provide directions for implementing federal statutes (often referred to as regulations). Since what is of interest here are management challenges on a local and regional level, federal regulations have been included, although it is important to recognize that these are both created by, and can be changed by, the public land management entities acting on a national level.[5]

Land use planners and managers, as governmental entities, generally only have authority to act to the extent that Congress or a state legislative body has provided it to them. This is true for each of the entities covered here except for LADWP, a department within the City of Los Angeles' municipal government that has holdings in Inyo County. Both land use planners and managers that are part of municipal or county governments may be located within municipalities or counties that are enabled through state law to institute "home rule" control, which is often carried out through the creation of a "charter" listing their governmental powers (see Egler, 2001; Antieau, 2008). California's constitution has such a provision (Cal. Const. art. XI, § 3, 2008), and Los Angeles has adopted a charter although the remaining relevant local government units in California have not (see Governor's Office of Planning and Research, 2008). Because an adopted charter is considered a "law of the State" in California, with the "force and effect of legislative enactments" (Cal. Const. art. XI, §§ 3(a), 5, 2008; see *C.J. Cubach Co. v. McGuire*, 248 P.676, 677 (Cal. 1926)), LADWP's authority is also effectively limited by state law. In other

[4] These include the California State Lands Commission and the California Department of Fish and Game for mule deer; the Wyoming Game and Fish Department for pronghorn; and the Bureau of Reclamation for elk.
[5] While there are other agency-wide documents that direct federal agency action, including guidance documents and policy manuals, this chapter is limited in scope to examining codified forms.

words, all of the land use planners and managers studied here can only legally take action to address threats to the seasonal ranges and travel corridors of migrating ungulates to the extent that they can point to some part of a relevant constitution or other state law that enables them to do so.[6]

Collectively, the legal framework under which each land use planner or manager operates can involve a variety of mandatory mandates (by requiring or forbidding action), permissive mandates (by allowing action), or broadly-enabling mandates (here, in reference to wildlife or habitat).[7] A major complication to identifying management challenges that result from these laws is that the mandate they provide is a matter of interpretation (see, generally, Congressional Research Service, 2008). By acting in a particular way, or not acting, a land use planner or manager is necessarily interpreting the authority it has been granted and the extent of that authority. Often, when these governmental entities make a regulatory decision, they will be challenged in court by those who are essentially interpreting the statutory mandate differently and claiming that the entity has failed to act how it was directed.[8] While the ambiguity of statutes and the potential for litigation illustrate the hazard of relying on the text of laws to deduce management challenges,[9] identifying the major textual references to wildlife and habitat, as well as the approach through which each governmental entity is directed to complete its land use planning or management, will provide a basis for comparing the actions taken by these governmental entities, i.e., the conservation strategies.[10]

III. **Action: Strategies for Addressing Threats**

After identifying the legal framework for each land use planner and manager, the next step will be to compare how governmental entities have chosen to act, or not act, to address threats to the migrating ungulate herds we examined. The threats themselves, as identified in

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[6] This is not to say the authorizing law must speak to the specific decision being made (e.g., whether to prohibit livestock grazing on a particular parcel of land), but rather that the mandate can be interpreted to supply the entity with the authority to make such a decision.

[7] See Congressional Research Service (2008) for a detailed analysis of how federal courts interpret statutes today.

[8] Although some of the individuals we interviewed discussed previous litigation their agencies had been a party to, few conveyed strong concerns about the results of potential litigation related to the strategies they were undertaking for ungulate migration.

[9] Statutory ambiguity and the threat of litigation can also be viewed as two management challenges. In this paper , however, they are treated as part of the context in which a land manager determines if, and how, to act.

[10] It is important to note that this chapter does not provide a classical legal analysis and does not answer the question of what the law *is* as dictated to local- and regional-level land managers. Instead it explores how law *has been applied* by land managers and includes the premise that using what amounts to land managers' interpretations of the law may provide a means of illuminating on-the-ground management challenges. Included in this exploration is the assumption that land managers themselves play some role in saying what the law is as a practical matter.

Chapter 5, can largely be separated into those occurring on private lands and those occurring on public lands. The threats not directly associated with habitat quality or use are not discussed here because wildlife management on private and public lands is generally in the purview of state and federal wildlife management agencies rather than land managers. These threats are, for select ungulates, disease and predation. Additionally, those threats that cannot themselves be directly mitigated through land use regulation, including, for select ungulates, drought and climate change, are not discussed here. While it would be possible to examine the authority land managers have to manage for the effects of these threats or to act to indirectly mitigate them, that analysis is beyond the scope of this paper. Additionally, because NPS land is only found within the summer ranges for these migrating ungulates, and the following threats occur almost exclusively within the winter ranges, migration routes, and spring holding areas, the management actions of NPS are not discussed here.

On private lands, residential development, including the subdivision of lands into smaller parcels, creation of infrastructure, and use of that immediate land, is one of the main threats for all three migrating ungulate herds. Human activity, in terms of human presence and recreation that is separate from activity occurring directly within developed areas, is a threat unique to Round Valley mule deer that occurs on both public and private lands. A threat unique to Grand Teton National Park pronghorn is fences, which also occur on both private and public lands, and are often associated with livestock grazing, property lines, and roadways.[11]

On public lands, the threats vary greatly across case studies. As indicated above, human activity is a threat for Round Valley mule deer, primarily within their migration route. Another serious threat for Round Valley mule deer on public lands, primarily within their winter range, results from a combination of the risk of fire and incursion by invasive species. Two threats unique to the Grand Teton National Park pronghorn on public lands are fences and natural gas development, the former mostly along their migration corridor and the latter currently within their winter range.

Within the following two sections of this chapter is a comparison of the conservation strategies used by individual local planning bodies and public land managers functioning in

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[11] Since the threat of roadways to Grand Teton National park pronghorn, as discussed in Chapter 6, is often associated with the fencing along the road, roadways are addressed as part of the threat of fencing in this chapter. Another aspect of the threat of roadways for pronghorn is that the animals need to cross over road in their migration route without getting hit by vehicles. Chapter 8 will discuss the efforts of the Wyoming Game and Fish Departments to address this need.

similar roles yet under distinct legal frameworks. This comparison includes investigating both their land use regulation generally and their strategies for addressing specific threats to the herds. Additionally, the conservation strategies discussed include not only those intended to address specific threats for the ungulate herds or species we examined, but also those that effectively do so but are aimed at addressing concerns for big game species or wildlife, broadly. Because of the lack of commonality among the threats faced by the migrating ungulates we examined, the only truly cross-case comparison for a specific threat is for residential development.

IV. **Identification of Management Challenges**

Following the comparison of conservation strategies used by local planning bodies and public land managers in our three case studies is an analysis of their flexibility to act, as well as an identification of major management challenges for addressing habitat-based threats to migrating ungulates. The range of actions taken by land use planners and managers, described above, provides one account through which limits to land managers' flexibility, and opportunities for innovation, in acting to address threats to migrating ungulates, can be ascertained. Stated differently, through their actions, which necessarily incorporate legal interpretations, land use planners and managers tell us what they have the authority to do and, in the process, reveal current management challenges for addressing habitat-based threats to migrating ungulates. This chapter ultimately aims to draw conclusions, useful for both individual decision-makers as well as others interested in influencing their decisions, about the amount and implications of flexibility existing within the legal mandates directing the actions of land use planners and managers. One of the principal conclusions arrived at is that the authorizing laws for these governmental entities are not preventing most local planning bodies or public land managers from considering concerns connected to ungulate migrations – the laws do allow land use planners and managers to acknowledge the ungulate migrations that exist in their jurisdictional backyards.

Private Lands: County and Municipal Planning Bodies

I. **Authority: Laws Directing Local Planning Bodies**

State statutes give authority to local governmental entities in California predominately via a broad grant of powers, whereas, in Wyoming, local governmental entities are granted specific powers listed in state statutes. Both states, however, require that the local governmental entities create long-term planning documents to regulate the development of lands under their jurisdiction. The components that entities must include in the plans are detailed in California's statutes but not Wyoming's, and the California statutes discuss the inclusion of conservation, wildlife, and open-space concerns. Additionally, California has a statutory provision directed at wildlife habitat management and requires that local governmental entities complete environmental assessments before allowing development projects. Neither state, however, has statutes directed at local governmental entities that directly mention wildlife migration or habitat fragmentation.

A. **California**

In California, the local governing bodies for municipalities that are incorporated (or that have officially established jurisdictional boundaries and a local governing body with corporate powers separate from those of the county)[12] and counties are granted broad authority to determine local policy and regulate the development of the land within their jurisdictions, although their actions are guided to some extent by the Governor's Office of Planning and Research, which provides guidance and expertise for local land use planning (see Cal. Gov't Code §§ 65030.1, 65040.2, 65040.3, 2008). Each incorporated municipality is given the general power, through a state statute, to pass ordinances, or local laws, as long as they do not conflict with the state or federal constitution or statutes (see Cal. Gov't Code § 37100, 2008), and each county is given the general power to regulate property in its jurisdiction as "the interests of its inhabitants require," among other powers (see Cal. Gov't Code §§ 23003-23004, 2008), also as consistent with state and federal law.[13] California statutes also grant specific powers to cities and counties. These include the ability to establish habitat maintenance assessment districts and, within them, implement a long-term habitat maintenance plan approved by the California Department of Fish and Game (CDFG) (Cal. Gov't Code §§ 50060-50070, 2008), and to establish open space maintenance districts to retain open space (Cal. Gov't Code §§ 50575-50628, 2008).

In terms of decisions that counties and incorporated municipalities make regarding the physical development of lands within its jurisdiction – which can include, as is the case with

[12] Procedures for incorporation can be found within the Cortese-Knox Local Government Reorganization Act of 2000, Cal. Gov't Code §§ 56000-57550, 2008.

[13] Additionally, the California constitution states that "[a] county or city may make and enforce within its limits all local, police, sanitary, and other ordinances and regulations not in conflict with general laws" (Cal. Const. art. XI, § 7, 2007).

Mono and Inyo Counties and the town of Mammoth Lakes, areas that serve as wildlife habitat – these decisions are guided by long-term planning documents, or general plans, that California requires each local jurisdiction to create (Cal. Gov't Code § 65300, 2008). In addition to requiring a general plan, California statutes require that local zoning ordinances, or regulations that, generally, divide the county or incorporated municipality into zones and dictate how land can be used in each zone (e.g., establish the minimum lot sizes, the number of buildings per lot, and where buildings can be located), conform with, or are consistent with, the general plan (Cal. Gov't Code §§ 65850, 65851, 65860, 2008).[14] A county or incorporated municipality is also restricted to approving proposed plans for the subdivision of lands into smaller parcels when such proposals are consistent with the general plan (Cal. Gov't Code § 66473.5).

Specifically required in California general plans is a number of "elements," including a land use element, conservation element, and open-space element, among others (Cal. Gov't Code §§ 65303, 65302, 2008). The land use element is described as providing for the general pattern – distribution and location – of potential land use, including for housing, business, industry, open space, natural resources, and other purposes (see Cal Gov't Code § 65302; Governor's Office of Planning and Research, 2003). The conservation element is described as focusing on the conservation, development, and use of natural resources, naming wildlife as one of the natural resources (see Cal Gov't Code § 65302). The Governor's Office of Planning and Research, which has issued guidelines about the content of general plans, provides the following ideas to jurisdictions in regards to creation of the conservation element: "identify the types of animals that might be found in a particular habitat, the time of year they might be found there, and their activities (e.g., winter range, breeding, etc.)" with help from CDFG and "assess the potential effects of development on the continuity of plant and wildlife habitats" (2003, p. 76). The open-space element, which the California legislature states exists partly "to assure that cities and counties recognize that open-space land…must be conserved whenever possible,"[15] is described

[14] The statute defines a zoning ordinances as consistent when "various land uses authorized by the [zoning] ordinance are compatible with the objectives, policies, general land uses, and programs specified in the plan" (Cal. Gov't Code § 65860(a)(ii), 2008). Also, this requirement, as well as most of the remainder of the state zoning laws, do not apply to chartered cities unless they adopted a similar regulation (Cal Gov't Code § 65803, 2008).

[15] Open space land is defined in the statute as "any parcel or area of land or water that is essentially unimproved and devoted to an open-space use…and that is designated on a local, regional or state open-space plan" for a variety of purposes, including the "preservation of natural resources," "the managed production of resources," "outdoor recreation," "public health and safety," "support of the mission of military installations," and "protection of places, features, and objects" (Cal Gov't Code § 65560, 2008).

as providing for the preservation and conservation of areas of open space (see Cal Gov't Code §§ 65302, 65562, 65563, 2008). The Governor's Office repeats its suggestion about identifying wildlife for the open-land element (see 2003, p. 83).

There is also an additional California statute of particular relevance to land use planning and habitat management – the California Environmental Quality Act, or CEQA, (Cal. Pub. Res. Code §§ 21000-21177, 2008). CEQA operates similar to the National Environmental Protection Act (NEPA), requiring that public agencies document and consider the environmental impacts, including impacts on the land, flora, and fauna, of proposed projects in an environmental impact report (Cal. Pub. Res. Code §§ 21060.5, 21100, 21150, 21151). CEQA applies equally to projects carried out by counties and incorporated municipalities and projects involving private parties for which governmental entities either provide support through funds or other assistance, or require a permit or similar approval (Cal. Pub. Res. Code §§ 201062-63, 21065, 21080; see *Friends of Mammoth v. Board of Supervisors of Mono County*, 502 P.2d 1049, 1056-59 (Cal. 1972)). This includes projects such as the creation or amendment of zoning ordinances, approval of plans for the subdivision of lands into smaller parcels, and the issuance of permits for individual development projects (see Cal. Pub. Res. Code § 21080). CEQA is stricter than NEPA in that it imposes substantive as well as procedural requirements, in particular that a public agency cannot allow a project to go forward if it has "significant effects on the environment" unless the project will include measures to mitigate or avoid the impacts (Cal. Pub. Res. Code §§ 21002, 21081).

B. **Wyoming**

The authority granted to local governing bodies for incorporated municipalities and counties in Wyoming is provided by statutes cataloguing specific powers rather than providing a broad grant of power as in California. While only a few powers are given to counties, a long list are provided to incorporated municipalities (compare Wyo. Stat. Ann. § 18-2-101, 2008 to § 15-1-103, 2008) which are also enabled with the ability to "perform all acts in relation to the property and concerns of the city or town necessary to the exercise" of its powers (Wyo. Stat. Ann § 15-1-103(a)(v), 2008). Both governmental entities do have the ability to implement zoning within their jurisdictions (Wyo. Stat. Ann. §§ 18-5-202, 15-1-503, 15-1-601, 2008), and counties are expressly required to regulate the subdivision of lands to meet minimum requirements via the issuance of permits (Wyo. Stat. Ann. §§ 18-5-305 to 18-5-306, 2008).

However, none of the powers granted to entities specifically discuss conservation, wildlife, habitat, or open-space concerns.

The powers granted to incorporated municipalities and counties are expanded through provisions that give municipalities the ability to create zoning regulations that involve more strict standards than are listed in the state statutes (Wyo. Stat. Ann. § 15-1-611, 2008), and counties the ability to create regulations addressing the subdivision of lands that are more strict than what is required by the state statutes (Wyo. Stat. Ann. § 18-5-315, 2008). Counties are also allowed to elect, by resolution, to regulate subdivision that results in parcels of 35-acres or larger, a size that otherwise exempts such subdivision from almost all of the statutory requirements (Wyo. Stat. Ann. §§ 18-5-304, 18-5-316, 2008).[16]

Like in California, counties and incorporated municipalities in Wyoming must create long-term planning documents, called land use plans in Wyoming, to guide their decisions about the development of lands within their jurisdictions (Wyo. Stat. Ann. §§ 9-8-102(a)(viii), 9-8-301, 2008). However, it is not easily discernible from the statutes what decisions must comply with these land use plans, if any, because the term “land use plan” is not applied in sections of the statute that describe how counties and incorporated municipalities carry out zoning and other land use measures. It is also not clear how these land use plans relate to discretionary “comprehensive plans” for counties and required “master plans” for incorporated municipalities (Wyo. Stat. Ann. §§ 15-1-503, 18-5-202, 2008).[17]

Wyoming statutes establish different requirements for how land use plans, comprehensive plans of counties, and master plans of incorporated municipalities are to address the development of lands although none of these requirements expressly discuss the incorporation of conservation, wildlife, or open-space concerns. Wyoming statutes do not require land use plans to include specific components other than an explanation of how the plan can be implemented (Wyo. Stat. Ann. § 9-8-102(a)(viii), 2008). Notably, Wyoming statutes expressly forbid land use plans from addressing zoning (Ibid.). However, Wyoming does allow, but not require, counties to create “comprehensive plans” that can address zoning and other matters (Wyo. Stat. Ann. § 18-5-202, 2008). Additionally, for incorporated municipalities, Wyoming

[16] This exception applies when no more than ten parcels are created from the original parcel and the subdivided parcels are also not greater than 140 acres in size (Wyo. Stat. Ann. § 18-5-316, 2008).

[17] Additionally, the statute that describes zoning for incorporated municipalities states that zoning must be made “in accordance with a comprehensive plan,” a term only used in reference to counties in the remainder of the statutes (Wyo. Stat. Ann. § 15-1-601(d), 2008).

statutes require that they create “master plans,” including zoning and other information that addresses the location and extent of development within the municipality (Wyo. Stat. Ann. § 15-1-503, 2008).

An additional element of Wyoming law that is relevant to land use planning and habitat management, is that currently Wyoming remains a “fence out” state for cattle and domesticated buffalo, meaning that it is the responsibility of private landowners to fence their property if they want to avoid property damage from wandering livestock, rather than the responsibility of the livestock owner to fence in their cattle or buffalo (*Garretson v. Avery*, 176 P. 433, 434 (Wyo. 1918); University of Wyoming Cooperative Extension Service, n.d.). Wyoming law does allow landowners, or other injured parties, to bring civil suits against owners of trespassing cattle in order to seek reimbursement of damages but only when the land the cattle enter is enclosed by a fence that fits statutory-defined specifications for what is “lawful” (Wyo. Stat. Ann. § 11-28-108, 2008; *Garretson*, 176 P. at 435). Incorporated municipalities, however, can pass ordinances that do place responsibility with the livestock owner (*Sowers v. Corthell*, 240 P.2d 891, 891 (Wyo. 1952)). Also, for wandering sheep, goats, and elk, damages can be sought in court regardless of if the damaged property is fenced, and the livestock owner also faces nominal criminal fines (Wyo. Stat. Ann. § 11-26-101, 2008).

II. **Action: Strategies of Local Planning Bodies**

The land use plans, also commonly called a general plan or comprehensive plan, of all five counties included in this investigation recognize the existence of wildlife migration corridors in their jurisdiction, and all but Park County in Wyoming have established policies addressing migration corridors. Both Mono and Inyo Counties in California make explicit reference in their plans to, as relevant, migration routes or winter range for mule deer or deer. Park County does not make an elk-specific reference, but it does mention big game habitat, migration corridors, and winter range. Sublette and Teton Counties in Wyoming also do not refer to the pronghorn, but they do discuss migration corridors. The one incorporated municipality in this investigation, Mammoth Lakes, however, only discusses the presence of wildlife habitat in its boundaries (and not migration corridors).[18]

[18] There is mention of wildlife corridors in the Mammoth Lakes general plan, but only in connection with the definition of “open space” as something an area designated as open space can protect (Mammoth Lakes, 2007).

The following table, Table 6.1, synthesizes and lists the specific conservation strategies that local planning bodies within each political subdivision have formally suggested in their plans or have employed that address particular threats to the migrating ungulate herds we examined. These strategies are further discussed in detail below, under headings for each of the threats. In the context of this chapter, the concept of strategies employed by local planning bodies is intended to incorporate the actions of county commissions and supervisors who often have the final say in land use planning decisions.

Table 6.1, Conservation strategies employed by local planning bodies

Threat	Ungulate herd	Conservation strategies
Residential development	Round Valley mule deer	• Requiring an environmental assessment for land subdivision or development – Mono County, Inyo County, Mammoth Lakes • Requiring a site-specific study for development within deer habitat – Mono County
		• Using comments from state wildlife agency to identify potential impacts of land subdivision or development – Mono County, Inyo County, Mammoth Lakes • Using wildlife maps (critical winter range, migration corridors) provided by state wildlife agency to identify potential impacts of land subdivision or development – Mono County
		• Minimum parcel size/low-density development – Mono County, Inyo County, Mammoth Lakes • Encouraging development to be in areas with lower habitat importance/sensitivity or close to other development – Mono County, Inyo County • Conservation easements/setting aside acreage for wildlife use – Mono County, Inyo County • Cluster development – Mono County • Use of terrain, vegetation, and wildlife-friendly fencing to maintain habitat use and allow passage of wildlife – Mono County • Off-site habitat enhancement/restoration – Mammoth Lakes
		• Land exchange with state and federal governmental entities that manage for habitat and wildlife – Mono County, Inyo County
	Grand Teton National Park pronghorn	• Requiring an environmental assessment for development within a Natural Resources Overlay[19] – Teton County
		• Using comments from state wildlife agency to identify potential impacts of land subdivision or development – Sublette County • Using wildlife maps (critical winter range, migration corridors) provided by state wildlife agency to identify potential impacts of land subdivision or development – Sublette County
		• Cluster development – Sublette County, Teton County • Requiring that development within a Natural Resources Overlay minimizes impact on migration routes, and winter ranges, that on- or off-site habitat mitigation or enhancement is completed on a 2:1 acre basis, and that domestic pets can be restrained – Teton County • Conservation easements – Teton County

[19] Although the Natural Resources Overlay was not directed at pronghorn or pronghorn habitat, as explained below, because it covers private lands within the migration route of the Grand Teton National Park pronghorn, its requirements pertain to lands that serve as pronghorn habitat. It is possible, however, that the associated requirements, including minimizing impact on migration routes and winter ranges, may not pertain to those areas for the pronghorn herd of interest.

Threat	Ungulate herd	Conservation strategies
Residential development (cont.)	Clarks Fork and Cody elk	• Using comments from state wildlife agency to identify potential impacts of land subdivision or development – Park County • Using wildlife maps (critical winter range, migration corridors) provided by state wildlife agency to identify potential impacts of land subdivision or development – Park County • Requiring a plan to protect habitat if development disturbs more than two acres of crucial big game habitat – Park County • Requiring that land subdivision minimize changes to terrain and vegetation and maximizes conservation of natural features like wildlife habitat/corridors identified by the state wildlife agency – Park County • Subdivision covenants that address grazing, pets, vegetation, fencing structures, and open space – Park County
Human activity	Round Valley mule deer	• Seasonal limitations on construction for recreation – Mammoth Lakes • Location of recreational areas away from habitat – Mammoth Lakes • Restriction of off-highway vehicle use – Mono County • Requirement for dogs to be leashed and monitoring for deer/wildlife problems – Mono County
Fencing	Grand Teton National Park pronghorn	• Plat warning for land subdivision and development for wildlife-friendly fencing – Sublette County

A. California

Mono County

The Mono County General Plan specifically discusses mule deer migration corridors and winter range. Within the land use element of its general plan, Mono County refers to migration corridors for mule deer in its descriptions of all of the planning areas that include the Round Valley mule deer migration route (Mono County, 1992). The county also explicitly mentions mule deer migration under a county-wide policy as well as policies specific to the Mammoth vicinity planning area and the planning area containing Swall Meadows and Paradise (Ibid.). The county-wide policy is to "maintain or enhance the integrity of critical wildlife habitat in the county by limiting development in those areas and requiring mitigation in conformance with CEQA and this General Plan," identifying an example of critical wildlife habitat as "key winter ranges, holding areas, migration routes, and fawning areas for mule deer" (Ibid., p. II-29). For the Mammoth-vicinity policy, the language on critical wildlife habitat and mule deer is replicated (Ibid., see p. II-67). In both locations, the action item listed is to "implement policies" in the combined open space and conservation element, which similarly discusses migration corridors and seasonal grounds as critical (and highly localized) wildlife habitat (Ibid., p. II-29, II-67). In the conservation/open space element of its general plan Mono County sets a policy that "future development projects…avoid potential significant impacts to animal or plant habitats or mitigate impacts to a level of non-significance unless a statement of overriding considerations is made." The subsequent action items, some deer-specific, are discussed below in reference to the threats of residential development and human activity. The policy in the land use element for the Swall Meadows/Paradise area, and additional policies within the conservation/open space element relevant for particular threats, are also discussed below.

Inyo County

Inyo County's general plan discusses deer winter range and, broadly, wildlife corridors. Inyo County's general plan mentions winter range for deer in descriptions of specific communities, although this is true for only some of the relevant communities (Inyo County, 2001). Additionally, in the land use element, Inyo County includes a policy that lists "winter deer range" as a sensitive environmental factor that qualifies as an environmental constraint that Inyo has to consider in "carefully evaluat[ing] sites proposed for residential development" (Ibid., p. 4-18). In its combined open space and conservation element, Inyo has a policy that the county "shall work to preserve and protect existing wildlife corridors where appropriate," as well as one to "direct development into less significant habitat areas" (Ibid., p. 8-34). The associated implementation measures are discussed below in association with the threat from residential development.

Mammoth Lakes

Mammoth Lakes discusses wildlife habitat in its general plan, but not migration corridors or mule deer specifically. In the land use element of The Town of Mammoth Lakes General Plan, the town has two policies focused on wildlife habitat (Mammoth Lakes, 2007). One is being "stewards of important wildlife and biological habitats within the Town's municipal boundary," under which is the action item of preparing "species, habitat and natural community preservation and conservation strategies" (Ibid., p. 44). Another policy is being "stewards of primary wildlife habitats through public and/or private management programs," including by locating recreational opportunities and development away from habitat (Ibid., p. 44), which relates to the threat from residential development. There is a separate action item also related to residential development that is discussed below.

B. **Wyoming**

Sublette County

Sublette County's comprehensive plan recognizes wildlife migration corridors and winter range. The Sublette County Comprehensive Plan contains goals and policies directed at a variety of issues, including two issues under which migration routes are mentioned: natural hazards/environmental considerations and natural environment/cultural resources (Sublette County, 2003). Specifically there is a county policy associated with the former issue of considering "site-specific environmental features as part of land use planning decisions and in the review of development proposals," including "wildlife habitat and migration routes" (Ibid., p. 26). There is also a policy, under the latter, of considering "wildlife habitat values" with development proposals and another of considering "migration corridors, crucial winter ranges, and other important habitats when evaluating land use proposals" (Ibid., p. 18). Associated with the latter policy, Sublette County makes the following statements:

> In some cases, the migration corridors that link summer and winter ranges are already tightly constricted. These are areas recognized as being very sensitive and their integrity should be protected. There are many tools available, beyond County zoning regulation, to shelter the function of important wildlife areas (Ibid., p. 57).

Sublette County also has a policy of to "encourage/support maintaining wildlife populations that are in balance with available habitat and other uses" (Ibid., p. 57).

Teton County

Teton County discusses wildlife migration corridors and habitat in its comprehensive plan.[20] An objective listed in the plan's chapter on the "community character" is to "identify and protect critical wildlife habitat and migration corridors" (Ibid., p. 3-4). In another chapter, entitled "natural and scenic resources" is the goal to "preserve and protect wildlife habitat, including continuous migration corridors" (*Jackson and Teton County comprehensive plan*, 2002, p. 4-5). An objective relating to this is to "[p]rotect natural areas, including critical wildlife habitat and migration corridors through incentives and flexible options for land development" (Ibid., p. 4-5). Teton County also has a statement, similar to Sublette's quoted above, about constricted migration routes, and suggests an implementation measure to protect migration

[20] Teton County's comprehensive plan was completed with the incorporated municipality of Jackson, although the entities do have some independent regulations.

corridors that is described below in association with the threat from residential development but does not apply to pronghorn.

Park County

The Park County Land Use Plan mentions wildlife migration corridors and winter range.[21] The plan contains a summary of local vision statements (although not official county policy) developed by individual planning areas that recognizes the existence of migration corridors and winter range for wildlife, generally (Park County, 1998). Like in Inyo County, this is true for only some of the relevant planning areas, although with the statements for all of the remaining relevant areas recognition of big game or wildlife habitat values is included (Ibid.). The Park County plan also includes a comprehensive policy statement for the county which includes an objective, under the issue of "environment," to "manage the quality and quantity of big game habitat" (Ibid., p. 13).

C. **Threat of residential development to mule deer, pronghorn, and elk**

For all three migrating ungulates addressed in this investigation, residential development, including the subdivision of lands into smaller parcels, creation of infrastructure, and use of that immediate land, is a serious threat. This threat exists both on winter ranges and within the migration routes of the migrating ungulates to varying degrees as discussed in Chapter 6.[22] Local planning bodies in every political subdivision discussed above has authority over land where the threat of development exists, although for Teton County this is only in relation to the private lands within the boundaries of Bridger-Teton National Forest referred to as inholdings. Also, since county and municipal local planning bodies are literally tasked with regulating the development and use of private lands, most restrictions they set on development will address the threat of development to migrating ungulates. The discussion below, however, is limited to ways that these bodies have incorporated impacts on wildlife or wildlife habitat into two of their major

[21] Park County's administrative code indicates that the development of subdivisions must "consider any current Park County plans," but it is not clear what the degree of conformance must be (Park County, Wyo. Code § 3-101, 2008). However, the county does have regulations addressing the impacts of development on wildlife habitat, as discussed below.

[22] Although LADWP is not discussed in this section, it is useful to note the pattern of development on LADWP lands here. LADWP lands do have some dispersed ranch houses and facilities within the winter range and migration route that are associated with grazing leases (B. Tillemans, personal communication, March 24, 2009). However, the department maintains a policy not to allow residential development on its lands and any residential development that might occur on what is now LADWP land would be the result of a land sale or exchange with either Mono or Inyo County (B. Tillemans, personal communication, March 24, 2009).

responsibilities – approval of plans for the subdivision of lands into smaller parcels and for individual development projects when such approval is required.

Two counties addressed in this paper expressly recognize development as a threat to wildlife. Mono County in California states that "the presence of significant environmental concerns will have a critical effect on future development and land use in the county" and that an important "issue affecting development…is the conservation of a variety of natural resources, including… wildlife habitat (in some places critical") (Mono County, 1992, p. II-7). Teton County in Wyoming states that "[m]any [migration corridors] have already been shifted, constrained, or totally cut-off by development, a trend which cannot continue if such mammals are to continue to exist in Teton County" (*Jackson/Teton County comprehensive plan*, 2002, p. 4-2). While local planning bodies in the other four political subdivisions studied here do not make this statement, all of them do consider the impact of development on wildlife habitat, some expressly requiring assessment of impacts on the migrating ungulate species studied here.

Mule deer

Residential development poses a threat to Round Valley mule deer within their winter range, which encompasses small communities within both Inyo and Mono Counties (primarily Rovana, Paradise, and Swall Meadows), as well as along the migration route in Mono County. The migration route includes a number of small communities and the area around the incorporated town of Mammoth Lakes that serves as a spring holding area for all of the migrating population, as well as a summer range for the portion of the population that does not cross over to the western side of the Sierra Nevada. Mono and Inyo Counties in California both work largely within the framework provided by CEQA to examine the impacts on mule deer from proposed subdivisions or development projects (S. Burns, personal communication, January 15, 2009; M. Conklin, personal communication, March 27, 2009). Mono County expressly requires that applicants identify impacts on migration routes and winter range for deer. Inyo County requires that applicants look at impacts on wildlife habitat.

Mono County has an action item in its general plan for avoiding significant impacts to wildlife habitats from proposed development projects, unless a statement of "overriding considerations" is made via the CEQA review process (Mono County, 1992, p. V-12).[23] The county requires, through an action item, that an applicant for a development project that has the "potential to significantly impact" wildlife habitat, including by "interfering substantially with the movement of any resident or migratory fish or wildlife species," fund an assessment of the "site-specific resource values and potential impacts" (Ibid., p. V-12). In addition, if a development project is proposed for location outside of an existing community and within deer habitat, including either migration routes or winter range, applicants are tasked with submitting a "site-specific deer study performed by a recognized and experienced deer biologist" in conjunction with the assessment (Ibid., p. V-13). If a project will involve features that might be an "attractive nuisance" to wildlife, that must be assessed as well (Ibid.). It is possible these same elements are also required as part of the environmental review process of a plan for the subdivision of lands, although the Mono County ordinance does not spell out these specific requirements (see Mono County, Cal. Code §§ 17.12.040, 16.04.010-16.04.040, 2008).

Additionally, Mono County asserts, in its administrative code, that it has the authority to require mitigation measures to be attached to project approval for a proposed development or subdivision of lands when doing so is "necessary or appropriate to mitigate all environmental impacts" of the project (Mono County, Cal. Code § 16.04.035, 2008).[24] Mono County will often rely on comments provided by the CDFG to identify appropriate mitigation measures and will use the wildlife overlay maps the agency provides to identify potential impacts (S. Burns, personal communication, January 15, 2009). The assessment required for a proposed development, and possibly for the subdivision of lands, has to itself provide recommended alternatives to the project or mitigation measures, and the general plan lists examples of these measures, including cluster development (or the grouping of houses from multiple plots in one location) and "large acre minimum parcel sizes (e.g., in key deer habitat, at least 20 acres for winter range and migration corridors, and at least 40 acres for critical winter range and critical corridors)" (Mono County, 1992, p. V-13). Other suggested mitigation measures include locating the development in less sensitive areas or close to other development, using fencing designs that

[23] A statement of overriding considerations involves a public agency concluding that "specific overriding economic, legal, social, technological, or other benefits of the project outweigh the significant effects on the environment" (see Cal. Pub. Res. Code § 21081(b), 2008).
[24] CEQA requires that mitigation measures be used to address significant environmental effects, so it is possible the Mono County ordinance goes further (Cal. Pub. Res. Code § 20108, 2008).

allow for wildlife movement,[25] and using terrain and vegetation to provide visual barriers for wildlife to maintain their use of habitat in "major deer use" and other areas (Ibid.). In connection with a recent subdivision project that occurred in the Swall Meadows area, a bottleneck area for the Round Valley mule deer, a developer sold approximately 100 acres of land specifically for the purpose of deer protection that CDGF now manages (Eastern Sierra Land Trust, 2006; S. Burns, personal communication, January 15, 2009).[26]

An additional way Mono County aims to address wildlife habitat, that may in effect address the threat of development, is through a policy to "support the acquisition of valuable wildlife habitat by federal or state land management agencies or land conservation organizations" (Mono County, 1992, p. V-16). Actions items associated with this policy include using various land acquisition means, including purchases, land donations, land trades, and easements, and investigating the feasibility of creating wildlife habitat preservation areas (Ibid.). Additionally, specific to the Swall Meadows/Paradise planning area, Mono County has a policy to encourage privately owned parcels that are environmentally sensitive or isolated to be exchanged with appropriate public lands, naming "deer migration route[s]" as an example of an appropriate location for transfer (p. II-78). Mono County has also established a subcommittee focused on "land tenure adjustments" as part of a Mono County Collaborative Planning Team that consists of representatives from a number of federal, state, and local agencies, for example, BLM, Inyo National Forest, CDFG, and LADWP, among others (Mono County, n.d.; S. Burns, personal communication, January 15, 2009). The land tenure adjustment subcommittee examines local ownership patterns and discusses potential land exchanges that might be completed among the parties in order to concentrate private lands around current community centers (S. Burns, personal communication, January 15, 2009).

Inyo County also has implementation actions in its general plan that are aimed at directing development to less significant habitat areas (Inyo County, 2001), and requires that studies completed via CEQA for proposed development projects or the subdivision of lands address a checklist of potential environmental impacts, including impacts on wildlife habitat (Inyo County, Cal. Code § 15.28.04, 2009; M. Conklin, personal communication, March 27,

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[25] Mono County's land use element also includes an appendix with design guidelines, some about fencing and walls, including the following: "the design of fences and walls should facilitate the migration and movement of wildlife, with particular attention given to deer migration routes and protection from highway traffic."
[26] CDFG also owns a significant parcel in the Swall Meadows area.

2009). One of the implementation actions in the general plan is that for “project sites that have the potential to contain species of local or regional concern…the County shall require the project applicant to have the site surveyed and mapped by a qualified biologist”[27] and that the County use this in its environmental review of the project (Inyo County, 2001, p. 8-36). Another is using land exchanges to protect “sensitive environmental resources from development” provided that the amount of developable private land is not decreased (Ibid.). While Inyo does have a policy of addressing winter range for deer when evaluating the location of proposed development projects (Ibid., p. 4-18), there does not appear to be an implementation action incorporating that policy.

Like Mono County, Inyo County indicates in its administrative code that it can require mitigation measures to be attached to project approval for a proposed development or subdivision of lands (Inyo County, Cal. Code § 15.12.080, 2008). Inyo County also relies on comments provided by CDFG. In connection with a recent proposal for a 100-home development project in the Rovana area, the necessary mitigation measures identified by CDFG and incorporated by Inyo County included, among others, setting aside acreage for winter feed for deer (M. Conklin, personal communication, March 27, 2009). Ultimately the developer decided not to complete the project and sold the property, although it is likely that the new owner will propose a lower-density development on the site (Ibid.).

The general plan for the town of Mammoth Lakes in California has an action item of planning development “to minimize removal of native vegetation and trees and destruction of habitat,” (Mammoth Lakes, 2007, p. 44), but it does not discuss what environmental impacts must be addressed during the CEQA environmental review process for proposed developments. Mammoth Lakes has, however, incorporated mitigation measures into development projects, as part of the CEQA review process, to address the loss of deer habitat (B. Taylor, personal communication, January 22, 2009). For a proposed golf course in the southeastern area of the town, where the mule deer are concentrated during spring migration periods, Mammoth Lakes is requiring the developer to complete habitat enhancement or restoration at other sites to compensate for the loss of foraging area (Ibid.). Similar to both Mono and Inyo Counties, Mammoth Lakes will use comments from CDFG to identify appropriate mitigation measures (Ibid.).

Pronghorn

[27] It is not clear if mule deer are currently considered a species of local or regional concern.

Residential development poses a threat to Grand Teton National Park pronghorn along the length of the migration corridor, including lands in Sublette County and inholdings in Bridger-Teton National Forest that fall within Teton County's jurisdiction. Sublette County identifies impacts on pronghorn from proposed subdivisions and development projects with the help of WGFD and, at times, requests that developers make changes. Teton County uses a Natural Resources Overlay to address the impacts of development on select species that, although not directed at pronghorn, covers the inholdings and may effectively provide protection.

Sublette County considers impacts on wildlife habitat when reviewing plans for the subdivision of county lands (when not exempted from regulation by Wyoming law), as described in its subdivision regulations. Sublette County requires that proposed subdivisions "will not have any significant adverse impacts on wildlife habitat, wildlife migration routes, or fisheries" (Sublette County, Wyo. Subdivision Resolution chp. II, § 7, 2005). Sublette County can condition its approval of a subdivision plan based on "modifications and conditions" that it determines are necessary to meet this requirement, and has sometimes requested that developers consider cluster development as a way to meet the requirement (Ibid., chp. II, § 5; B. Myers, personal communication, May 22, 2008). Sublette County has denied at least one subdivision proposal recently, a proposal that would have split 120 acres of land near Trapper's Point into multiple 2- and 5-acre parcels, due to the habitat the land provides (B. Myers, personal communication, May 22, 2008).

A similar requirement is not imposed for development proposals, and denial of such proposals is limited, as described in zoning and development regulations, to non-compliance with the Sublette County Comprehensive Plan, "applicable zoning district regulations," and "applicable development standards" (Sublette County, Wyo. zoning and Development Regulations Resolution chp. IV, § 5, 2008). However, because the default zone for county land was agriculture, proposals for both individual development projects and subdivisions are often accompanied by a request for a zone change, which Sublette County has more flexibility in determining whether to approve (B. Myers, personal communication, May 22, 2008). In making a decision the county is directed to consider a number of factors, including "the public gain compared to the owner's hardship" and the "community need for the proposed use," and has broad authority to condition approval on "conditions and restrictions" (Sublette County, Wyo. zoning and Development Regulations Resolution chp. VIII, § 2, 2008).

Additionally, the Sublette County Planning and Zoning Administrator will identify for the Planning and Zoning Commission potential impacts from both subdivision and development project proposals on critical winter range and migration routes for wildlife, including for pronghorn (B. Myers, personal communication, May 22, 2008). The Planning and Zoning Administrator provides this information by using WGFD maps of critical winter range and migration route and soliciting comments from WGFD, among other agencies, on proposed subdivision and development projects, although the regulations do not require this step (Ibid.).

The comprehensive plan for Teton County in Wyoming suggests a number of implementation measures to address development in connection with natural resources, including wildlife and wildlife habitat. The measure that is the main source for further restrictions on development in connection with wildlife concerns is a Natural Resources Overlay, which Teton County's land development regulations have implemented, and which serves to protect migration routes and critical seasonal ranges for species of special concern on a federal or state level (*Jackson/Teton County comprehensive plan*, 2002; Teton County, Wyo. Code § 3240). Although pronghorn are not identified as a species of special concern, the overlay does extend to inholdings within Bridger-Teton National Forest (see Teton County, Wyo. Code § 3240, 2007; Teton County, n.d.).[28] The county's comprehensive plan also discusses conservation easement and cluster development as potential implementation measures (*Jackson/Teton County comprehensive plan*, 2002).[29]

For most proposed developments projects within the Natural Resources Overlay, an environmental assessment is required and a variety of standards are imposed. Teton County can determine which elements must be submitted in an environmental analysis, including a habitat inventory that discusses the vegetative cover and condition of the site; an assessment of the short and long-term impacts of development upon habitat; and alternative site designs (Teton County, Wyo. Code, §§ 3140-3150, 2007). Additionally, the following standards apply to development within the Natural Resources Overlay: that "the location of the proposed development shall minimize impacts on the areas protected (e.g., crucial migration routes, crucial winter range,

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[28] All inholdings in Teton County are subject to the management authority of Teton County and owners of inholdings hold the same property rights as other private property owners in Teton County and Wyoming, such as the ability to install fencing.

[29] Teton County's regulation of the subdivision of lands is not addressed here as it is likely to, although it is interesting to note that Teton County also does not regulate those exempted from regulation by default in Wyoming law, (Teton County, Wyo. Code § 6040.D, 2007).

nesting areas)"; that the "developer provides mitigation and habitat enhancement for the land impacted, either on-site or off-site" on a 2:1 acre basis; that the developer submits a habitat enhancement plan following the regulations' instructions; and that "domestic pets (e.g., dogs and cats) shall be physically restrained (i.e., leashed, chained, fenced), or accompanied by a person who has strict voice control over the animal at all times" (Teton County, Wyo. Code § 3270.H, 2007).

The county's land development regulations further state that Teton County has broad power to "impose restrictions and conditions on an approved permit, the approved use, and the property to be developed or used pursuant to such approval" in order to comply with the land development regulations and objectives of the comprehensive plan (Teton County, Wyo. Code § 5120.N, 2007). Teton County also has the authority to take these actions in order to "minimize the adverse effects on other land in the neighborhood and on the general health, safety, and welfare of the County" (Ibid.).

Elk

For Clarks Fork and Cody elk, residential development poses a threat within the winter range in Park County. Park County in Wyoming considers impacts on wildlife habitat when reviewing plans for both the subdivision of county lands that are not exempted from regulation in Wyoming law, and during review for individual development projects,[30] as described in its subdivision regulations and zoning regulations. Specifically Park County reviews whether a subdivision plan "makes every effort" to allow for the continued existence of wildlife habitat and invites the Wyoming Game and Fish Department (WGFD) to comment on the plan (Park County, Wyo. Code §§ 2-303, 2-406, 2-506, 2-603, 2008). The developer is also required to contact WGFD him/herself (L. Gillett, personal communication, January 14, 2009). Recently, Park County also began using wildlife seasonal range maps provided by WGFD, including of elk migration routes and seasonal ranges, to identify potential impacts from subdivision proposals (Ibid.).

[30] If a proposed subdivision or development project is within one mile of the incorporated city of Cody, the development must comply with any Code regulations as well (Park County, Wyo. Code § 3-101(B) 2008; L. Gillett, personal communication, April 17, 2009).

Additionally, subdivisions are required to comply with design and improvement standards established in the administrative code, some of which address wildlife.[31] One is that subdivisions must "be designed to minimize the alteration of natural landforms and native vegetation and to maximize the conservation of distinctive natural features, including wildlife habitat and corridors as identified with assistance from [WGFD]" (Park County, Wyo. Code § 3-3-102). Another is that a subdivision may be asked to include covenants (or restrictions on the use or development of lots) that address "grazing animals, pets, the preservation of natural vegetation, fencing standards, open space management and use, weed control and re-vegetation…landscaping…etc," (Ibid., § 3-101(B)). Park County may also require subdivisions to include "undeveloped" open space which is to be "designed to preserve important site amenities, including …wildlife corridors" (Ibid., § 3-215). At least in recent years Park County has not imposed any requirements for subdivisions, such as covenants or open space areas, due to potential impacts on elk (L. Gillett, personal communication, January 14, 2009). The Planning Coordinator for Park County explains that this is because subdivisions are usually located in the plains and farmland, as opposed to near the mountains (Ibid.). However, for at least one subdivision located within the elk winter range that was approved a few years ago the county had received comments expressing concern about potential impacts to large herds of elk that used the area's private pastures (Ibid.).

Park County applies different regulations for proposed development projects than the subdivision of lands. The county checks that development plans comply with standards related to wildlife habitat.[32] The wildlife habitat standard requires that any proposed development that disturbs more than two acres of "crucial big game habitat," as identified by WGFD seasonal range overlays, include a plan for protecting that habitat by minimizing land disturbance, providing ways for wildlife to move through and around development, re-vegetating disturbed areas, and promoting "long range maintenance of the wildlife habitat and all protection features" (Park County, Wyo. § 4-620, 2008). Park County can impose "conditions, safeguards and restrictions upon the physical development of the site as deemed necessary to secure

[31] Park County's Planning Coordinator can exempt a proposed subdivision resulting in less than six lots from compliance with this and other subdivision design and improvement standards if he/she "determines such standards are not applicable" based on "good cause" (p. 66, 72).
[32] Park County can grant exceptions from a standard "as may be reasonable and within the general purpose and intent of the [site plan review regulations], if literal enforcement of the standards is impractical or will exact undue hardship because of peculiar conditions pertaining to the land in question" (Park County, Wyo. Code § 4-620(D), 2008).

compliance" with the standards as long as they address "matters directly related to impacts of the proposed use" (Park County, Wyo. Code § 4-625).[33]

D. **Threat of human activity to mule deer**

For migrating Round Valley mule deer, human activity is mainly a threat in the migration route within Mono County, particularly near the incorporated town of Mammoth Lakes where some of the mule deer population will remain for the summer and a majority will use as a spring holding area before crossing over to the western side of the Sierra Nevada. Because most of the land surrounding Mammoth Lakes is owned by USFS, a combination of mainly Inyo National Forest and Mammoth Lakes (rather than Mono County), regulate land use in this area. Mammoth Lakes constitutes approximately 4 square miles and the town also has some authority over development (e.g., for building permits) extending another 22 squares miles into the surrounding Inyo National Forest land (B. Taylor, personal communication, January 22, 2009).

The actions Mammoth Lakes has taken that address the threat of human presence to mule deer include examining the location and timing of construction for future infrastructure for recreation, as opposed to the recreational activity itself, and are incorporated in the requisite CEQA review process. The effects of human activity on mule deer in terms of human presence are not specifically raised in Mammoth Lakes' general plan and the town does not restrict the timing, location, or extent of recreational activities within its boundaries.[34] However, Mammoth Lakes explicitly recognizes that within its boundaries is important wildlife habitat and it maintains a policy of locating recreational areas away from such habitat (Town of Mammoth Lakes, 2007). The mitigation the town has required of recreational development projects has focused mostly on the timing of initial construction to avoid spring migration periods when deer are concentrated within and along the southern and eastern edges (B. Taylor, personal communication, January 22, 2009). The actions taken by Inyo National Forest in the area outside the town boundaries, where many of the Mammoth Lake's residents and visitors go to recreate, are examined below.

The remainder of the private lands within Mono County are under the jurisdiction of the county. There is explicit language in Mono's general plan naming recreation as a potential threat

[33] This ability is discussed in the implementation section of Park County's land use plan on page 70 (Park County, 1998).

[34] As used here, boundary refers to the 4-square mile area within Inyo National Forest holdings begin. What is technically the incorporated boundaries includes the approximately 22 square miles of Inyo National Forest land (B. Taylor, personal communication, January 22, 2009).

to wildlife generally, and identifying possible mitigation options; however, Mono County has not restricted recreational activities within the mule deer migration route or winter range, instead encouraging recreation in and around most of the residential communities. In its general plan Mono County states that "[i]ncreased recreational use in the County and increased development, particularly in areas outside of existing community areas, creates potential impacts to the long-term sustainability of fish and wildlife populations and plant communities through degradation of resources and increased conflicts between wildlife and humans" (Mono County, 1992, p. V-3). One of its policies in the conservation/open space element is to "restrict [off-highway vehicle] use in valuable habitat areas" (Ibid., p. V-17). Requiring domestic animals to be leashed and that dog/wildlife problems are monitored in deer habitat areas are listed as examples of mitigation measures for development that would otherwise significantly impact wildlife habitat is (Ibid.). Deer kills along roadways, which can be associated with traffic from recreational users of surrounding lands, are also highlighted as a problem in the general plan, although there do not appear to be current strategies for addressing the problem (Ibid.).

Simultaneously, Mono County has policies in its general plan of encouraging recreation. Specifically Mono County seeks to create additional recreational opportunities near Mammoth Lakes, including a geothermal interpretive center; encourages year-round recreation near Lake Crowley (e.g., fishing, skiing, water skiing) along the migration route; and aims provide for to the recreational use of lands in and around Swall Meadows and Paradise in the winter range (Mono County, 1992).

E. **Threat of fences to pronghorn**

Fences along private property lines inhibit Grand Teton National Park pronghorn migration along the length of the migration route, covering both Sublette County and inholdings in Bridger-Teton National Forest governed by Teton County. Also hindering pronghorn movement within Sublette County is fencing on private property along Sublette County roads, which falls under the authority of the Sublette County Road and Bridge within its Planning and Zoning Office, and along state and federal roadways in Sublette County, including US-191 and WY-352, which falls under the authority of the Wyoming Department of Transportation rather than the county.

For all incoming subdivision and development proposals, Sublette County has begun requiring that a plat warning be attached to the property title indicating that any fencing placed on the property by subsequent owners, including along county roadways, must comply with "wildlife-friendly" standards established by WGFD (B. Myers, personal communication, May 22, 2008). Additionally, when newly installing or maintaining fencing along country roadways, which is only done at the request of adjacent landowners, Sublette County Road and Bridge will use a design that complies with WGFD's wildlife-friendly standards if appropriate for the use to which the land is being put (B. Myers, personal communication, April 17, 2009). Sublette County does not, however, have a program for addressing established fencing on residential property (B. Myers, personal communication, May 22, 2008). As relevant to inholdings in Bridger-Teton National Forest, Teton County imposes a restriction that any new fencing erected in county after September, 2006 comply with wildlife-friendly standards established in country regulations (Teton County, Wyo. § 49220, 2008).

While it is possible county roadways are not be fenced along their entirety, the Wyoming Department of Transportation installs and maintains fencing infrastructure along the length of US-191 and WY-352 (J. Eddins, personal communication, May 27, 2008). For new installments the agency uses a wildlife-friendly design where possible, but works with private land owners to ensure the fencing along private property is appropriate for the land use, such as when the land owner wants tightly-gridded fencing for sheep farming (Ibid.). Chapter 8 will discuss the ways in which WGFD works with the transportation agency to reduce impediments for wildlife to cross over roads themselves.

<u>Public Lands: Federal and State Land Managers</u>

I. Authority: Laws Directing Public Land Managers

USFS and BLM are both federal agencies directed by different federal statutes to manage lands under their jurisdiction for multiple use and sustained yield. LADWP is a municipal utility department within the City of Los Angeles that is directed to manage its lands in California to promote, deliver, and conserve water and power for Los Angeles. WY OSLI, a state agency and land owner in Wyoming, is directed to manage a set of state lands in conjunction with the Board of Land Commissioners as trustee for Wyoming public schools and, potentially, other state institutions. For none of these four entities do the relevant laws directly mention wildlife migration or habitat fragmentation.

In statutes for both BLM and USFS, the terms “wildlife” and “watershed” appear and sustained yield is defined the same, although the concept of multiple use is defined and described overall somewhat differently for each agency. Additionally, the concept of managing for multiple use is described for both agencies as a combination that best meets the needs of the American people, although the statute directing BLM discusses this further, in terms of present and future needs, including the “long-term needs of future generations” (see 43 U.S.C. § 1702(c), 2009). Both USFS and BLM are directed to create plans for geographical units to guide their land management, and, most, if not all, decisions made by both agencies has to be consistent with their respective management plans. The components required for each agency’s plans are not described by statute but rather by federal regulations created by each agency, are vastly different for each agency, and do not provide much detail for either agency regarding plan structure or organization, leaving much discretion to individual units within each agency.

A. **U.S. Forest Service**

The authority of USFS in relation to habitat management comes primarily from two statutes – the Multiple-Use Sustained Yield Act of 1960 (MUSYA) (16 U.S.C. §§ 528-531, 2009) and the National Forest Management Planning Act of 1976 (NFMA) (16 U.S.C. §§ 1600-1614, 2009).[35] In what is commonly described as USFS’ multiple-use mandate, Congress has declared that national forests “shall be administered” for multiple purposes, including “outdoor recreation, range, timber, *watershed*, and *wildlife and fish* purposes” (16 U.S.C. § 528, emphasis added) and that USFS is “directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of [their] several products and services” (16 U.S.C. § 529). While the term renewable surface resources is not defined in MUSYA, NFMPA defines “renewable resources” as “those matters within the scope of responsibilities and authorities of the forest service,” (16 U.S.C. § 1610), indicating an expansive meaning. Mineral resources, however, are explicitly excluded from these requirements (see 16 U.S.C. § 528) and management is provided by the Department of the Interior subject to some oversight by USFS (16 U.S.C. § 520, 2009; Reorganization Plan No. 3 of 1946, *reprinted as amended in* 5 U.S.C. app. § 903, 2009).

[35] See *The Forest Service: An Overview* for a summary of other major laws that affect USFS management (U.S. Forest Service, n.d., pp. 30-33).

NFMA also requires that national forests have land and resource management plans that provide for both multiple use and sustained yield and "consideration of the economic and *environmental* aspects of various systems of renewable resource management" (16 U.S.C. § 1604(a), (e)(1), (f), (g)(3)(A), emphasis added). NFMA reiterates that "watershed," and "wildlife and fish" are elements to be "coordinat[ed]" in the plan, adding "wilderness" as another element (16 U.S.C. § 1604(e)). MUSYA dictates that managing for multiple use does not mean that every renewable surface resource must be used on every part of the land, but instead that they "are utilized in the combination that will best meet the needs of the American people" and in "harmonious and coordinated management…without impairment of the productivity of the land" (16 U.S.C. § 531). Additionally, MUSYA defines sustained yield as "achievement and maintenance in perpetuity of a high-level annual or regular periodic output…without impairment of the productivity of the land" (16 U.S.C. §§ 529, 531).

In regulations implementing NFMA, USFS has provided more detail about what should be included in a land and resource management plan, commonly referred to as a forest plan (see 36 C.F.R. §§ 219.1-219.16, 2009). These forest plans are publicly-vetted, as required by statute, (16 U.S.C. § 1604(d)) and NEPA-compliant (36 C.F.R. § 219.4)[36] documents that provide a long-term vision for management of a forest as well as "guidance and information" for decision-making about individual "projects" and "activities" that are not themselves typically incorporated into the plan (36 C.F.R §§ 219.2(b), 219.3(b)). Since, under USFS regulations, decisions about timber development, livestock grazing, oil and gas development, other mineral development, roadways, use of USFS land that is termed "special uses" (including commercial outdoor recreation and surface uses connected to oil and gas development), and most land exchanges must be made consistent with the forest plan, (36 C.F.R. §§ 212.5(b), 222.2(c), 223.30, 228.43(a)(4), 228.100(c), 228.102(d)(1), 251.50(a), 251.54(e)(1)(ii), 254.3(f), 2009), the content of a forest plan is highly important in directing how a national forest factors habitat concerns into decision-making.

Components that USFS regulations currently require in a forest plan include desired conditions, or "social, economic, and ecological attributes toward which management of the land and resource is to be directed"; objectives, or "concise projections of measurable time-specific

[36] USFS is required to comply with NEPA in creating, amending, or revising forest plans (see 36 C.F.R. § 219.4, 2009).

intended outcomes"; and guidelines for how to achieve desired conditions and objectives (36 C.F.R. § 219.7(a)(2)). Forest plans can also include standards, or procedures that must be followed for achieving desired conditions and objectives, although standards are not currently a required component (36 C.F.R. § 219.7(a)(3)). The distinction between guidelines and standards was made explicit and official in 2008 in conjunction with a large-scale revision and reorganization of the planning regulations (see National Forest System Land Management Planning, 73 Fed. Reg. 21,468 (Apr. 21, 2008) and National Forest System Land and Resource Management Planning, 47 Fed. Reg. 43,026 (Sep. 30, 1982)).[37] Three additional mandatory components are identification of areas in the forest as "generally suitable" or "not generally suitable" for particular uses; identification of areas that are "unique or special"; and a monitoring program that can assess whether "on-the-ground management is maintaining or making progress toward the desired conditions and objectives" (36 C.F.R. §§ 219.6, 219.7(2)(iv)-(v), 219.12).

B. **Bureau of Land Management**

BLM's authority for habitat management originates primarily from the Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. §§ 1701-1787, 2009), and the subsequent Public Rangelands Improvement Act (PRIA) of 1978 (43 U.S.C. § 1901-1908, 2009).[38] Similar to USFS, BLM operates under a federal mandate to manage lands for multiple use and sustained yield (43 U.S.C. § 1701(a)(7), 1732(a)). Additional in FLPMA is an explicit statement that management is to be as such "unless otherwise specified by law" (43 U.S.C. 1701(a)(7)).

FLPMA defines multiple use similar to MUSYA, although the former refers to managing "resource values" as opposed to renewable surface resources (compare 16 U.S.C. § 528, 2009 with 43 U.S.C. § 1702(c)). FLPMA also specifies in the definition that the needs of the American people to be met through management are "present and future"; that multiple use means

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[37] The 2008 planning regulations replaced regulations from 2005 that discussed guidelines as discretionary procedures but did not mention standards (see National Forest System Land Management Planning, 70 Fed. Reg. 1,023 (Jan. 5, 2005). In 2007 USFS was enjoined from using the 2005 regulations partially due to failure to comply with the National Environmental Protection Act, Endangered Species Act, and requirements for public comment periods (see Citizens for Better Forestry v. United States Dep't of Agric., 481 F. Supp. 2d 1059, 1100 (N.D. Cal. 2007); National Forest System Land Management Planning, 73 Fed. Reg. 21,468 (Apr. 21, 2008)). Previous sets of regulations from 2000 and 1982 had grouped guidelines and standards together as plan components that described procedures that could both be either discretionary or mandatory for USFS employees (see National Forest System Land Management Planning, 70 Fed. Reg. 1,023 (Jan. 5, 2005)).

[38] Another major law directing the BLM's land management, particularly in regards to grazing allotments, but of less direct relevance to this chapter's analysis, is the Taylor Grazing Act of 1934 (43 U.S.C. §§ 315-315r, 2009).

coordinated management not resulting in "permanent" impairment of land productivity or "quality of the environment" (a phrase not in MUSYA); and that multiple use also means the following: "a combination of balanced and diverse resources uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources, *including, but not limited to*, recreation, range, timber, minerals, *watershed*, *wildlife and fish*, and *natural scenic, scientific and historical values*" (43 U.S.C. § 1702(c), emphasis added). Sustained yield is defined the same in FLPMA and MUSYA (compare 16 U.S.C. § 531, 2009 with 43 U.S.C. § 1702(h)).

Also generally similar to USFS, BLM is instructed to manage its land within a jurisdiction according to a land use plan (43 U.S.C. §§ 1712, 1732). These documents are also publicly-vetted, as required by statute, (43 U.S.C. § 1712(f)) and NEPA-compliant (43 C.F.R. §§ 1601.0-6, 1610.5-5, 1610.5-6, 2009) documents.[39] BLM has termed them "resource management plans," or RMPs (43 C.F.R. §§ 1601.0-1, 1601.0-7, 1610.1(b), 2009), stating that the objective in creating them is to "maximize resource values for the public," and that they are "are designed to guide and control future management actions and the development of subsequent, more detailed and limited scope plans for resources and uses" (43 C.F.R. § 1601.0-2, 2009). FLPMA instructs BLM to prepare the RMPs to "use and observe" multiple use and sustained yield principles within FLPMA and other applicable laws (43 U.S.C. § 1712). In FLPMA Congress has also declared that management of BLM lands has to be carried out "in accordance with the land use plans" except when a tract of land is dedicated for a specific use by law (43 U.S.C. § 1732), making the content of an RMP, like that of a USFS forest plan, important in directing how a BLM office includes habitat concerns in decision-making.

In its regulations implementing FLPMA, BLM describes the required content of RMPs broadly and in terms of the process for their creation (see 43 C.F.R. §§ 1601.0-1 to 1610.8, 2009). First the agency is to initially identify and select "issues" for the RMP to address (such as "concerns, needs, and resource use, development and protection opportunities") and then complete an analysis of the "ability of resource values to respond to the identified issues and opportunities" (43 C.F.R. §§ 1610.4-1, 1610.4-4). BLM is then to consider "all reasonable resource management alternatives" before selecting the one that ultimately becomes the RMP

[39] BLM is required to comply with NEPA in creating, amending, or revising its land use plan, but not for maintenance, which is "limited to further refining or documenting a previously approved decision incorporated in the plan" (see 43 C.F.R. §§ 1601.0-6, 1610.5-4, 1610.5-5, 1610.5-6, 2009).

(43 C.F.R. §§ 1610.4-5, 1610.4-7, 1610.4-8). Three other required elements include identification of areas that are unsuitable for types of surface coal mining (43 C.F.R. § 1610.7-1); identification of areas to be designated as "Areas of Critical Environmental Concern" or ACECs (43 C.F.R. § 1610.7-2); and "intervals and standards" for monitoring and evaluating the plan to "determine its effectiveness" (43 C.F.R. §§ 1601.0.5, 1610.4-9). In order for an area to qualify as an ACEC the area must have "relevance" and "importance" (43 C.F.R. § 1610.7-2). Relevance means containing "significant historic, cultural, or scenic value; a fish or wildlife resource or other natural system or process; or natural hazard" (Ibid.). Importance is when the relevant element is of "substantial significance and values," described as "generally…more than local significance and special worth, consequence, meaning, distinctiveness, or cause of concern" (Ibid.). In defining a RMP, BLM regulations also list additional components that the plans "generally" cover, including, among others, "land areas for limited, restricted or exclusive use"; "allowable resource uses…and related levels of production or use"; and "resource condition goals and objectives" (see 43 C.F.R. § 1601.0-5(n)).

C. **Los Angeles Department of Water and Power**

LADWP, as a department within the chartered City of Los Angeles (LA), gets its authority for land management through the city's local charter, which has the force of state law, as discussed above. While chartered cities in California must comply with the state's requirement to create a general plan with specific elements, the general plan for LA does not address the lands owned by LADWP; instead, the management and control of these lands is given to LADWP within the charter.

LA's charter creates LADWP as a proprietary city department and directs it to operate with the following purposes: "[i]n connection with, or for the production and delivery of water and electric power, and for the promotion of the conservation of water and power resources" (Los Angeles, Cal. Charter §§ 600-601, 2008). LADWP is given the "possession, control, and management" of water, water rights, and the "*lands*, rights-of-ways, sites, facilities, and *property* used for the capture, transportation, distribution and delivery of water for the benefit of [LA], its inhabitants and its customers," collectively termed water assets (Los Angeles, Cal. Charter § 672, 2008, emphasis added). Specifically, LADWP is granted the ability to make rules and regulations "governing the construction, maintenance, operation, connection to and use" of its water assets for the department's purposes (Los Angeles, Cal. Charter, § 675(a), 2008). It also has the ability to create "improvements, utilities, structures, facilities and services" for department purposes; to "acquire or take, by purchase, lease, condemnation, or otherwise" property or property interests for department purposes; and potentially,[40] with the approval of the LA City Council, to sell, lease, dispose of, or "withdra[w] from its control" real property or property rights that it manages (Los Angeles, Cal. Charter § 675(c), (d), 2008). Thus, the proposed development and use of LADWP lands are governed predominately via LADWP's rules and regulations, not LA's general plan.[41]

D. **Wyoming Office of State Lands and Investments**

WY OSLI, with oversight from the Board of Land Commissioners, is granted authority to manage the surface and/or mineral rights for many of the dispersed parcels of land that the federal government provided to Wyoming, and that Wyoming accepted in its enabling act, when Wyoming became a state in 1890 (Wyo. Const. art. 18, §§ 1, 3, 2007; Wyo. Stat. Ann. §§ 36-2-101, 36-3-102 to 36-3-103, 2008; Wyoming Act of Admission, chp. 644, 26 Stat. 22, §§ 4-5, 1890; Wyoming Office of State Lands and Investments, n.d.; L. Boomgaarden and S. Child, personal communication, May 29, 2008). Specific to lands managed through the Board of Land Commissioners that were given to Wyoming from the federal government for the "benefit and support of public schools," termed "school lands" in the statute, the Wyoming Supreme Court has determined that such land is held in trust by the state for the benefit of Wyoming public schools (*Riedel v. Anderson*, 70 P.3d 233, 227-28, 231-33 (Wyo. 2003); see, Wyo. Stat. Ann. §§ 36-1-101(v), 2008). Unlike for "state trust land" found in other states, the trust relationship in Wyoming is said to originate with Wyoming's state statutes, rather than through its constitution or enabling act, and to be recognizable from statutory language discussing the requirement that agricultural leases on state lands are completed so as to "inure to the greatest benefit to the state land trust beneficiaries" (see *Riedel*, 70 P.3d at 231-33; Wyo. Stat. Ann. § 36-5-105(a), 2008).[42]

[40] This is described as a potential power because it is included in the charter as a prohibition against LADWP selling, leasing, disposing of, or "withdraw[ing] from its control" property unless the department gets LA City Council approval (Los Angeles, Cal. Charter § 675(d)(2), 2008).

[41] However, it is helpful to note that the management of LADWP lands is not solely with LADWP because the city of LA retains its general ability to veto the actions of LADWP and to pass ordinances on "upon any subject of municipal concern" (see Los Angeles, Cal. Charter §§ 240, 245, 2008).

[42] Because the Wyoming Supreme Court, is reaching its conclusion, interprets a statute for leasing on "all state lands leased by the state board of land commissioners" and "state lands" are broadly defined as "all lands under the jurisdiction of the board of land commissioners," it is possible that non-school lands, such as "institutional lands," which are "state lands selected for the benefit of state institutions or any lands other than school lands" also are subject to a similar trust requirement (Wyo. Stat. Ann. § 36-1-101(a)(iv)-(v), 2008).

Outside of the general management directive for agricultural leases that is quoted above, clear direction on how WY OSLI is to manage state lands is missing from the statutes themselves. In general, the statutes discuss the ability of the agency to issue "all standard lease and permit renewals which do not convey any permanent interest in state lands," as well as, specifically and in addition to grazing and other agricultural leases, to issue oil and gas leases and coal and other mineral leases (Wyo. Stat. Ann. §§ 36-3-102(c)(i), (iv), (v), 36-5-103, 360-5-105, 36-6-101, 2008). The agency is also given the ability to complete timber sales (Ibid., § 36-1-112, 2008). More direction for management is provided by the Wyoming legislature via a statement of principles that was included in a 1997 act that amended parts of the relevant statutes discussed here (see Act of Mar. 13, 1997, ch. 200, 1997 Wyo. Sess. Laws 200). These principles include the following directions to the Board of Land Commissioners and WY OSLI:

> (i) The state land trust, consisting of trust lands, trust minerals and permanent land funds shall be managed under a total asset management policy;
>
> (ii) The state land trust is intergenerational. Therefore, the focus is on protecting the corpus for the long term;
>
> (iii) Trust land should remain a substantial, integral component of the state land trust portfolio. There is no mandate to sell any trust asset to maximize revenue in the short term;
>
> (iv) All leases of trust land shall assure a return of at least fair market value considering the management practices and risk assumed by the lessee when determining fair market value;
>
> (v) Investment policies shall ensure that the earning power of the permanent land fund is not reduced from the effect of inflation.

(Ibid.; Wyo. Stat. Ann. § 36-9 note, 2008).

II. **Action: Strategies of Public Land Managers**

The land use plans of all the geographical units of the federal agencies included in this analysis (three offices of USFS and three offices of BLM) mention the existence, on lands in their jurisdiction, of migration corridors or winter range, as relevant, for the ungulate species we examined, and each agency has incorporated plan components that provide some protections for these areas. The other two public land managers with holdings within migration corridors and seasonal ranges for particular ungulates, LADWP and WY OSLI, do not address migration corridors with their plans or management documents, although both have taken into account such concerns, as discussed below.

The following table, Table 6.2, synthesizes and lists the specific conservation strategies that each of these public land managers formally suggested in their plans or have employed that address particular threats to the migrating ungulate herds we examined. These strategies are further discussed in detail below, under headings for each of the threats.

`Table 6.2, Conservation strategies employed by public land managers

Threat	Ungulate herd	Conservation strategies
Human activity	Round Valley mule deer	• Prohibition of dispersed camping near Mammoth Lakes – Inyo National Forest • Design/location of new recreational development to maintain deer migration corridors/key habitat – Inyo National Forest • Restriction of vehicular access to protect deer winter range/fawning areas/holding areas and coordination with BLM for seasonal road closure dates for mule deer – Inyo National Forest • For ski areas around Mammoth Lakes, seasonal road closures, mitigation of impact on deer migration corridors/fawning areas/holding areas from construction of infrastructure, location/design of new infrastructure to not significantly impact these areas – Inyo National Forest • Seasonal and year-long protections for mule deer habitat from recreation use and other discretionary uses – Bishop Field Office • Declining to encourage recreation in specific areas – LADWP • Ensuring recreation aligns with watershed plans for around Crowley Lake – LADWP
Fire/invasive species	Round Valley mule deer	• Fire suppression – Inyo National Forest • Management of vegetation in key mule deer habitat areas to provide forage – Inyo National Forest • Not increasing grazing when it would significantly degrade wildlife habitat and amending grazing permits to include mitigation measures when grazing is doing so – Inyo National Forest • Bitterbrush plantings (habitat improvement) in mule deer winter range – Bishop Field Office • Not leasing areas – LADWP • Using guidelines for grazing leases that are similar to hose for nearby federal grazing allotments - LADWP
Fencing	Grand Teton National Park pronghorn	• Proposed fencing subject to requirements to allow for pronghorn passage within designated migration route of the Grand Teton National Park pronghorn – Bridger-Teton National Forest • Fence modification and removal to allow for wildlife passage – Bridger-Teton National Forest • No additional fencing in Trapper's Point area – Pinedale Field Office

Threat	Ungulate herd	Conservation strategies
Natural gas development	Grand Teton National Park pronghorn	• Area within migration route and some winter range for the Grand Teton National Park pronghorn unavailable for future natural gas leasing – Pinedale Field Office • Mitigation of impacts on big game winter ranges and restrictions on travel for current natural gas leases in areas newly designated as unavailable for leasing or traditionally available for leasing – Pinedale Field Office • Seasonal restrictions on surface disturbing or disruptive activities in areas unavailable or traditionally available for natural gas leasing – Pinedale Field Office • Off-site mitigation fund for impacts of Jonah Field – Pinedale Field Office • Lease stipulations, surface use stipulations, and travel restrictions for new natural gas leases in Jonah Field and Pinedale Anticline Project Area – Pinedale Field Office • No-surface occupancy and other stipulations on natural gas leases to protect big game winter range/habitat with opportunity for lessee to devise alternative mitigation measures – WY OSLI

A. U.S. Forest Service

As described above, national forests are managed according to statutorily-mandated forest plans that provide a long-term vision for management of each forest under principles of multiple use, sustained yield, and consideration of the economic and environmental aspects of "various systems of renewable resource management" (16 U.S.C. 1604(a), (e)(1), (f), (g)(3)(A), 2009). The forest plans for all three forests with land holdings within the migration routes or seasonal ranges for the migrating ungulates herds we examined discuss the species of interest in their plans and have incorporated plan components that provide some protections for important habitat areas for the species, including along each of the migration routes. In particular, Bridger-Teton National Forest in Wyoming, with a recent amendment to its forest plan, explicitly discusses the Grand Teton National Park pronghorn and their migration route.

Inyo National Forest, California

Inyo National Forest (INF) is continuing to manage its lands under a 1988 plan which mentions key mule deer habitat within many of its components. These components are different from those called for by the current regulations and include "issues and concerns"; forest-wide objectives; forest-wide guidelines; "management prescriptions" for the management of INF resources including the habitat of specific species; and "management area direction" for designated management areas within INF (Inyo National Forest, 1988). While the forest plan as created called for incorporation by reference of specific deer herd management plans issued by

CDFG, these references were replaced via a forest plan amendment in the mid-1990s with statements for INF to work with CDFG (Inyo National Forest, 1994; R. Perloff, personal communication, 2009). Multiple plan components for mule deer were also updated in the amendment, and the monitoring technique included in the forest plan for complying with guidelines and management directions for mule deer was changed to read "evaluate [CDFG] population counts" for mule deer and how specific projects "influenc[e]" habitat quality and quality (Inyo National Forest, 1994, p. 6).[43]

The issues and concerns identified in connection with mule deer in INF's forest plan include declining populations of mule deer in the 1950s through 1970s and a focus on mule deer habitat. Forest-wide objectives include increasing the number of mule deer by 20% and forest-wide guidelines, which the plan describes as establishing "minimum resource conditions that will be maintained," include the following: "maintain or enhance the integrity of key winter ranges, key holding areas, key migration routes, and key fawning areas for mule deer"; coordinate with CDFG on deer herd plans, to identify "winter ranges, holding areas, migration routes and fawning areas for mule deer," and to ensure that the most up-to-date information is used in INF project planning; "coordinat[e]" land uses not solely under the management authority of INF to mitigate their impacts on mule deer habitat; and conduct ecosystem-level analyses to "address habitat condition and the maintenance of biodiversity for a variety of species, including deer" (Shoshone National Forest, 1988, p. 74; Shoshone National Forest, 1994, p. 4). The management prescriptions described in the forest plan for specific resources include a number for "mule deer habitat," as its own resource (Shoshone National Forest, 1988, p. 106). These prescriptions, designed to "preserve or enhance key mule deer habitat in order to maintain or increase existing population levels," are discussed below in connection with particular threats faced by mule deer, although a general one is to "maintain habitat quality in key fawning areas, winter range, holding areas, and key migration routes" (Ibid., p. 117-18). The management area direction for designated areas within the mule deer migration route is also general, stating "maintain the integrity of key winter ranges, holding areas, migration routes, and fawning areas for mule deer" although this direction is not included for the two management areas containing portions of the

[43] Additionally, until 2007 mule deer, as a type of big game, served as a "management indicator species" in the forest plan (Inyo National Forest, 2007). Ten national forests managing areas in the Sierra Nevada region amended their forest plans in 2007 to have the same management indicator species, resulting in INF eliminating mule deer as one (Ibid.; R. Perloff, personal communication, January 23, 2009).

winter range (Ibid., p. 189, 195, 203). Specific directions in this section as relevant for particular threats are also discussed below (Inyo National Forest, 1988).

Bridger-Teton National Forest, Wyoming

Bridger-Teton National Forest (BTNF), while in the midst of a comprehensive revision process for its forest plan, currently manages its forest under a 1990 forest plan that discusses big game generally but, until a recent amendment discussed below, did not focus on pronghorn individually except in listing them as an important harvest species within BTNF (Bridger-Teton National Forest, 1990; see Bridger-Teton National Forest, n.d.). The plan components, like those within INF's forest plan, are not the components listed in current regulations. The plan components in BTNF's plan that are relevant for discussion here include "issues, concerns, and opportunities"; forest-wide "management prescriptions, standards, and guidelines"; and "desired future conditions" that are descriptions of resources or areas with an anticipated 50-year planning window for achievement through a set of associated prescriptions, standards, and guidelines (Ibid.).

Under the section on issues, concerns, and opportunities, BTNF's forest plan states that "big-game wildlife species and their habitats need to be maintained at sufficient levels to ensure viable outfitting and guide industry" (Bridger-Teton National Forest, 1990, p. 88). The subsequent forest-wide management prescriptions, standards, and guidelines are described as responding to the issues, concerns, and opportunities identified, and they include some that address big game migration: a standard[44] that "to provide for habitat effectiveness established for each Management Area, non-motorized and motorized vehicle access will be regulated either seasonally or year-round to protect such important big game habitat components as primary feeding areas…and big-game migration corridors"; a standard that "[s]tructural improvements will be designed to allow big-game movement and avoid and reduce hazards to other wildlife species"; a prescription that "forage is provided on a sustained-yield basis that protects rangeland values, wildlife habitat, and meets other resources needs" and that "all practices available can be used to improve forage supplies and quality"; and a standard that "[c]onservation easements will be acquired on private inholdings to limit future development that would adversely affect

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[44] BTNF's plan describes standards as directions "intended to be adhered to closely during plan implementation so they are stated in the future tense as 'will be' requirements," whereas the guidelines are described as directions that are "intended to be more flexible, setting parameters rather than tight requirements (Bridger-Teton National Forest, 1990, p. 121). Prescriptions are described as directions that apply to BTNF activities "beginning immediately after th plan is approved."

wildlife habitat on or migration routes across the private lands" and that "procedural priorities for acquiring easements will be 'willing seller-willing buyer,' and, if that approach fails and only as a last resort, condemnation" (Bridger-Teton National Forest, 1990, p. 124, 127, 129, 138).[45] The forest plan also includes a relevant desired future condition – the existence of areas that that offer big-game hunting, dispersed recreation, and wildlife security (Ibid.). Associated directions for achieving these areas discuss the management of habitat to sustain big game populations (Ibid.).

Although pronghorn were not a focus within the forest plan as created, in 2008 BTNF amended its forest plan to incorporate the pronghorn migration corridor for the Grand Teton National Park pronghorn herd via "designation" of the route with a map illustrating the route[46] and the addition of the following standard: "[a]ll projects, activities, and infrastructure authorized in the designated Pronghorn Migration Corridor will be designed, timed and/or located to allow continued successful migration of the pronghorn that summer in Jackson Hole and winter in the Green River basin" (Bridger-Teton National Forest, 2008b). The decision notice accompanying the amendment explains that current uses of lands within the route allow for "successful pronghorn migrations," but that BTNF must determine the same is true for any future uses within the route before authorizing them (Ibid.). In conjunction with the designation, BTNF also created a pledge that other land managers with holdings along the route (e.g., BLM and Teton County) and local land trusts (e.g., Jackson Hole Land Trust and Green River Valley Land Trust) could sign to indicate support for the continued migration of the pronghorn herd and recognition of their ability to contribute to its protection; nearly all land managers have signed onto the pledge (Hatch, 2008).

Shoshone National Forest, Wyoming

In the draft forest plan for Shoshone National Forest (SNF), a proposed comprehensive revision to its 1986 forest plan, elk are identified as a species of interest for which they are specific plan components (i.e., desired conditions, objectives, guidelines, and standards) provided. SNF has identified elk as a species of interest due to social and economic interest,

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[45] While there are more standards described for big game winter ranges, such areas are not relevant for the Grand Teton National Park pronghorn herd which winters south of BTNF.

[46] The map included in the amendment shows the migration route within BTNF, including over inholdings, as well as where it extends into Sublette County; however, the decision notice accompanying the amendment makes clear the amendment only applies to USFS land (Bridger-Teton National Forest, 2008b; Bridger-Teton National Forest, 2008a).

specifically “their status as a game species and a species that hunters and non-hunters alike enjoy viewing” (Shoshone National Forest, 2008, p. 41).

The overall desired conditions described for elk are that they “occur at population levels that provide hunting and viewing opportunities that contribute social and economic benefits to local communities” (Ibid.). The plan indicates that a variety of other desired conditions will contribute to the maintenance of elk, including the following: that elk habitat that qualifies as secure be present in almost all watersheds and exist near migration corridors when the other habitat in a watershed is lower security; that habitat connectivity be provided to allow for seasonal animal movement via vegetation patterns, the location of roads and infrastructure, and that big game migration corridors contain “some secure habitat”; that big game winter range and birthing areas have “quality forage, water, and secure habitat” as well as a low density of roads, trails and areas open for public motorized recreation; that aspen and other cover types are maintained within their historic range of diversity; and that rangeland of sagebrush and grasslands are managed for habitat as well as livestock grazing (Ibid., p. 30-31; Shoshone National Forest, 2007).

In the section of the plan that identifies measurable objectives associated with these desired conditions, the following concepts are discussed:[47] improving habitat security within seasonal ranges; focusing on watersheds where the elk habitat in migration corridors is of low security; coordinating with the Wyoming Department of Transportation to reduce animal/vehicle collisions; coordinating with the WGFD to get data on big game migration corridors; making annual changes to seasonal closures that reduce disturbances on big game winter range and birthing areas; providing more acres of aspen, sagebrush, and grasslands; and keeping the number of livestock permitted to use rangelands in SNF within a specified range while using grazing as a tool to improve forage conditions on big game winter ranges and setting aside grazing areas to serve as temporary “grass banks,” when necessary[48] (Shoshone National Forest, 2008). A smaller number of guidelines are provided that describe, but do not mandate, how the above described desired conditions and objectives can be met. The most relevant standards are

[47] The objectives themselves are measurable quantitative goals, although much of the information in the objectives section is qualitative (Shoshone National Forest, 2008). Both forms of goals are referenced in this discussion.

[48] Additionally, the plan indicates that SNF will talk to the Wyoming Game and Fish Department “during periods of prolonged drought” about big game populations in connection with the SNF’s management of livestock grazing (Shoshone National Forest, 2008, p. 76). While not explicit, the plan implies there may be a need to consider the effects of drought when managing livestock grazing.

that management activities that affect big game on their winter ranges should, for the most part, not be completed during the season when big game use the ranges; that livestock grazing on big game winter range should "avoid negatively impacting the quality and quantity of forage for wintering wildlife" and leave adequate quality and quantity of forage for them (Shoshone National Forest, 2008, p. 101).[49]

B. **Bureau of Land Management**

BLM lands (which can include surface and/or mineral rights) are managed via RMPs that are required by statute, as discussed above. Similar to forest plans, RMPs provide a long-term vision for management of geographical units under principles of multiple use and sustained yield. The RMPs for all three field offices with land holdings within the migration corridors or seasonal ranges for the migrating ungulates herds we examined discuss the species of interest in their plans and have incorporated plan components that provide some protections for important habitat areas for the species. In particular, the Bishop Field Office in California specifically discusses protections for the Round Valley mule deer and the Pinedale Field Office in Wyoming broadly asserts that the "[d]evelopment of private lands has increased the importance of maintaining functional habitats on public lands" (Bureau of Land Management, 2008, p. 2-4).

Bishop Field Office, California

The Bishop Field Office's 1993 RMP lists protections for both mule deer habitat generally and for the habitat of the Round Valley mule deer herd specifically. The RMP includes the following overall guideline for the management of lands under its jurisdiction: "[a]ctions that interfere significantly with efforts to maintain or enhance mule deer winter range will generally not be allowed" (Bureau of Land Management, 1993, p. 9). The RMP also includes a resource-specific guideline, termed "standard operating procedures," for wildlife that discusses consulting or notifying the CDFG about projects for wildlife habitat improvement or revegetation (Ibid.). The main section of the RMP includes field office-wide decisions, one of which is discussed below in reference to the particular threat of fire and invasive species to the Round Valley mule deer herd, as well as decisions organized by designated management areas, two of which contain lands within the Round Valley mule deer migration corridor and winter range and have decisions addressing the herd specifically (Bureau of Land Management, 1993).

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[49] One of the guidelines associated with livestock grazing is that "allotments that are or become vacant should continue to be available for commercial livestock grazing," implying that SNF does not intend to retire any areas as grazing allotments (Shoshone National Forest, 2008, p. 108).

The two management areas that contain habitat of the Round Valley mule deer herd are an area around Lake Crowley and a large area encompassing lands to the west and northwest of Bishop as well as many lands south of Bishop (Ibid.). For the area around Lake Crowley, the RMP lists the following decisions: "[y]earlong [p]rotection of the mule deer migration corridor"; "acquire up to 80 acres of private land to protect the mule deer migration corridor"; and "[e]nhance wildlife habitat and watershed conditions" via the meeting of vegetation goals for a percentage of acres with a particular plant community, one of which is to meet vegetation goals on 25% of the acres of sagebrush-bitterbrush "to provide cover and forage for mule deer, pronghorn and sage grouse" (Ibid., p. 46). For the area that includes lands west and northwest of Bishop, the RMP lists the same year-long protection for the migration corridor, the decision to acquire up to 1,820 acres of private land within the migration corridor and winter range,[50] and the same goal for the sagebrush-bitterbrush plant community, in addition the following decisions: "[s]easonal protection of the Round Valley…mule deer winter ranges from 11/1 to 4/30"; "[m]aintain or enhance mule deer winter ranges to meet objectives of [CDFG] herd management plans"; "[m]anage deer winter ranges to provide at least 70% of the bitterbrush in mature or younger age classes, and to provide enough annual growth to support 5,400 deer on the Round Valley winter range"; and decisions related to grazing allotments that are discussed below in reference to the particular threat of fire and invasive species (Ibid., p. 54-55). In relation to the decision regarding the acquisition of private lands in the latter management area, the RMP indicates that the office will make available more than 2,000 acres of BLM lands as an "exchange base" for "communities service needs, agricultural use and residential expansion" (Ibid., p. 56).

Although the RMP lists the preparation of a "Habitat Management Plan for the Round Valley mule deer winter range and migration corridor" as a "support need" for implementing its decision, the office has not completed one after concluding that the additional layer of planning was not needed to implement either habitat protection measures or habitat restoration projects in the area (Bureau of Land Management, 1993, p. 46, 55; S. Nelson, personal communication, January 23, 2009). According to Steven Nelson, Supervisory Natural Resource Specialist in the Bishop Field Office, "the overall emphasis of the RMP on maintaining and improving mule deer

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[50] This, and the 80 acres mentioned for the management area around Lake Crowley, is the total number of acres of private land within the management area.

habitat has allowed the office to focus on project level planning and implementation" which "has proven to be a more efficient approach for managing mule deer habitat on public lands in the area" (S. Nelson, personal communication, April 17, 2009). Specific projects aimed at Round Valley mule deer habitat are discussed below in reference to the particular threat of fire and invasive species.

Pinedale Field Office, Wyoming

The Pinedale Field Office of the BLM completed a new RMP in the fall of 2008 that includes multiple restrictions on land uses within areas of both big game winter ranges and migration areas, including the location of the Grand Teton National Park pronghorn. In completing its new RMP, the office identified an issue relating to wildlife habitat of "disruptive activities, human presence, and loss of habitat in big game (i.e., elk, deer, pronghorn, moose, and bighorn sheep) habitat, [and] big game crucial habitat (crucial winter range, migration routes, and birthing areas)" (Bureau of Land Management, 2008, p. 2-4). The RMP further states that the issue encompasses "managing nonlimiting habitats, such as traditional and summer ranges, to prevent these habitats from becoming limiting" (Ibid.).

The main section of the RMP provides resource-specific management decisions[51] that address big game habitat in decisions for wildlife habitat, ACECs, and other "special designations and management areas," in addition to decisions for oil and natural gas leasing, livestock grazing, recreational use, and land sales or acquisition (Bureau of Land Management, 2008). Within the decisions for wildlife habitat is the goal to "[m]aintain functioning big game habitats and migration corridors that allow free movement and use of habitats," and the objectives to "[m]aintain sufficient undisturbed or minimally disturbed habitats to maintain persistent, well-distributed, self-sustaining, and productive populations of all native and desirable non-native…wildlife species" and to "[m]aintain and enhance big game habitats to support big game populations at WGFD planning objective levels" (Ibid., p. 2-45, 2-47).

To achieve the wildlife habitat objectives, the office divided lands under its jurisdiction into categories of intensively developed oil and natural gas leasing fields, areas that have traditionally been available for oil and natural gas leasing, and areas that will be unavailable for leasing in order to protect wildlife habitat (Bureau of Land Management, 2008). All of the

[51] The management decision section is broken down into management goals, objectives, and actions, which is a similar structure to that used by many of the private lands managers discussed in Section 2.

migration route of the Grand Teton National Park pronghorn herd is classified as unavailable for leasing, as is much of the winter range.[52] Sections of the winter range do, however, also include traditionally available areas and the intensively developed Jonah Field in western Sublette County and Pinedale Anticline Project Area in eastern Sublette County (Bureau of Land Management, 2008, see map 2-9). In addition to decisions specifically addressing future oil and natural gas leasing in each of the three areas, which are discussed below in reference to the particular threat of natural gas development, the RMP establishes decisions for any land use in each of the three areas that BLM might issue permits for or that would lead to surface disturbance or disruption (Bureau of Land Management, 2008). These land uses include, among others, recreation, livestock grazing, and infrastructure development (see Bureau of Land Management, 2008, Appendix 3, p. A3-1). The decisions for both unavailable and traditionally available areas include "[b]ig game migration routes will be protected"; seasonal prohibitions on activities requiring a BLM permit in big game birth areas between May 1 and June 30; and seasonal prohibitions on surface disturbing or disruptive activities in big game crucial winter ranges between November 15 and April 30 (Bureau of Land Management, 2008, p. 2-48 to 2-49). The decisions for intensively developed fields are that activities that activities requiring a BLM permit "will be designed and implemented to minimize impacts on big game during migration" and "in big game [birthing] areas from May 1 to June 30 to the extent practicable" and that "surface activities will be designed and implemented to minimize impact in big game crucial winter ranges between November 15 to April 30…to the extent practicable" (Ibid., p. 2-48).

The RMP also establishes a 9,540 acre ACEC near Trappers Point, and within the Grand Teton National Park pronghorn herd's migration route, to "[p]reserve the viability of the big game migration bottleneck," among other purposes, as well as two management areas that include some of the herd's winter range (Bureau of Land Management, 2008, p. 2-54). The stipulations for the Trappers Point ACEC include the following: unavailability for oil and natural gas leasing; that off-highway vehicles are prohibited between November 15 and April 30 and that during other times they must stick to designated roads and trails; a prohibition on surface disturbing activities "except those to enhance the viability of the big game migration" and other

[52] However, some of the areas classified as unavailable for leasing include current natural gas leases that will be honored until they expire (Bureau of Land Management, 2008).

activities relevant to the ACEC's purpose; that a portion of the ACEC would not be available for sale and may be "withdrawn" in the future[53]; and a fencing stipulation discussed below in reference to the particular threat of fencing (Ibid., p. 2-56).

The RMP lists other relevant resource-specific management decisions. These include that livestock grazing in "crucial big game winter ranges will be managed to maintain or enhance vegetation condition and forage availability for wildlife, as appropriate"; that alternative energy development projects are to be avoided in these winter ranges; and that land sales and acquisitions "that would protect wildlife migration routes will be considered" and "[p]ublic lands will be retained to provide for free movement of migrating big game animals at…"important wildlife migration routes as identified" (Bureau of Land Management, 2008, p. 2-15, 2-18). Additionally, the office includes a decision to limit the use of off-highway vehicles "on a seasonable basis as needed," including, potentially, for "over-the-snow recreational motorized equipment" within big game crucial winter range between November 15 and April 30 (Bureau of Land Management, 2008, p. 2-37).

Cody Field Office, Wyoming

The Cody Field Office for BLM currently manages its lands with a 1990 RMP that discusses broadly the use of seasonal restrictions on land uses in areas of crucial habitat for big game, including elk (Bureau of Land Management, 1990). The office is also currently working on revisions to its RMP that will combine the management of the Cody and adjoining Worland Field Offices under one regional Bighorn Basin RMP (Bureau of Land Management, 2009a). While the field offices are in the early stages of plan revision, an analysis of the current management situation that was recently released identifies a number of trends impacting wildlife, including habitat loss and fragmentation and the incursion of invasive plant species from uses on BLM lands (Bureau of Land Management, 2009b). Specific to elk and other big game, the report discusses the need to consider how to mitigate the impacts of oil and natural gas and other mineral development in big game crucial habitat (Ibid.).

[53] Withdrawal is defined in FLPMA as "withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program; or transferring jurisdiction over an area of Federal land, other than "property" governed by the Federal Property and Administrative Services Act, as amended (40 U.S.C. 472) from one department, bureau or agency to another department, bureau or agency" (43 U.S.C. § 1702(j), 2009).

Within the main portion of the current RMP, the Cody Field Office discusses decisions for different “resource programs,” including wildlife and habitat (Bureau of Land Management, 1990). Under decisions for wildlife and habitat, the RMP puts forth an overall objective to “maintain and enhance fish and wildlife resources so that the forage production and quality of rangelands and fish and wildlife habitat will be maintained or improved,” and includes a “management action” of applying seasonal restrictions “as appropriate to surface-disturbing and disrupting activities and land uses on big game crucial habitat, including winter ranges and elk calving areas” (Ibid., p. 38, 40). The recently released analysis in conjunction with the anticipated plan revision indicates that BLM is considering establishing criteria for determining the “allowable disturbance” in these areas (Bureau of Land Management, 2009b). Other management actions listed in the 1990 RMP are that BLM has to approve snow removal activities in crucial winter ranges for big game when there is severe winter weather and that BLM will work with WGFD on wildlife population and habitat management (Ibid.).

The appendix to the RMP details the variety of standard seasonal restrictions the Cody Field Office can apply for land uses that create “surface disturbance or human presence impacts” (Bureau of Land Management, 1990, p. 63; D. Harrell, personal communication, January 21, 2009). These land uses include almost any activity taking place off a road, such as exploratory drilling for minerals, grazing by livestock, and oil and natural gas exploration (D. Harrell, personal communication, January 21, 2009). The relevant stipulation is a restriction on “activities or surface use” in big game (including elk) winter range from November 15 to April 30 and big game (including elk) birthing areas from May 1 to June 30 (Bureau of Land Management, 1990). BLM applies these stipulations within the Carter Mountain ACEC, an area that was established to protect the alpine tundra area and that falls within the winter range for the Clarks Fork and Cody elk (Bureau of Land Management, 1990), although it is not clear the extent to which it has applied the stipulations on activities[54] in a majority of the winter range. In the RMP appendix, the Cody Field Office does assert a commitment to consult with WGFD in applying the restrictions and to perform an environmental analysis in determining when to grant an “exception, waiver, or modification of mitigation requirements” (Ibid., p. 63).

[54] These activities include, predominately, livestock grazing and oil and natural gas development (D. Harrell, personal communication, January 21, 2009).

The Cody Field Office has also engaged in specific projects aimed at wildlife habitat, including where Clarks Fork and Cody elk are found. The office has conducted a number prescribed burns, in conjunction with detailed treatment and restoration procedures, to reduce conifer encroachment and improve habitat quality of rangelands (D. Harrell, personal communication, January 21, 2009). Additionally, the field office is pursuing a potential land exchange that would provide it with an area of value for both wildlife habitat and recreational uses (Ibid.).

C. **Los Angeles Department of Water and Power**

As discussed above, LADWP manages its land through authority granted via LA's City Charter. The department has created a comprehensive land management plan and implements an approach that provides for management similar to that for public lands (B. Tillemans, personal communication, January 12, 2009). LADWP offers grazing leases (often requiring the lessee to comply with guidelines similar to those for adjoining or nearby federal grazing allotments), keeps a large percentage of its land open for recreational use (currently, approximately 75%), and incorporates wildlife habitat concerns into its land management plan (Ibid.).

In general, LADWP manages it lands to achieve high watershed quality with the goal to "employ best management practices…for land and water uses that maintain water supplies to the city while protecting water quality, habitat, biodiversity, and threatened and endangered species throughout the watershed" (B. Tillemans, personal communication, January 12, 2009; Los Angeles Department of Water and Power, n.d.a). LADWP states that the "key to good watershed management is good land use," further described as that which "prevents soil erosion and promotes vegetation cover" (Los Angeles Department of Water and Power, n.d.a). The department also lists eight "watershed management goals," and while none of them specifically mention wildlife and habitat, one is "to strive for a healthy watershed," and another is to "[a]void or minimize resource conflicts that may threaten [LA] water supply" (Los Angeles Department of Water and Power, n.d.d).

D. **Wyoming Office of State Lands and Investment**

WY OSLI manages the mineral or surface rights of lands within its jurisdiction to generate revenue, and, to this end, maintains a primary goal of proactive management that preserves and protects the land's underlying value (L. Boomgaarden and S. Child, personal communication, May 28, 2008). WY OSLI's mission statement is to "support the Board of Land

Commissioners in applying total asset management principles in order to optimize and diversify trust asset revenue and preserve and enhance trust asset values" (Wyoming Office of State Lands and Investments, n.d.).[55] Within the "most important" functions that WY OSLI describes for itself is "the preservation and enhancement of trust asset values for current and future beneficiaries" and the agency further describes that school lands are "managed, preserved and enhanced through responsible stewardship to contribute directly to the economic, social and environmental well being of Wyoming's public school children, local communities and natural resources" (Ibid.).

WY OSLI is not required to go through a public comment period for the leases or easements it grants for use of state lands, but for the last three years the agency has sought input from WGFD when receiving applications for oil and gas leases and special use leases or easements (often for commercial or industrial infrastructure development) (L. Boomgararden, S. Child, personal communication, May 28, 2008). This policy is discussed in further detail below as relevant for particular threats. WY OSLI has also actively sought to geographically consolidate, through land sales, exchanges, and acquisitions with private land owners and federal agencies, its mineral and surface rights to enable it to better reach its objectives (L. Boomgararden, S. Child, personal communication, May 28, 2008).[56] The agency has had greater success in working with private land owners throughout the state in recent years because, as it explains, the federal processes for completing land sales or exchanges can be onerous, and WY OSLI's revenue-generation mission can conflict in some circumstances with the multiple-use mission of federal land managers (Ibid.).

E. **Threat of human activity to mule deer**

As discussed above in relation to private lands, human activity is a threat to Round Valley mule deer mainly within the migration route in Mono County, particularly near Mammoth Lakes. INF is one of the main public land managers with holdings in this area, as well as, to a lesser extent, the Bishop Field Office of the BLM and LADWP. INF's forest plan identifies both campground use and dispersed recreation as "heavy" near Mammoth Lakes and today there are

[55] Although WY OSLI's mission is focused on revenue generation and value creation, a common mission for the management of state trust lands, according to a recent report commissioned by the Sonoran Institute, such a mission does not necessary exclude the consideration of conservation uses of the land, such as for wildlife habitat, because such use might also generate revenue or create value (Culp, Laurenzi, & Tuell, 2006).
[56] Wyoming, similar to other states, was granted geographically dispersed parcels of land from the federal government when it became a state in 1890, resulting in a patchwork of ownership (Culp, Laurenzi, & Tuell, 2006).

several campgrounds to the south near Lake Crowley that remain full throughout the summer (Inyo National Forest, 1988, p. 192; R. Perloff, personal communication, January 23, 2009). In terms of other common land uses involving human activity that might occur on public lands, there is no oil or natural gas or mineral leasing within the Round Valley mule deer winter range although there is a small geothermal facility in the northern portion of the migration corridor within INF (S. Nelson, personal communication, January 23, 2009).

INF's forest plan contemplates some expansion of summer and winter recreation around Mammoth Lakes, including of day-use activities, hiking, horse-back riding, mountain biking, and camping in designated campsites, although there is a direction to prohibit dispersed camping in the area closest to the town (Inyo National Forest, 1988). Additionally, INF has established a number of management prescriptions in its forest plan focused on addressing recreational and other human activities within mule deer habitat. The forest plan lists the following directions: "design new [recreational] development so that the integrity of mule deer staging areas, migration corridors, and key habitat is maintained"; locate trails, roads, and heliports where they will not conflict with mule deer habitat; allow dispersed recreation (while maintaining the integrity of wildlife habitat); permit off-road vehicles only on designated roads and trails; "restrict vehicular access as necessary to protect deer winter range, holding areas, and known key fawning areas"; and coordinate with BLM for seasonal road closure dates in connection with mule deer (Inyo National Forest, 1988, p. 117-18). Ski areas are specifically addressed as a resource, and wildlife measures are incorporated for both existing ski areas (e.g., Mammoth Mountain Ski Area) and potential future ski areas. For existing and potential ski areas, directions include seasonal road closures, mitigation of the impacts on mule deer migration corridors from the construction or maintenance of ski runs, and the location and design of new infrastructure so as not to significantly impact deer "migration corridors, fawning areas or staging areas," or the movement of deer (Inyo National Forest, 1988, p. 139, 142; Inyo National Forest, 1994). There is also a direction to limit the number of nordic skiers to a specific density (Inyo National Forest, 1994). Additionally, the potential impact on mule deer habitat from activity in relation to mineral development and energy development is discussed in the forest plan, with directions to consider seasonal limitations or recommend against development leading to impacts that cannot be mitigated (Ibid.).

In its RMP the Bishop Field Office of the BLM highlights recreational opportunities as important elements of both of its management areas that contain the Round Valley mule deer migration corridor and winter range, indicating that there is "tremendous potential to enhance recreational opportunities and increase visitor use" around Lake Crowley (Bureau of Land Management, 1993, p. 47). According to the RMP, off-highway vehicles are limited to designated roads and trails within the Round Valley mule deer habitat (Bureau of Land Management, 1993). Also, the office takes into account the impacts of recreation on mule deer via its decisions, described above, to provide year-long and seasonal protection for mule deer habitat (Bureau of Land Management, 1993; S. Nelson, January 23, 2009). In implementing these decisions, the office does not authorize recreational activity that it determines would negatively impact mule deer (S. Nelson, January 23, 2009). This is also the case for other land uses where BLM has discretionary authority to either approve or deny an action or activity, unless there was a valid existing right to the land use before the RMP was created such as with an existing permit (Ibid.). In the case of a non-discretionary action, the office still considers and may incorporate mitigation measures to protect mule deer habitat (Ibid.).

LADWP currently allows recreation on its lands (e.g., camping, off-road vehicle use on designated roads and trails, and fishing), although it has the ability to change this policy in the future because it functions as private property owner within Mono and Inyo Counties and is held to purposes, in the LA City Charter, focused on water provision and conservation (see Los Angeles Department of Water and Power, n.d.b.). LADWP has prohibited off-highway vehicle use in some portions of the Round Valley mule deer winter range and at times made decisions not to encourage recreation in specific locations (B. Tillemans, personal communication, January 12, 2009). Recently LADWP declined to advertise some of the off-road vehicle trails on its lands in order to reduce the impact on habitat and watershed quality (B. Tillemans, personal communication, January 12, 2009, April 20, 2009). Additionally, in describing management of recreational use around Crowley Lake LADWP asserts that, "[r]ecreational activities and improvements must dovetail with watershed plans" (Los Angeles Water and Power, n.d.c).

F. **Threat of fire/invasive species to mule deer**

The combined threat of fire and incursion by invasive species is a threat to Round Valley mule deer primarily within the winter range, an area managed largely by INF, the Bishop Field

Office of the BLM, and LADWP.[57] Interwoven with the threat of fire and incursion of invasive species is the need for adequate forage for mule deer on winter range.

INF recognizes in its forest plan that the forest includes 112,119 acres of "key deer winter range" (Inyo National Forest, 1988). Within this area INF does not do very many habitat enhancement or improvement projects, instead focusing on fire prevention and control (R. Perloff, personal communication January 23, 2009). Included in INF's the forest plan is a list of management prescriptions for mule deer habitat discussing fire and rangeland vegetation. These include directions to "use fire suppression strategies of confinement, containment, or control for management of unplanned natural fires," and to control unplanned human-caused fires, and that prescribed fire can be used for improvement of mule deer habitat. Additionally, INF lists management prescriptions to "manage vegetation on key habitat areas for optimum forage-to-cover ratios" and to manage "non-key winter range" to provide vegetation that will "meet the dietary needs of mule deer" (Inyo National Forest, 1988, p. 117-18). For the two management areas that contain mule deer winter range for the population of interest there are specific management directions provided about livestock grazing: that, generally, INF should "allow not increases in grazing where this would significantly degrade fish or wildlife habitat" and should "amend [permits] to include mitigation measures and take corrective actions where grazing is significantly impacting wildlife habitat" (Inyo National Forest, 1988, p. 215, 220). According to the 1988 forest plan, the areas of the winter range owned by INF contain one to two grazing allotments that this management direction would be relevant for, although it is not clear how expansive these areas are (Inyo National Forest, 1988).

While INF does not focus on habitat improvement, the Bishop Field Office of BLM engages in projects to re-establish bitterbrush, to provide forage for mule deer, in areas of their winter range that have been previously burned in fires. Although such efforts are labor intensive and dependent on rain or supplemental water for success, they are able to complete a few plantings a year utilizing funding and volunteer efforts from area non-governmental organizations (S. Nelson, personal communication, January 23, 2009). Within its RMP the office explicitly lists a field office-wide support need to "[d]esign and implement habitat improvement projects in cooperation with the…Mule Deer Foundation…and other conservation organizations"

[57] While Mono and Inyo counties manage private lands within the winter range, the threat of fire/invasive species was not discussed in conjunction with private lands because the threat is largely connected to the provision of forage and management of invasive species and risk of fire on the public lands in the winter range.

(Bureau of Land Management, 1993). Additionally within the RMP, the office establishes a field office-wide decision that "[l]ivestock grazing utilization on bitterbrush within mule deer migration corridors or winter ranges will not exceed 30% of annual growth," although in 1999 this was reduced to 20%, and a support need that the office will coordinate with INF on grazing allotment management (Bureau of Land Management, 1993, p. 24; S. Nelson, personal communication, April 17, 2009). This decision and support need is relevant for the one grazing allotment that BLM currently permits within the Round Valley mule deer winter range[58] (S. Nelson, January 23, 2009).

LADWP's efforts aimed at improving habitat in the winter range result mainly through the department working with grazing lessees to ensure adequate forage; in general, LADWP's restoration work is focused on riparian vegetation (see Los Angeles Department of Water and Power, n.d.a).[59] As stated above, LADWP often requires grazing lessees to comply with guidelines similar to those for nearby federal grazing allotments, and it has stopped leasing out one area within the Round Valley mule deer winter range to allow for forage growth (B. Tillemans, personal communication, January 12, 2009).

G. **Threat of fences to pronghorn**

Fences pose a threat to Grand Teton National Park pronghorn along the length of their migration route, including areas managed by BTNF in the northern section of the route, and the Pinedale Field Office of BLM and WY OSLI in Sublette County within the southern section of the route. Fencing can be located within or along property boundaries as well as along roadways. As discussed above for fencing on private lands bordering roadways, fencing on public lands along roadways, here as relevant for BLM and WY OSLI lands, falls under the authority of Sublette County Road and Bridge when the road is a county road and under the Wyoming Department of Transportation for US-191 and WY-352. Similar to private lands, on public lands Sublette County Road and Bridge will install wildlife-friendly fencing, with approval from BLM and WY OSLI, when appropriate for the land use (B. Myers, personal communication, April 17, 2009). The Wyoming Department of Transportation defers to recommendations from both BLM

[58] This decision is also relevant for two grazing allotments that exist in the management area around Crowley Lake (S. Nelson, personal communication, January 23, 2009).

[59] Is it also useful to note that LADWP, as part of the city of LA, has to comply when CEQA when it engages in projects. Thus, it is possible that future project it might undertake within the winter range for the Round Valley mule deer would be subject to mitigation measures or alternatives that would avoid impacts to mule deer. Currently LADWP is engaged in a habitat restoration process in other locations within Inyo County as a result of impacts on habitat from its groundwater use (Los Angeles Department of Water and Power, 2008).

and WY OSLI in selecting fencing infrastructure for new installments, the common choice being for wildlife-friendly design (J. Eddins, personal communication, April 13, 2009).

BTNF does not specifically discuss fencing in relation to pronghorn or other big game species within its forest plan, although the standard, listed above, for designing future structural improvements to not impede big-game movement is relevant for fence design. Additionally the stipulations included in the forest plan amendment that designate the pronghorn migration corridor, also discussed above, relate to how future fencing can be established along the migration route. BTNF has, for a recent project to improve and install fencing along an allotment near the route, incorporated wildlife-friendly fencing standards (J. Ozenberger, personal communication, May 29, 2009).

For fencing that currently exists on BTNF lands, including within the migration route, the forest has completed, and is continuing to engage in, projects to remove fencing or make it less of a wildlife passage barrier, often with the help of volunteers and non-profit organizations (J. Ozenberger, personal communication, May 29, 2008). One project BTNF completed recently within the migration corridor was removing 8-foot wire mesh fencing that is particularly impervious to wildlife movement (J. Ozenberger, personal communication, May 29, 2008). Since approximately two-thirds of the corridor contains grazing allotments, some of the fencing that crosses or is adjacent to the corridor is associated with these allotments (F. Ryan, personal communication, May 23, 2008). BNTF is currently working to assure that fences established prior to the forest plan design guidelines are conductive to pronghorn crossing (Ibid.).

In the new RMP for the Pinedale Field Office, the only mention of fencing is in relation to the Trapper's Point ACEC. The office established a decision that no "additional fences will be constructed…except to enhance the viability of the big game migration" (Bureau of Land Management, 2008, p. 2-56). The office does not appear to be engaged in projects to catalogue whether existing fencing on grazing allotments and other areas is wildlife friendly or to modify any non-wildlife friendly fencing on its land.

WY OSLI has not actively regulated fencing on lands under its jurisdiction and does not have accurate data on the type of fencing that exists currently (L. Boomgaarden and S. Child, personal communication, May 29, 2008). This is largely because lessees of any type have, by state statute, the discretion to install and maintain fencing on state trust lands when the improvements total less than $2000 for particular areas as designated in the statute (Ibid.; Wyo.

Stat. Ann. § 36-5-110, 2008). Additionally, although WY OLSI has added some stipulations to new oil and gas lease agreements, none of the current stipulations address fencing type (see Wyoming Office of State Lands and Investments, 2008). Similarly, for grazing and other agricultural leases, which was the primary surface use of its lands historically, WY OSLI has not imposed fencing requirements upon lessees (L. Boomgaarden and S. Child, personal communication, May 29, 2008). WY OSLI has required grazing management plans although the agency explains that the procedure for grazing and other agricultural leasing is more detailed in state statute than for other leasing, which gives the agency less flexibility to impose requirements on the lessee (Ibid.).

H. **Threat of natural gas development to pronghorn**

The threat of natural gas development is most prevalent for Grand Teton National Park pronghorn within their winter range in Sublette County, although it would also be a threat along the length of the migration route if the area were to be leased to a greater extent. Although private land owners have the ability to lease out their lands for natural gas development, the Pinedale Field Office of the BLM and WY OSLI are the two predominant grantors of leasing permits for natural gas development in these area.

As discussed above, the Pinedale Field Office of the BLM makes all of the migration route and a substantial part of winter range for the Grand Teton National Park pronghorn herd unavailable for oil and natural gas leasing. There are current leases in both of these areas, and the RMP addresses such leases through a decision that they will be honored but “regulated to mitigate impacts on important wildlife habitat, including big game crucial winter ranges” (Bureau of Land Management, 2008, p. 2-22, see map 2-9). The RMP includes two additional decisions for areas designated as unavailable: “[t]ransportation planning will be implemented to avoid creating unusable islands of wildlife habitat and proliferation of access points” and existing designated routes have to be used in areas outside of the natural gas fields that are within big game crucial winter ranges (Bureau of Land Management, 2008, pg. 2-49). For areas designated as traditionally available for oil and natural gas leasing, a designation given to portions of the winter range, these same three requirements are imposed for leases and transportation (Bureau of Land Management, 2008). Additionally decided in terms of allowing leasing is that “[k]nown big game bottleneck areas are available for oil and gas leasing with [no surface occupancy] restrictions” unless otherwise protected (Ibid., p. 2-48). For the intensively developed Jonah Field and Pinedale Anticline Project Area, which include portions of the winter range, any new oil and gas lease "will include standard lease stipulations and appropriate [no surface occupancy] and [controlled surface use] stipulations,"; transportation planning is to be "designed and implemented to minimize cumulative impacts,"; and the same restriction on transportation in areas outside of natural gas fields imposed for other areas is imposed here (Bureau of Land Management, 2008, p. 2-21, 2-48).

For areas falling within all three designations, the different seasonal restrictions on surface disturbing or disruptive activities that are discussed above apply for activities connected to oil and gas leasing (the least restrictive decision for the intensely developed fields, where such activities are allowed but with minimization of impacts) (Bureau of Land Management, 2008). The RMP also states that year-round drilling may be allowed for either new or existing leases within intensively developed fields that are currently subject to seasonal restrictions (Ibid.). Additionally, the designation of areas as unavailable for oil and gas leasing could itself "be reevaluated in site-specific situations" where the office determines that development of adjacent state or federal oil or natural gas reserves is "draining federal oil and gas resources"; where wildlife and other "surface resource values" could be "adequately mitigated"; or where the office amends the RMP (Ibid.).[60]

In addition to providing varying levels of protection for big game habitat in land within its jurisdiction, the office also discusses offsite mitigation as a potential mitigation measure that could be used to address impacts of oil and gas development on habitat (Bureau of Land Management, 2008). The RMP contains an objective to "[c]ollaborate with state and local governments to identify areas for offsite mitigation" and lists onsite mitigation as a preferable mitigation measure if possible (Ibid., p. 2-52). Off- site mitigation projects connected to wildlife and other natural resource impacts from the Jonah Field are specifically coordinated through the Jonah Interagency Mitigation and Reclamation Office, of which BLM is the lead participating agency (Bureau of Land Management, n.d.a). The projects approved by Jonah Interagency Office are funded with industry dollars from companies with leases within the Jonah Field and have included projects to study prehistoric pronghorn behavior, to place message signs warning of antelope crossing along highways, to purchase conservation easements within the Grand Teton

[60] That language in the RMP does not make clear whether all of these circumstances need to be met for the designation of the area to change, or just one.

National park pronghorn migration route and other areas (often contingent upon matching funds), and to modify fences along the migration route to make them wildlife-friendly (Bureau of Land Management, n.d.b).

A majority of WY OSLI's mineral rights are currently leased, and although the agency historically did not put stipulations on its oil and natural gas leases, it has begun to do so in recent years with input from WGFD (L. Boomgaarden and S. Child, personal communication, May 28, 2008). WY OSLI has worked with WGFD to create a number of potential stipulations to put into the oil and gas lease agreements that would protect areas to be offered for lease within big game crucial winter range, and other habitat areas, which the Board of Land Commissioners must, and has, approved for individual parcels (Ibid.; Wyoming Office of State Lands and Investments, 2008).[61] The stipulations are similar to those used by BLM and include limitations such as "no surface occupancy for any operations or ground disturbing activity" within specific areas and avoiding human activity during winter months (Wyoming Office of State Lands and Investments, 2008). Unlike BLM, OSLI also includes the following statement, giving the lessee the ability to suggest alternative solutions for protecting wildlife values: "in the alternative, exploration and development activities shall be subject to approval by the Director of the Office of State Lands and Investments, subject to the Director's consultation with the [WGFD] regarding alternative practices and/or plans of development which provide similar resource protection and mitigation" (Ibid.).[62]

Management Challenges on Private and Public Lands

Comparing the conservation strategies employed by local planning bodies and public land managers, it becomes evident that the authorizing laws themselves – the legal framework of state and federal constitutions, state and federal legislative statutes, and federal regulations that gives each governmental entity its authority – are not preventing most land use planners or managers from expressing concerns about the habitat of migrating ungulates. In the context of the analysis used in this chapter, this is the same as saying that, for the most part, these

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[61] Board Matter E.1 from the June 3, 2008 board meeting of the Board of Land Commissioners provides a good example of a set of Board-approved stipulations (see Office of State Lands and Investments, 2008).
[62] WY OSLI explains that it is able to include this statement, creating flexibility in the choice of mitigation measures for impacts on wildlife habitat, because it is not regulated under a state version of NEPA (L. Boomgaarden and S. Child, personal communication, May 28, 2008). As of last spring, no lessee had suggested an alternative measure to WY OSLI (Ibid.).

governmental entities have not interpreted their legal mandates narrowly so as to exclude the consideration of ungulate migration or to view ungulate migration as irrelevant to their purpose.

While most land use planners and managers have illustrated that they have some flexibility to express concerns about migrating ungulates, as explored more below, the authority granted to these governmental entities and the type of mandates included with that authority – mandatory (requiring or forbidding action) or permissive (allowing action) or broadly-enabling (in reference to habitat management) – impacts the flexibility they have to address specific habitat-based threats. Three comparisons of the authority versus actions of land use planners and managers stand out as revealing current management challenges for addressing habitat-based threats: how both land use planners and managers, operating from a variety of legal frameworks, have incorporated concerns about the habitat of migrating ungulates in their long-term planning documents; what strategies have been undertaken by different geographical units of USFS and BLM, operating from similar legal frameworks, to address specific habitat-based threats; and how local planning bodies, operating from differing state directives, have addressed the specific threat of residential development, the primary threat for all three ungulate species as discussed in Chapter 5. The management challenges identified using these three comparisons are not only challenges that land use planners and managers themselves face, but are also challenges for anyone interested in influencing conservation strategies to conserve ungulate migrations.

I. **Private and Public Lands: Legal Frameworks**

As indicated in the Sections 2 and 3 above, none of the laws examined for local planning bodies or public land managers directly mention wildlife migration or habitat fragmentation, yet nearly every entity, excluding only the town of Mammoth Lakes, LADWP, and WY OSLI, discuss in their long-term planning documents that lands within their jurisdiction contain, as relevant, wildlife migration corridors or seasonal ranges. Many plans refer to the ungulate species we examined, particularly plans for geographical units of USFS and BLM. Similarities shared by two of the public land managers who do not discuss the habitat of migrating wildlife within their plans – LADWP and WY OSLI – are apparent. Neither of these land managers have legal mandates mentioning "wildlife," which shows up in the mandates for the other public land managers (USFS and BLM), and both have mandates with more specific purposes than any of the other land managers. LADWP is specifically directed to manage lands to promote, deliver, and conserve water and power for Los Angeles; WY OSLI is specifically directed to manage lands as trustee for Wyoming public schools and, potentially, other state institutions.

The exceptions provided by LADWP and WY OSLI reveal a management challenge of finding ways for land use planners or managers whose legal mandates may appear to exclude wildlife concerns, in other words, less permissive or broadly-enabling than others', to work within their mandates to address habitat-based threats to migrating ungulates on lands within their jurisdiction. This means identifying specific actions the agencies are legally authorized to take within their legal frameworks. This challenge can be met through the leadership or innovation of individual staff within these entities; through input or political pressure from wildlife managers, non-governmental organizations, or other interested stakeholders; or a combination of the two. Although a majority of WY OSLI's mineral rights are leased, in implementing stipulations for natural gas leases to protect big game crucial winter and other habitat areas, WY OSLI has been able to meet this challenge to some degree for the specific threat of natural gas development to the Grand Teton National Park pronghorn.

II. **Public Lands: Multiple-Use Mandate**

Another comparison can be made regarding how different geographical units of the USFS and BLM, operating under what can be described as similar broadly-enabling multiple-use mandates, have acted to address specific habitat-based threats to migrating ungulates. It is evident from the actions taken by individual offices of USFS and BLM within our case studies that such a mandate is flexible enough to allow offices of both of these agencies to prioritize wildlife above other uses in designated areas, specifically, to prioritize important habitat for migrating ungulates. BTNF has successfully done this with its forest plan amendment to "designate" the migration corridor of the Grand Teton National Park pronghorn, requiring that any future actions authorized in the route, including the addition of fencing, allow for the pronghorn to pass. The concept of designating a migration route is an innovative strategy BTNF is the first national forest to employ, but it also illustrates that BTNF understands its authority to include the ability to prioritize the needs of migrating ungulates. This conclusion can be similarly drawn about the Pinedale Field Office of the BLM in Wyoming which recently decided, within a comprehensive revision to its RMP, to designate areas within the same route, as well as areas of the Grand Teton National Park pronghorn winter range, as unavailable for natural gas leasing, although reserves do exist. In so designating its lands, and in establishing associated seasonal restrictions for any land use that might lead to surface disturbances, BLM has in effect prioritized the use of the area for wildlife habitat above that for mineral development and most other uses.

Although the examples from the Grand Teton National Park pronghorn case study illustrate that USFS and BLM have flexibility to prioritize important habitat for migrating ungulates, the challenge is getting other USFS and BLM offices to do so when warranted by identified habitat-based threats to migrating ungulates. This challenge results partially from the broadly-enabling language of the multiple-use mandate. The mandate does not dictate when agencies have to prioritize specific uses over others, instead giving USFS and BLM offices general direction and much discretion in determining land use prioritizes. Examining other examples provided in the case studies, it appears that along with the decision-making contexts (e.g., political climate, resource constraints, and decision-maker perspectives), another factor influencing USFS and BLM manager's decisions is the availability of data on whether a land use poses a threat to migrating ungulates. A lack of concrete data may be one reason both INF and the Bishop Field Office of the BLM in California contemplate, in their long-term planning documents, increasing on-foot recreational use of lands within mule deer migration corridor and winter range, as relevant, despite speculation that such activity, including rock climbing and other recreation, may be a stressor to mule deer.

III. **Private Lands: State Directives**

Unlike the federal agencies included in this analysis, local planning bodies in California and Wyoming are operating under different sets of directives, and a comparison of their actions show that these directives can expand or limit their ability to address the threat of residential development to migrating ungulates. California's laws provide a more permissive, broadly-enabling mandate for local planning bodies, and also subject them to mandatory CEQA requirements in issuing permits for subdivision or development project proposals. Within this context both Mono and Inyo Counties have required that developers undertake specific mitigation measures aimed at protecting mule deer habitat within the winter range for Round Valley mule deer, necessarily interpreting potential impacts as a "significant effect[t] on the environment" under CEQA (Cal. Pub. Res. Code §§ 21001, 21081, 2008). As Mike Conklin, Interim Planning Director for Inyo County, California, summarizes, "CEQA is an extremely good planning tool" for addressing the environmental impacts from residential development (personal communication, March 27, 2009). The challenge, within the California directives, is to ensure that the mitigation measures are enough in light of the relative permanence of development and possibility climate change will alter habitat availability and location for migrating ungulates.

Wyoming laws are more restrictive in terms of the authority local planning bodies have and local planning bodies have acted with restraint in addressing impacts to migrating ungulates. Wyoming laws give local planning bodies specific powers and exempt from regulation, by default, most subdivision of land into 35-acre or larger parcels. Sublette and Park Counties have worked within this directive to identify impacts of proposals on pronghorn and elk using input from state wildlife agencies, at times requesting that developers made changes to their proposals, but have not required nearly the extent of mitigation measures as those required for mule deer in California. However, Teton County's use of Natural Resources Overlay, although currently aimed at benefiting species other from pronghorn, indicates that the county has interpreted state laws to allow local planning bodies to require mitigation measures for identified areas. The challenge, therefore, within Wyoming's directives, appears to be for local planning bodies to be resourceful in finding ways to require mitigation measures for the impact of residential development on migrating ungulates, or to encourage developers to incorporate measures voluntarily, which Sublette County has pursued by engaging developers in discussions.

IV. **Conclusion**

Overall, most of the laws directing the regulation of land use on private and publics lands involve permissive or broadly-enabling mandates rather than mandatory mandates, leaving land managers with a large amount of flexibility to determine how, and whether, to act to address habitat-based threats to migrating ungulates. The conservation strategies taken by local planning bodies and public land managers in our case studies illustrate that most of these entities do have enough flexibility to discuss ungulate migration. Our case studies also illuminate that these entities have more varied degrees of flexibility to implement conservation strategies to address specific habitat-based threats to migrating ungulates.

Although land use planners and managers may have enough flexibility to address ungulate migration, because permissive or broadly-enabling mandates do not require action, land managers may choose not to act to address habitat-based threats. In such circumstances, there is a more pressing need for others interested in the conservation of ungulate migrations, including wildlife managers and non-governmental organizations, discussed in the following chapters, to provide input or apply political pressure to land managers, or to find creative ways of ameliorating habitat-based threats as an alternative to the regulation of land use. Additionally, sometimes use of a conservation strategy may be desired by land use planners and managers, but complex legal procedures limit their flexibility to effectively execute the strategy. This is particularly evident in the case studies for the conservation strategy of land exchanges among agencies and individuals. While a number of land use planners and managers we analyzed actively seek to make land exchanges (e.g., WY OSLI and Mono County) or identify land exchanges as a main strategy for addressing the habitat of migrating ungulates (e.g., Bishop Field Office of the BLM), not many exchanges are occurring and some decision-makers have expressed frustration with the required processes. In these circumstances, effective communication between parties, which is discussed in Chapter 9, becomes a vital compliment of the suite of conservation strategies for addressing habitat-based threats to ungulate migrations.

Chapter 7
State Wildlife Management: Implications for Migrating Ungulates

Introduction and Background

This chapter introduces potential areas for state wildlife agency involvement in dealing with migration threats, and then looks at ways that two of these agencies have acted. The three case studies, Grand Teton National Park pronghorn, Clarks Fork and Cody elk, and Round Valley mule deer, provide the context for the information and analysis presented. The goal here is to show the most significant instances, or key components, of what appears to be facilitating and constraining state wildlife agencies' effectiveness in meeting migration conservation challenges. The following chapters, 8 and 9, will continue to explore in greater detail two of these key components of effective conservation programs, partnerships with nongovernmental organizations (NGOs) and communication strategies.

It is helpful to consider state wildlife agencies and their actions separately from the multitude of federal, state, and local land managers and regulators discussed in chapter 6. As coordinators for wildlife conservation in the states and advisors on planning and development actions, the wildlife agencies approach management at a more extensive scale than land managers. Only to a small extent do they operate as protected area managers and they generally are not instigators of large-scale development activities. Their mission is more singular and focused than land managing agencies. For these reasons, this chapter presents state wildlife agency roles, actions, and some insights into their effectiveness, but does so separately from the land managing authorities presented in chapter 6[1].

I. An Introduction to State Wildlife Agencies

Western U.S. wildlife agencies are tasked with managing wildlife within state boundaries, generally to perpetuate wildlife populations while also providing recreational opportunities. A board of commissioners is generally involved in setting agency policy, approving management actions, projects, and hunting regulations. Agency staff is dispersed

[1] The analytical approach applied in this chapter differs significantly from that in chapter 6, which relies heavily on goals and objectives from planning documents and descriptions of laws. The state wildlife agencies are generally less beholden to plans than to the land management authorities discussed in chapter 6. Required planning for endangered species or to qualify for certain federal funds are notable exceptions. But, in the cases examined, ungulate management is based principally on annual reporting and managers did not indicate that habitat management is inhibited by state plans. An analysis of legal authorities based largely on planning documents is thus potentially a less informative undertaking for state wildlife agencies than for other public agents.

among regions or political boundaries, and for the most part is organized by specialty: fish, wildlife, habitat, administrative operations, and in some cases, parks.

Responsibilities and authorities legislated to the wildlife agencies differ across the West. But, because the agencies own and fully manage so little habitat, they all function primarily through two avenues: setting and enforcing hunting regulations and engaging with land managing partners to provide advice and resources.

Big game management "typically focuses on manipulating hunting season timing and length, and manipulating harvest regulations to maintain population density and desired ratios of males to females" (Mule Deer Working Group, 2004). Success depends in large part upon good population estimates and modeling. It is an adaptive process that is generally driven by certain population targets. Game migrations are important to this hunting management; it is necessary to understand seasonal movements to understand population dynamics and to set hunt area boundaries and timing to optimize hunters' chances of success.

The amount of influence wildlife agencies wield depends in large part on the strength of their advisory relationship with landowners, local elected officials and land managers. To effectively engage with these partners, the agencies must be authorized and prepared to work on both private and public lands and to enter into contracts and agreements with others to carry out their responsibilities. For management and conservation efforts on private lands, effectiveness has a lot to do with their ability to provide incentives and the extent to which the community trusts them to follow through[2].

Since state wildlife agencies play a lead role monitoring wildlife population sizes and characteristics, they are a critical source of information for land managing partners such as the U.S. Forest Service and Bureau of Land Management. The land managers look to state wildlife agency information and management objectives as they evaluate uses and determine management actions in their spheres of influence. Ideally, wildlife agency objectives are shared with these partners, who cooperatively align their plans and actions. In some cases a level of cooperation is required by state law or federal regulation.

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[2] An observation informed by the authors' personal experience working for a Michigan Department of Natural Resources' private lands initiative, its Landowner Incentive Program.

II. **Migrations Pose Some Exceptional Management Challenges to State Wildlife Agencies**

Perpetuating wildlife populations can be a challenging mandate for agencies when the species they manage or protect must migrate in order to thrive. As the earlier chapters in this report have indicated, several primary threats specific to the case study ungulate migrations are identified by the authors based on information from interviews with wildlife managers; these are:

- climate change/drought
- residential development
- human activity
- roads
- fences
- invasive species
- predation
- disease

Additionally, the ecological complexities associated with migrations present their own set of management challenges to wildlife agencies, including:

1) Variations in habitat use over time, even seasonal movements where a species returns to the same ranges, make mapping critical habitat more difficult.

2) Understanding species' use of particular routes and potential disturbances, like the effects of climate change, require detailed observations over a long period of time.

3) A single obstruction can feasibly jeopardize an entire local population.

4) Managing or converting critical habitat to benefit one migrating species can be detrimental to some other particular species.

III. **Ecosystem Management**

Recent years have witnessed a significant agency shift in focus from management of populations of individual species to ecosystem management principles where management actions are designed to benefit a community of plants and animals and the landscape's full range of values and functions. To meet these challenges, wildlife agencies have expanded from their role as game managers to take on expansive habitat conservation responsibilities. Strategic planning at the state and regional level reflects this shift. New initiatives coming from the Western Association of Fish and Wildlife Agencies (WAFWA), the regional coordinating body for state wildlife agencies, embrace an "ecoregional approach," where management guidance and objectives are differentiated according to ecoregion characteristics (Mule Deer Working Group, 2004). In game management, the ecoregion approach may involve a shift from single species, single herd management, to an approach that assesses combined populations, aggregated according to ecosystem boundaries. In areas where big game predators are present in significant numbers, the value of ungulates as prey species would also be an important consideration.

Specific migrations can be difficult to prioritize under an ecosystem-based approach because preserving specific routes for one species' movement may not be an effective way to preserve other plants, animals, or landscape functions. The migrating ungulates in particular have expansive critical habitat areas, ranges that are necessary to maintain herd populations near the current sizes. This makes them especially susceptible to any habitat reductions, which is why habitat protection is a primary strategy for state wildlife agencies.

The Western Association of Wildlife Agencies' Mule Deer Working Group has outlined strategic objectives reflecting wildlife biologists' belief that habitat impacts are the greatest threat to maintaining game populations at current sizes. In their North American Mule Deer Conservation Plan, they urge agencies to actively participate in land planning processes and to coordinate on the review of development proposals to discourage growth into critical habitat areas (Mule Deer Working Group, 2004). This type of management recommendation is articulated in countless other professional and academic reports[3], including guidance focused on corridors[4]. Engagement with land managers in their planning processes and advising on local development impacts are strategies that are essential for state agencies to conserve transitional habitat and migration routes. These strategies, among others, will be discussed in detail in the context of the research case studies in Wyoming and California.

As state wildlife agencies take on new roles and administer new programs focused on habitat conservation, they must turn to new approaches to support these efforts. Committing agency resources to employ habitat biologists can be a challenge for states, let alone coming up with the funds for habitat projects at a scale able to improve and secure wildlife corridors. Fortunately, conservation projects taking a corridor-based approach generally fit within existing habitat funding schemes, with corridors being considered a crucial habitat. Viewed this way, many existing state and federal programs are applicable, such as certain elements of the Farm Bill's Conservation Reserve Program and working lands conservation programs, or private efforts like Wal-Mart's Acres for America program. These programs are just examples from a

[3] It is notable that California's Wildlife Action Plan and Wyoming Game and Fish Department's Strategic Habitat Plan are strategically focused on rights acquisition and planning actions.
[4] Paul Beier, on his Corridor Design webpage, offers a useful bibliography of corridor focused articles, some with management guidance; online at http://www.corridordesign.org/designing_corridors/resources/bibliography

multitude of resources applicable to corridor conservation. Other recent publications explain the potential applicability in great detail, notably the 2006 Arizona Wildlife Linkages Assessment[5] and Environmental Defense Fund's 2009 Safe Journey's Report[6]. Rather than reproducing that effort, the authors suggest these reports as resources.

Because some existing conservation programs and state habitat priorities are designed specifically around endangered species, corridor conservation efforts at least partly centered on rare species may be considerably different than efforts aimed at abundant big game species. State Wildlife Action Plans are one example. They can provide good guidance when it comes to rare species habitat prioritization, helping states tap into rare species funding. Species movements and corridors, however, are seldom considered and described in detail within the plans.

Because conservation actions considered in this study's three cases were primarily intended for abundant game species, they tended to rely heavily on the support of hunting user groups. A design approach with multiple focal species, including rare species, could have the ability to secure a broader base of support and funding than the cases discussed within this report.

IV. **Political and Programmatic Realities**

Impetus to consider migration corridors within existing conservation programs and strategies has grown out of local movements initiated by state transportation agencies and non-profit environmental groups to recently include new national-scale grant programs and more coordinated regional efforts like that by the Western Governors Association.

State and federal transportation authorities have played a critical role in the few statewide wildlife corridor planning efforts to date. The Arizona Wildlife Linkages Assessment is perhaps the prime example of a state wildlife and transportation agency working together to identify obstacles and natural connections for wildlife movements. Roads and associated right of way fencing are clearly one of these obstacles, and are recognized in this study as a threat in the pronghorn case. Because of the seriousness of road impediments to endangered species movements, wildlife and human mortality caused by collisions with animals, and the extreme cost of mitigation measures on poorly designed or sited roadways, transportation authorities have

[5] Arizona Wildlife Linkages Workgroup. (December, 2006). Arizona's wildlife linkages assessment. Section XII. Online at: http://www.dot.state.az.us/Highways/OES/AZ_WildLife_Linkages/assessment.asp
[6] Environmental Defense Fund. (2009). Safe journeys: Opportunities for wildlife corridor conservation through the Farm Bill. Online at: http://www.edf.org/documents/9238_Safe_Journeys_report.pdf

a large stake in understanding and planning around wildlife movements. In the pages that follow, the transportation authorities' actions are described to a very limited extent and in terms of how they work with state wildlife agencies to minimize wildlife impacts.

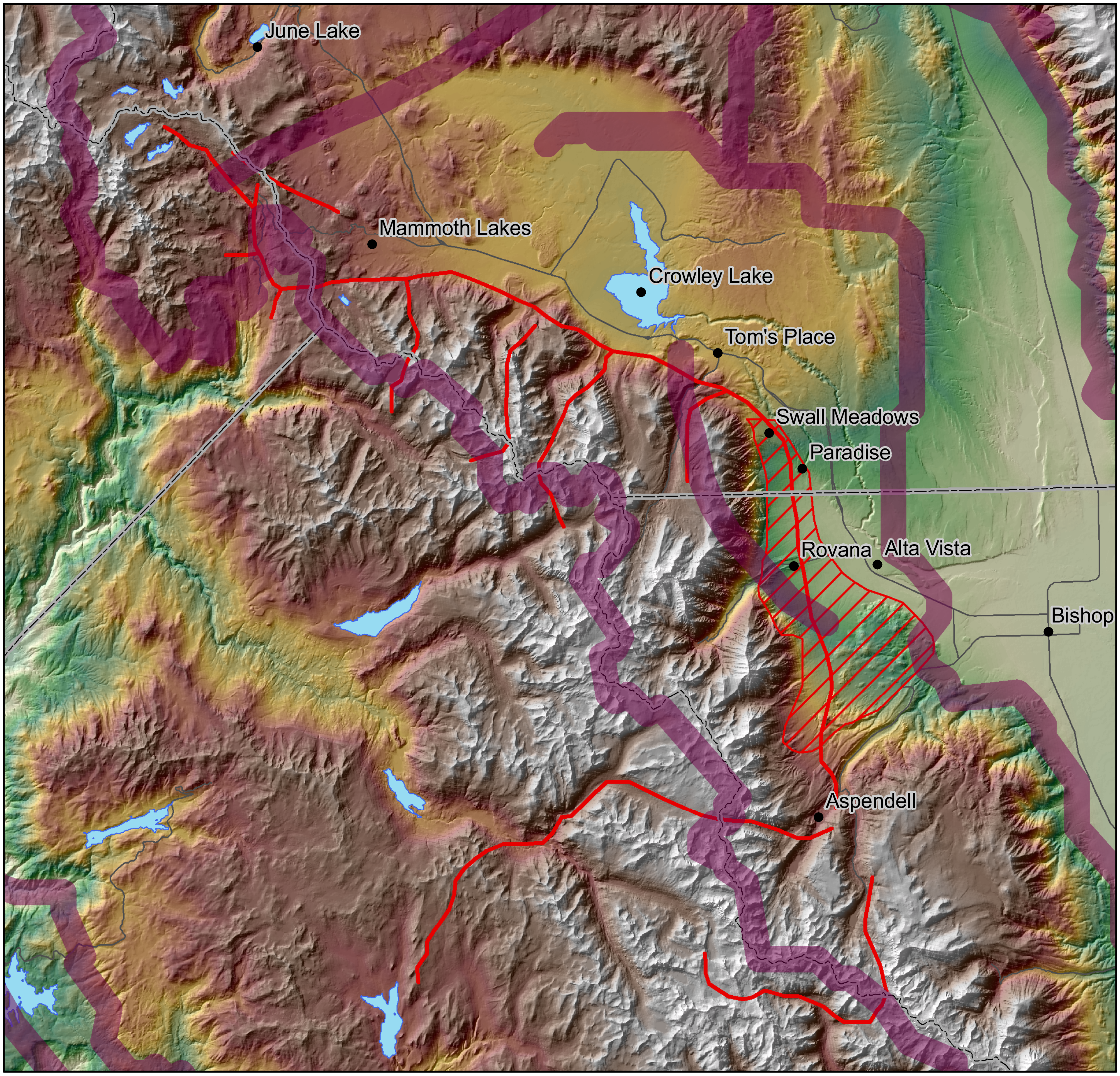
The WGA adopted a comprehensive report on June 29, 2008 that outlines steps for addressing the growing problem human development poses for wildlife movement in the West, and that acknowledges the shortcomings of existing conservation approaches in identifying and prioritizing critical habitat for multi-species migration. Recommendations by the WGA's Wildlife Corridors Initiative working groups in 2008 focus heavily on the lead role wildlife agencies play in corridor preservation, calling for improvements in:

- mapping seasonal movements and ranges
- including corridors in conservation planning (especially State Wildlife Action Plans)
- sustained funding for state wildlife agency habitat responsibilities
- providing input on development and planning decisions
- incentives for conservation on private lands, and
- coordination between state and federal agencies

Because the WGA's recommendations stand as the most recent and comprehensive multi-discipline approach to identifying conservation challenges for wildlife corridors[7], they are especially relevant to this report and its conclusions. Management and knowledge shortcomings identified in the WGA report were readily observable by the authors of this report, for example, the lack of standards for demarcation of crucial habitat and corridors and absence of movement data for many individual species. Of the 14 states that responded to the WGA Wildlife Corridor Initiative's Science Committee with data, only 4 states – which included California and Wyoming[8], mentioned the existence of a statewide corridor map (Western Governors' Association, 2008). Even among these four, corridors are designated differently; in some instances they show precise location of a single species' movement with a line, but in other cases a map may provide a low resolution generalization of important multi-species movement corridors. California's Missing Linkages Project, an NGO led effort to identify critical corridor habitat, produced just such a generalized layer in 2000, illustrated in the graphic on the following page.

[7] The Wildlife Corridor Initiative's Science Committee, in its report, defines wildlife corridors to encompass connectivity over different time scales, thus including long-term plant and animal dispersals in addition to seasonal migrations.
[8] Wyoming maintains a GIS with fine detail data on large mammal movements and migration obstructions. Data that they share includes elk, deer, pronghorn, bear, bighorn sheep, and lynx corridors.

Comparison of Round Valley Mule Deer Routes to California Missing Linkages Project's Major Habitat Corridor Information



Sources:
Roads, Lakes and County Boundaires data from Mono County Community Devlepment Department
Mule Deer Range and Route from Shasta Ferranto
Major Habitat Corridors data from California Missing Linkages Project (2000)

Layout: A. Fotinos

The extent to which U.S. Fish and Wildlife Service (USFWS), U.S.D.A. Natural Resources Conservation Service (NRCS), and National Fish and Wildlife Foundation (NFWF) encourage corridor conservation by prioritizing projects or implementing new programs for that sole purpose could have wide reaching influence on how corridor projects are designed and to what extent state wildlife agencies are involved in implementation. USFWS, NRCS, and NFWF play a critical role as providers of funds and other resources for wildlife conservation. Some of their efforts are administered in coordination with or entirely through state wildlife agencies.

The U.S. Fish and Wildlife Service administers several relevant habitat programs. The Service's attention is limited, however, to dealing primarily with 'Federal Trust Species', which include "migratory birds; threatened and endangered species; inter-jurisdictional fish; certain marine mammals; and species of international concern" (U.S. Fish and Wildlife Service, Partners for Fish and Wildlife Program, n.d.).

As described earlier, the NRCS may support habitat conservation projects designed to benefit wildlife migrations through several Farm Bill programs. It is difficult to say to what extent migrations have been targeted as an important component of habitat value. As Environmental Defense Fund's analysis of the Farm Bill conservation programs[9] suggest, there is certainly room within the existing programs' criteria for considering migration routes as a worthy target.

Lastly, and especially worth of mention, NFWF recently launched several new initiatives aimed at migration and corridor conservation. The group, under its Wildlife and Habitat Conservation "Keystone Initiative," has a focal theme on "Wildlife Movement & Migration". Through this program, NFWF has identified conservation efforts in the Upper Green River Basin aimed primarily at the Grand Teton National Park pronghorn migration and efforts to conserve corridors in the Greater Yellowstone Ecosystem for the grizzly bear and other animals.

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[9] Environmental Defense Fund. (2009). Safe journeys: Opportunities for wildlife corridor conservation through the Farm Bill. Online at: http://www.edf.org/documents/9238_Safe_Journeys_report.pdf

The Case Studies: Ungulate Migration Conservation in Wyoming and California

Judging from the three cases, it is evident that Wyoming and California consider migration routes for large game species as worthy of action within existing agency habitat conservation programs and objectives. Interviews conducted with wildlife managers for each of the case study areas suggest that in California, conservation of deer habitat and migration routes is prioritized well below the state's efforts to address habitat loss for rare, threatened and endangered species. In Wyoming, greater agency attention and effort appears to be focused on game management, with more active state-federal and state-private partnerships to maintain and restore game habitat. A close examination of land management and conservation projects over the past decade in each area support these conclusions. In all three cases, the state wildlife agencies specify that habitat preservation, with easements and land acquisition, is a primary effort for the agency to maintain the viability of the migratory herds. Recent conservation easements and acquisitions to secure critical game habitat, the wildlife agencies' unsupportive reactions to particular development proposals in California and Wyoming, extensive research and mitigation efforts, and recognition of migrations within recent state strategic plans provide additional evidence that wildlife agencies consider game migrations worthy of state action.

Based on the three migration cases in this study, several of Wyoming Game and Fish Department and California Department of Fish and Game's management directives and activities are examined in this section. After a brief description of the agencies and their current activities, some factors facilitating and constraining conservation of the case study migrations are covered in detail.

I. Political and Programmatic Realities

The Wyoming Game and Fish Department (WGFD) and California Department of Fish and Game (CDFG) operate under Wyoming statute 23 and the California Fish and Game Code, respectively. Each agency's central directive is listed in Table 7.1.

Table 7.1, Wyoming and California statutory wildlife agency directives

Wyoming Game and Fish Department	
W.S.§ 23-1-103	"…all wildlife in Wyoming is the property of the state. It is the purpose of this act and the policy of the state to provide an adequate and flexible system for control, propagation, management, protection and regulation of all Wyoming wildlife"
California Department of Fish and Game	
California Fish and Game Code: 1801	"…encourage the preservation, conservation, and maintenance of wildlife resources under the jurisdiction and influence of the state" (a) To maintain sufficient populations of all species of wildlife and…habitat… (b) To provide for the beneficial use and enjoyment of wildlife by all citizens of the state. (c) To perpetuate all species of wildlife for their intrinsic and ecological values… (d) To provide for aesthetic, educational, and nonappropriative uses… (e) To maintain diversified recreational uses of wildlife… (f) To provide for economic contributions to the citizens of the state, through the recognition that wildlife is a renewable resource of the land… (g) To alleviate economic losses or public health or safety problems caused by wildlife… (h) It is not intended that this policy shall provide any power to regulate natural resources or commercial or other activities connected therewith, except as specifically provided by the Legislature.

A. **Limits to authority**

The statutory authorities and mandates, as interpreted by state biologists and resource managers, constrain state agency ability to manage and conserve long-migrating ungulate species. The agencies do not consider themselves as having much, if any, regulatory authority over most activities that have the potential to significantly impact migrating ungulates:

- Residential development
- Most outdoor recreation activities
- Roads and transportation
- Livestock grazing, logging, energy extraction or other commercial activities
- Fire regime

A recent interview with former California statewide deer management program coordinator, Ken Mayer, published in *California Deer* magazine, serves a good example of this perceived limitation in authority. When asked what he believes is causing California deer numbers to continue to decrease, Mayer answered that, "…Obviously, poor-quality habitat is number one, followed by the lack of interest by the USFS and BLM in deer habitat management" (Springer, 2008). He later explained, "…This is because of the decline of habitat carrying capacity, especially on the west slope of the Sierra Nevada. Unfortunately, CDFG has little control over that because the federal land management agencies hold all the cards" (Ibid.). Mayer identifies the limiting management factor for deer populations as the CDFG's inability to influence the U.S. Forest Service and U.S. Bureau of Land Management to manage forests with disturbances like selective timber extraction or managed fires to create successional habitat.

In Wyoming, the Department of Game and Fish makes its stance on its authority very clear, presumably in an effort to allay citizens' concern over state infringement on personal property rights. As an example, in a letter dated June 12, 2003 from Wyoming Game and Fish director, Brent Manning, to Sublette County Commissioners, Manning writes, "…Throughout Wyoming, the Department's position has always been that rural developments should avoid crucial winter ranges and important migration corridors. However, the Department has no authority to require such avoidance, nor do we have any control over the approval or denial of this development. For private lands, we must rely on the counties and their zoning restrictions to control development in these important habitats" (Manning, 2003). This position is reiterated in an October 16, 2003 follow-up letter from Wyoming Game and Fish deputy director, Bill Wichers, to the Sublette County Commissioners, where Wichers states, "…The Department can only recommend avoiding these habitats, as we have no authority in this regard. If the Commission chooses to rezone this area for subdivisions, we provided suggestions both in our June 26 letter and in other communications with our local personnel on how to minimize impacts to migrating wildlife" (Wichers, 2003).

B. **Environmental review**

The major difference in agency approaches to advising and influencing development activities has to do with California's adoption of legislation that includes environmental review of land use development and management decisions. The California Environmental Quality Act (CEQA) requires that for certain proposed development, a report of environmental impacts (EIR) must be filed with the state and reviewed by relevant local, state and federal agencies. A 'lead agency' is designated, which has primary responsibility for approving or carrying out a project (California Department of Fish and Game, California Environmental Quality Act, n.d.). An agency may also be labeled a 'responsible agency' if they have any legal responsibility for approval or completion of the project, such as the issuance of a permit. The CDFG functions as lead agency for its own projects in state wildlife areas or with restoration projects. It is considered a responsible agency when a streambed alteration agreement or endangered species incidental take permit are required. The CDFG is always considered a 'trustee agency', however.

It is because of this role that the agency receives notice about development activities that will impact wildlife and rare plants, and is able to review and comment on CEQA documents.

CDFG is thus directly involved in the environmental review process and can influence development decisions affecting the Round Valley mule deer based on its input. Significant adverse project impacts that are determined in the CEQA documentation in the Round Valley area include loss of critical deer habitat and increase in deer mortalities, among many other types of impacts (Rock Creek Ranch Specific Plan and Draft EIR). According to a Mono County wildlife manager, because Fish and Game decided mule deer were covered by CEQA they have been successful for many years in influencing local development decisions to minimize migration impacts (anonymous personal communication, April 8, 2009). Mono County was willing to require the mitigations Fish and Game sought, based on in depth site specific planning completed by project consultants (Ibid.). Examples of mitigation measures include reducing the number of lots, clustering lots, and limiting lot location to certain areas to provide an adequate corridor for wildlife movement. At present, with its years of experience dealing with similar wildlife impacts and potential mitigations, the County now generally looks to past mitigation measures to determine the new mitigation requirements rather than asking for new site specific plans (Ibid.).

Wyoming, on the other hand, has no such state legislation for comprehensively evaluating environmental impacts from development. WGFD's advisory effort is based on procedures they set up with each entity that reviews or makes decisions that enable development activities. County planners and wildlife managers interviewed for both of the Wyoming case studies indicated a high level of cooperation at present. Game and Fish had shared up-to-date GIS data on big game migration routes and critical habitat areas with the planners, which they then regularly used to identify potential wildlife impacts (Gillett, personal communication, January 14, 2009). In Pinedale, planner Bart Myers indicated that all zoning and development activities subject to county approval are shared with Game and Fish regardless of potential wildlife impacts (personal communication, May 22, 2008). In Park County, planners indicated less interaction with Game and Fish staff, but noted that they are invited to comment on proposals and to attend planning and zoning meetings. Accordingly, Game and Fish staff tended to attend meetings or submit comments on only the larger development proposals within sensitive habitat areas (Gillett, personal communication, January 14, 2009). These two cases, while showcasing working cooperative relationships, also indicate the potential for a great deal of variability in the level and effectiveness of communication between WGFD and planning authorities.

Another important consideration concerning environmental review is CDFG's ability to collect a filing fee for all projects it reviews that are subject to CEQA and that have an impact on fish and wildlife (CDFG, California Environmental Quality Act, n.d.). Because the filing fees are substantial, several thousand dollars – with a fee schedule dependent on the agency's findings, CDFG is able to defray some of the cost it puts into reviewing documents, coming up with mitigation measures, creating monitoring plans, and conferring with other public agencies.

Table 7.2, Comparison of WGFD and CDFG Roles in Development Impact Review

	Wyoming	**California**
Notification	No legal requirement for notifying WGFD of development projects, excepting some federal actions. Coordination with the decision maker is dependent upon processes WGFD sets up with each entity. Impact review is completed as the discretion of WGFD.	Laws require that CDFG be notified of all development projects
Advising	WGFD advises lead decision maker of adverse impacts and suggests mitigation measures	CDFG advises lead decision maker of adverse impacts and suggests mitigation measures
Endangered Species Authority	Federal endangered species laws apply, administered by USFWS.	Federal endangered species laws apply, administered by USFWS. California state laws for endangered plants and animals apply, administered by CDFG. If there is the potential that an endangered species will be killed, a permit is required from CDFG for 'take' that is "incidental to otherwise lawful development projects," and impacts must be fully mitigated (CDFG, California Endangered Species Act).
Cost recovery	No cost recovery for review effort	Costs defrayed by filing fees payable to CDFG

C. Game management

The Absaroka Divide in Wyoming and Round Valley in California are both prized hunting destinations. The elk and mule deer herds that reside there are managed to take full advantage of recreational opportunities while also sustaining each herd's size.

This study's evaluation of threats in each of three case studies did not identify current hunting practices as a primary concern, with one exception being the difficulty with hunter access to resident elk herds on private lands in Wyoming. Consequently, game management practices are not covered in detail here. The following description is meant to give a basic idea of current practice.

Wyoming

- Annual management reporting: Job Completion Reports with management recommendations based on population counting and other annual data
- Notable effort at monitoring vegetation conditions
- Population modeling and ongoing effort to keep models accurate
- Adaptive approach to setting hunting regulations based on population size, forage, hunter success and other factors

California

- Management, beginning in the 1980s, was guided by deer management plans, but these are used to guide management much less now than in the past
- Deer Assessment Units are generally used to determine management direction rather than population goals for individual herds; each Deer Assessment Unit covers a large geographic area, including multiple zones that may contain several herds
- Annual population surveys determine management direction

D. **Habitat conservation**

California

The embracing of ecosystem management principles in response to new management responsibilities and the loss of large areas of habitat has transformed the California and Wyoming wildlife agencies in recent years. In its 1998 strategic plan, the California Fish and Game Commission described the commitment to this change: "The Commission recognizes the unique interdependencies between individual fish and wildlife resources, their habitats and man. This has led to a shift toward policies aimed at managing resources on an ecosystem basis rather than on a species by species basis." In another 1998 report, this one addressed to the California Fish and Game Commissioners, an interagency group of wildlife and habitat biologists described their effort to assess the current state of deer populations and habitat as a "step back in time" (An Assessment of Mule and Black-tailed Deer Habitats and Populations in California, 1998). Agency efforts, even at that time, were self-described as biodiversity and ecosystem management focused. Among the changes to fully embrace ecosystem management principles in practice, CDFG has largely abandoned its deer management plans. A legislated responsibility from the 1980s, the plans were an institutionalization of single species management that is not very relevant to current agency priorities or direction. Wildlife biologists and resource managers interviewed about the Round Valley deer herd all indicated that the deer management plans for the area were no longer referenced in practice.

Two substantial assessment efforts of California's Sierra Nevada ecosystems and human systems have taken place in the past fourteen years. The first, the Sierra Nevada Ecosystem Project, concluded in 1996 having produced a three volume report to Congress. The second, California's Wildlife Action Plan (WAP), was completed in 2007. In the WAP, the Sierra Nevada and Cascades are grouped into a region, and conservation actions required to manage rare species and ecological communities in this area are emphasized. Management for hunting and habitat management for mule deer in the Sierra Nevada are noticeably absent from these two assessments. However, the Wildlife Action Plan does call out migrations as especially in need of conservation action in the Sierra Nevada. The plan states, "In areas where substantial development is projected, the state and federal land management and wildlife agencies should identify and protect from development those critical wildlife migration or dispersal corridors that cross ownership boundaries and county jurisdictions" (p.327). The Wildlife Action Plan also calls for "long-term monitoring of priority wildlife migration and dispersal corridors" (p.497).

Planning habitat conservation is just the beginning, leading us to ask, just where does support for mule deer projects in the Sierra Nevada come from? For conservation of critical deer migration routes in the Round Valley, the California Wildlife Habitat Board is an important sponsor. The Wildlife Habitat Boards supports a wide range of projects across the state each year. A local wildlife manager explained how the Board is one of few sources of funds tapped for critical deer habitat conservation in the Round Valley in recent years (Anonymous, personal communication, April 8, 2009). But, it is important to note that projects that either do not or only tangentially benefit endangered species are less of a priority for the Board. For projects aimed primarily at deer it generally takes longer to secure funding (Ibid.).

Wyoming

Wyoming's approach to move beyond single species management is based upon habitat planning. The Game and Fish Department created a Strategic Habitat Plan (SHP) in 2001 to provide guidance for a "landscape level" approach to conserving habitat on public and private lands (Wyoming Game and Fish Department, 2001). To fulfill the plan, regions each created a set of spatial habitat priorities, from 1 to 10, based on community types in "greatest need of attention/restoration" (Ibid.). Spatial extent for each priority area was based on watershed boundaries. Prioritization descriptions were based on a description of limiting factors to wildlife species present. The impact of an invasive plant would be described in terms of its impact on habitat requirements for a specific species, for example. This approach, in effect, combined into one score a measure of habitat importance with a second concern, level of habitat degradation.

A major revision of the Strategic Habitat Plan was completed in January, 2009, which takes a markedly different approach to prioritization of areas. The new approach, as shown in table 7.3, makes two spatial designations instead of just one. The first is a measure of how critical the habitat is for maintaining the current level of wildlife populations in Wyoming, deemed "Crucial Habitat Area". The second is a designation of restoration need, called a "Habitat Enhancement Area". These areas are illustrated in Figure 7.1. The project ranking procedure is better defined under the new plan, with projects assigned value for inclusion in either Crucial Habitat or Habitat Enhancement areas, and the most value for meeting both criteria. The plan does leave the door open for projects to occur anywhere and for any reason, and even the spatially defined areas allow a great deal of flexibility because they encompass huge swaths of the state.

The 2009 revised Strategic Habitat Plan incorporates migrations and corridors explicitly. The new emphasis is quite clear when compared to language form the preceding plan, see Table 7.3. At the least, the emphasis on migrations is an acknowledgement of the threat to wildlife from habitat fragmentation. If the Game and Fish Department follows through with implementation of a new 'action plan' for corridor protection, as described in the new plan, the agency may differentiate its approach to corridor protection from its other habitat conservation efforts. Many of the relevant actions emphasized in the 2001 plan have remained the same. There continues to be an emphasis on creating and sharing GIS data, prioritizing rights acquisitions and working with partners to address connectivity.

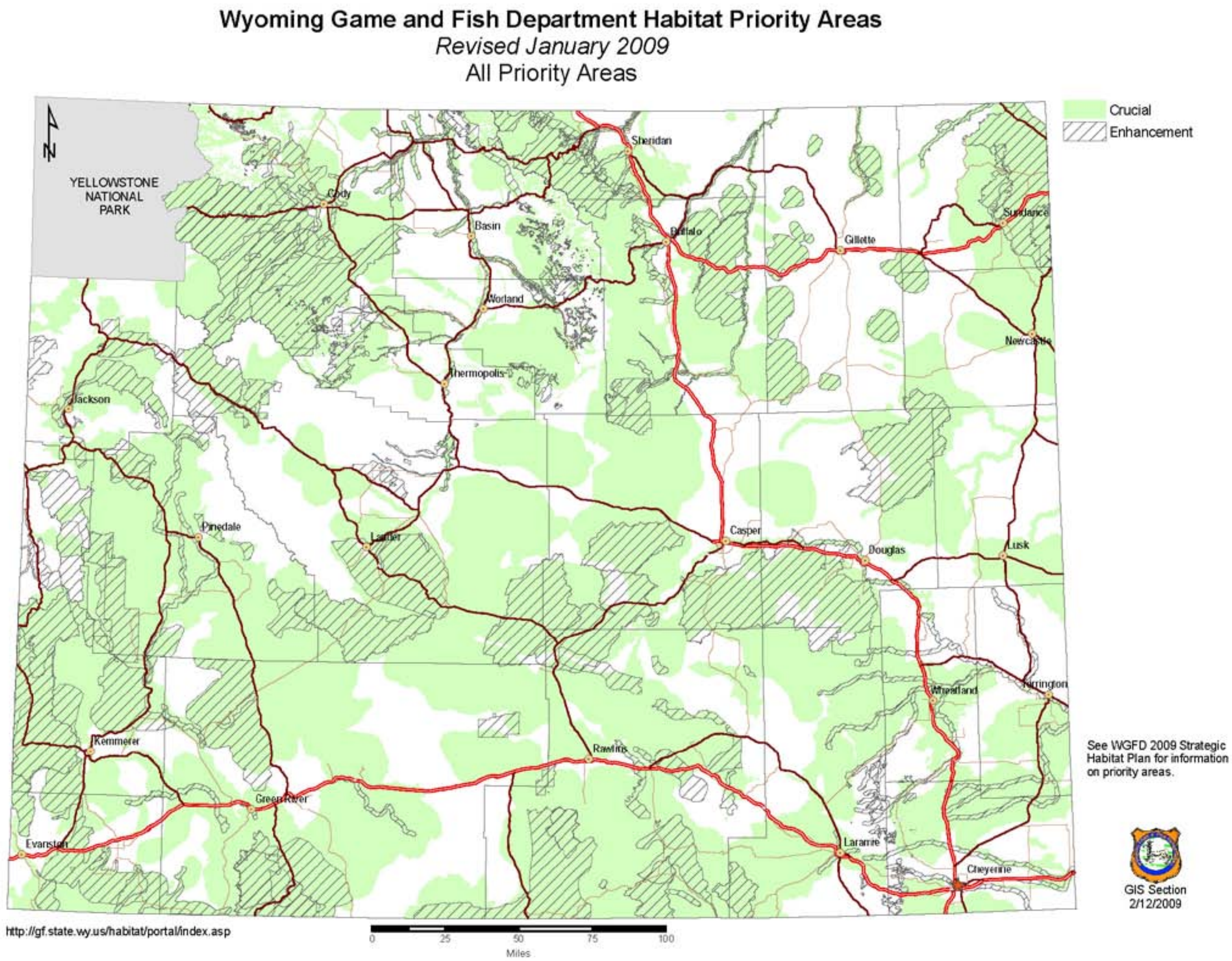
As its strategic plans explain, Wyoming Game and Fish Department's property rights acquisition program plays an important role in this new habitat based conservation approach, as does increased habitat biologist staffing, use of technology for habitat assessment and coordination with partners, strategic partnerships for acquisition and restoration, public involvement, and development of standard enhancement strategies for each ecosystem.

Table 7.3, Comparison of Wyoming's 2001 and 2009 Strategic Habitat Plans*

2009 Strategic Habitat Plan	2001 Strategic Habitat Plan
Goals	
1. Conserve and manage wildlife habitats that are crucial for maintaining terrestrial and aquatic wildlife populations for the present and future.	1. Manage, preserve and restore habitat for long term sustainable management of wildlife populations.
2. Enhance, improve and manage priority wildlife habitats that have been degraded.	2. Increase wildlife based recreation through habitat enhancements that increase productivity of wildlife.
3. Increase wildlife-based recreation through habitat enhancements that maintain or increase productivity of wildlife.	3. Increase or maintain wildlife habitat and associated recreation on Commission lands.
4. Increase public awareness of wildlife habitat issues and the critical connection between healthy habitat and abundant wildlife populations.	
5. Promote collaborative habitat management efforts with the general public, conservation partners, private landowners and land management agencies.	
Specific focus on Migrations / Connectivity	
Goal 1, Objective A: Maintain existing habitat values within crucial habitat areas. Strategy IV: Protect and maintain big game migration routes and other important wildlife movement corridors. **Action a)** Maintain the wildlife migration corridor and barrier GIS layer and distribute to all partners. **Action b)** Identify important wildlife movement corridors that are threatened. **Action c)** Develop strategies and funding sources and prioritize and implement easements or management actions to maintain important wildlife movements. **Action d)** Remain involved in and support the Western Governor's Association (WGA) Wildlife Corridors Initiative…	Goal 1, Objective 3: Identify wildlife habitats where habitat quality should be preserved and work with Lands Administration (Lands) to implement. Strategy ii: Provide recommendations to modify the current system of rating property right options; specifically work to include GIS data criteria for connectivity, species assemblage, species-in-jeopardy, community type and area (size)… **(a)** Provide or share data layers with partners. **(b)** Evaluate proposed property right acquisitions …using modifications of these new habitat based criteria. **(c)** Provide information to partners for their property rights priorities…
Goal 2, Objective B: Implement projects to address and reduce habitat issues and enhance wildlife habitat. Strategy IV: Maintain or enhance populations of big game, neo-tropical birds, fish and other wildlife by increasing natural movement opportunities. **Action a)** Prioritize big game migration corridors regionally and statewide, develop an action plan, make that action plan compatible with the WGA Wildlife Corridors Initiative, and identify and secure funding to prevent, remove or modify migration barriers. **Action b)** Use proven programs such as Farm Bill CCRP, EQUIP, WHIP, and CRP among others for sustainable grazing management to enhance riparian corridors that provide habitat connectivity. **Action c)** Use easements and land use agreements that maintain or improve habitat connectivity and prevent fragmentation.	Goal 1, Objective 3: " Strategy iii: Seek partners such as TNC, State Land Office, BLM, FS, RMEF, Wildlife Heritage Foundation, etc. to establish conservation easements, create grass banks or change uses of water rights to maintain the condition, quality and connectivity of high priority habitats.

**Text from Wyoming Game and Fish Department's 2001 and 2009 Strategic Habitat Plans*

Figure 7.1, Habitat Priority Areas in WGFD 2009 Strategic Habitat Plan



E. **Mitigation activities**

In Wyoming and California, landscape scale mitigation efforts are taking place, preserving and restoring habitat to make up for widespread impacts on ecological communities and endangered species.

The Wyoming Game and Fish Department holds a seat with three other representatives of state and federal agencies in an interagency office for mitigation and reclamation due to gas development on the Jonah Field in Sublette County, Wyoming (the JIO). In this position, WGFD helps make decisions about where mitigation projects occur, and how they are accomplished. Because the Jonah Record of Decision sets mitigation of gas field disturbances at a 3 to 1 ratio of disturbance to mitigated area, a huge amount of off-site mitigation must be included to meet the requirement. Because of this, the JIO operates within a large 'mitigation area', with two areas prioritized within the larger boundary. One of these prioritized 'focal areas' contains critical winter range for the Grand Teton National Park pronghorn. The required mitigation has funneled a large amount of cash at fence removal activities to benefit migrating pronghorn, among many other types of projects. The fence project, because of its direct relevance to migration threats, is discussed in greater detail in chapter 6.

Years ago, the Wyoming Game and Fish Commission (WGFC) created a mitigation policy for the Game and Fish Department. "The mitigation policy was established by the WGFC in recognition that growth, development, and land use changes will continue to occur in Wyoming, and when adverse impacts to wildlife or their habitat is unavoidable, it directs the WGFD to develop and promote further mitigation that best protects wildlife" (Wyoming Game and Fish Department, 2009, pg.10). It is worthy of mention here that in 2007, at the September 6-7 Game and Fish Commission Meeting, the Commissioners added 'migration corridors' as a specific habitat to the mitigation policy in recognition of their importance and differentiation from other habitat.

California's Natural Community Conservation Planning (NCCP), is an ambitious state effort to comply with the California and federal Endangered Species Acts beyond site specific mitigations, instead targeting landscape scale areas. NCCP is worthy of mention here because of its scale and potential for application to corridor conservation. With its focus around a covered species' recovery, NCCP could potentially protect areas critical for a suite of other species associated with the covered species' habitat.

F. Partnerships

Wildlife agency partnerships are strong in the Round Valley, Pinedale area and Absaroka Divide. In each of the three cases, there is a high level of engagement and coordination on big game migration issues. The initiation of many of these coordination efforts in the past decade seems to indicate that a major change has taken place. Either California Fish and Game or Wyoming Game and Fish Department provide guidance on location of migration corridors, management actions, or mitigation measures for the three critical habitat areas in this study through the following means[10]:

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[10] State wildlife agency engagement with other public and private entities concerning migrations is not limited to these examples.

Wyoming

- Wyoming Land Conservation Initiative; regional inter-agency coordination of conservation goals and objectives for southwest Wyoming
- National Forest planning and BLM Resource Management planning
- WGFD communication and standard advisory process with Sublette, Teton and Park County planners
- WGFD cooperative relationship with Wyoming Department of Transportation to deal with wildlife road mortality and road crossings
- WGFD partnership with many sportsmen's and not-for-profit groups that help support research, conservation planning and habitat acquisition

California

- Mono County Collaborative Planning Team; inter-agency planning coordination
- National Forest planning and BLM Resource Management planning
- CDFG engagement in the CEQA Environmental Impact Review process
- CDFG partnership with several sportsmen's and not-for-profit groups that help support research and habitat acquisition

II. Management Practice

Wildlife and land managers in each of the three case study locations were asked to describe any on-the-ground actions and strategies of benefit to the ungulate herd of interest. This information, supplemented with details from agency reports and descriptions of completed projects, was used to create a rough 'data set' of management actions over the past nine years. This information, summarized according to threat and case study, is included in table 7.4.

Wyoming Game and Fish Department and California Department of Fish and Game are involved in similar management actions to address threats to the ungulate populations under their jurisdictions. Population surveys, counting and classifying animals, is a major ongoing effort for managers in all three cases. The two Wyoming Game and Fish regions expend a great deal of resources to collect pronghorn and elk data, using surveys by helicopter and plane to collect enough information for the population models they depend on for decision making. CDFG activities for the mule deer are focused on habitat protection and environmental impact review, and historically have included significant research efforts on movement, predation, and habitat. The agency's outreach to the public and partnership with groups including the Eastern Sierra Land Trust is considered important to achieving its habitat conservation goals.

Restoration projects in all three cases are quite limited in scale as compared to the size of critical ranges and length of migration routes. In California the major restoration effort is toward bitterbrush replanting on the winter range and noxious weed eradication. In Wyoming, the efforts include prescribed fire, herbicide, and mechanical treatment of sagebrush, noxious weed eradication, fence removal, prescribed fire in aspen communities, and removing conifers that encroach into sagebrush communities. Comparatively, there is much more restoration activity taking place for the elk and pronghorn in Wyoming than for the mule deer in California. Managers indicate that this is due to the levels of success they have achieved with past efforts and the fact that agencies seek to invest in projects they know will succeed.

The two Wyoming cases suggest that outreach to the public and engagement with partners in the context of pronghorn and elk migrations receive considerable attention by WGFD biologists and managers. Working with partners, the agency is able to tap into external fundraising efforts to achieve common goals.

III. **Select Management Actions**

To give the reader an idea of some of the actions managers have tended to focus on, several particular actions are described below. Because of the wide range in types of actions and the sheer number of these in the past 9 years (the timeframe the authors set for inquiry), these descriptions only serve to provide a glimpse at management activity.

A. **Mapping routes**

In Wyoming, the Game and Fish Department maintains a centralized GIS including migration route data for large mammals and obstructions to known routes throughout the state. The data is shared with other agencies and planners, where it is used to help inform decision-making. In the Round Valley, California vicinity, migration data is maintained and shared by the Bishop Field Office, but is similarly used to inform development decisions and growth planning.

For all three of the case study migrations, the connection between the state wildlife agency and state universities is active. Much of the movement data seems to come from students' theses or studies required to assess environmental impacts of certain activities. In Wyoming, the university cooperative extension has produced several recent mapping related projects, one using GAP analysis to identify the least secure routes in the state. Ongoing GPS work to track movements of Clarks Fork and Cody elk also involves the university as a partner.

Table 7.4, Management Actions by Agency and by 'Threat to Migrating Ungulate Herd', 2000-2008

	Identifying Threats						Developing Responses				Implementing Strategies							Monitoring Effectiveness			
	Population Counting	Locate Migration Corridors/Movements	Monitor Range Condition	Instigate Movement/Habitat/Predation Research	Monitor Population Health & Diseases	Raising Awareness	Set Hunting Regulations	Habitat Management Planning	Regular Cross Agency Coordination for Critical Wildlife Migration Areas	Critical Habitat Acquisition Planning	Habitat Improvement	Acquire Habitat or 'Rights' for Wildlife	Engagement in FS and BLM Planning Processes	Enforce Hunting Regulations	Outreach to Public and Partners	Support Habitat Improvements on Private Land	Comment on Local Development Proposals	Population Counting	Monitor Population Health & Diseases	Post-action Vegetation Monitoring	Measure Effectiveness of Outreach
State Wildlife Agency																					
WGFD Cody (elk)																					
WGFD Pinedale (pronghorn)																					
CDFG (mule deer)													11			11					

*Darker colors indicate higher frequency of activity

[11] The CDFG is involved in Inyo National Forest and Bureau of Land Management planning processes and support of habitat improvements on private land, but the authors are uncertain of the frequency and extent of this activity.

B. **Game management**

WGFD expends a great deal of effort managing game for their recreation value. Some examples of management actions in the two Wyoming cases include changing hunting regulations, updating population models, and increasing forage for game. Around 2003, after observing declining bull:cow ratios in the Cody elk herd, WGFD modified hunting regulations for two of its hunt areas. Antlerless elk permits for the area were reduced considerably and limited quota any elk licenses were reduced to a lesser extent. Around that same time, WGFD revised the Clarks Fork and Cody elk population models based on new productivity and survival data for elk on the Northern Range of Yellowstone National Park.

As a final example, WGFD has, for years, fertilized irrigated meadows at its Sunlight Wildlife Habitat Management Area to improve foraging conditions for wintering Clark's Fork elk. Funding for this effort has been provided by hunting user groups in the past.

C. **Outreach and work with partners**

Wyoming Game and Fish has resolved to work directly with landowners in the Pinedale area to remove fencing barriers to ungulate movement since 2000, if not earlier. Contacting individual landowners about fence modifications, gates and other conservation options was identified as an action item at a migration corridor meeting held just outside of Pinedale on September 8, 2000. In 2004, Game and Fish stepped in to work with homeowners on the Bridger-Teton National Forest (BTNF) boundary and adjacent to the Grand Teton National Park pronghorn herd migration route. When BTNF's notice of intent for conifer burning didn't go over well with the local homeowners Game and Fish worked with owners to encourage other disturbance mitigating options.

California Fish and Game worked with local schools to provide classroom instruction and in the field learning on wildlife conservation, including spatial analysis of GPS collar data, animal capture, and habitat assessment for the Round Valley mule deer (Stephenson, 2007).

Wyoming Game and Fish Department was represented within the Trappers Point Working Group in 2003. They engaged with the Wildlife Conservation Society, Green River Valley Land Trust, Wyoming Department of Transportation (WYDOT) and others to generate consensus based recommendations for the Bureau of Land Management's Resource Management Plan and develop a protection plan for the Trapper's Point area.

Related to the trappers point effort, WGFD informally came to an agreement with WYDOT that gives them the ability to open gates of right-of-way fencing during migrations. The two agencies have also worked together on joint research into overpasses. Other efforts, like roadkill data collection and the testing of a wildlife warning system, are led by WYDOT, but the data is freely shared with WGFD.

In the Cody region, WGFD has worked with the Rocky Mountain Elk Foundation (RMEF) to create a conservation plan for Clarks Fork and Cody elk. The two groups have worked together in a joint effort to acquire easements or otherwise conserve habitat along the boundary of Shoshone National Forest.

D. **Environmental review**

As described earlier, CDFG takes an active role in the environmental impact reporting process in the Round Valley area.

What is Facilitating Wildlife Agency Effectiveness dealing with the Threats?

In addition to examples of particular actions, wildlife and land managers in each of the three case study locations were asked what has facilitated or constrained their actions or ability to deal with the threats to the migratory herd in their area. Responses from all respondents were fairly similar, but did not provide much depth into underlying reasons. As a result, conclusions based on several themes from the interviews are presented below.

- Dedicated individuals and strong project leaders
- Interagency communication
- Partnerships with groups well positioned to help agencies meet common goals
- Management plans with specific goals and objectives for migrations

Dedicated individuals and strong project leaders: Dedicated individuals and strong project leaders are instrumental in agency coordination in each of the three cases. The success of outreach and partnership efforts has a lot to do with the leadership abilities of the staff. Biologists and managers interviewed showed a high level of initiative and entrepreneurship in their approach to dealing with management challenges. These leaders have a big outreach role, explaining the importance and success of agency actions, involving the community in choosing what gets done, and being a constant advocate for conservation actions.

Interagency communication: Wildlife and resource managers in the three case study areas are engaged in a high level of inter-agency communication. The local-level managers in each of the three case study areas tend to maintain close professional relationships with their counterparts at other public agencies, an outcome encouraged by the small number of managers and long lengths of service in the same regions.

Partnerships with groups well positioned to help agencies meet common goals: Partner groups can be well positioned to help agencies meet common goals by taking actions agencies are not able to do. NGOs have had some success at funneling private dollars toward habitat protection in the three case study areas. Partner agencies may also be effective at organizing people to ask for certain outcomes that then gives agencies a legitimate reason for doing them, for example, spending money on restoration.

Management plans with specific goals and objectives for migrations: Management plans with goals that include specific objectives for migrations provide agencies with justification for actions that are beyond the scope of past practice. They are also useful to help public agencies align goals, especially when these are dependent upon mutual actions. Management plans that incorporate migration objectives may also communicate to the public what the agency considers worthy of conservation. The researchers noticed a marked difference in the state field biologists' reliance on and commitment to agency planning in California and Wyoming. In Wyoming, planning guidance and action items seem less exclusive of game species than in California, and agency priorities are more clearly defined and available to the public.

What is Constraining Wildlife Agency Effectiveness dealing with the Threats?

Factors that constrained wildlife managers' actions or ability to deal with the threats to the migratory herd in their area are summed up as follows:

- Different goals across public agencies
- Capacity of staff to be involved in planning processes and advising
- Incremental decision-making in environmental review

Different directives and goals across public agencies: Because wildlife agencies do not have the ability to force federal land managers to align wildlife goals with the state's wishes, there are cases where the differences are highly incompatible between organizations. The wildlife agencies may provide a great deal of input into federal land use planning, as was the case with WGFD's "Recommendations for Development of Oil and Gas Resources within Crucial and Important Wildlife Habitats". In this case, WGFD was responding to rapid expansion of gas leasing in Wyoming and its negative habitat effects. Wyoming Game and Fish developed the document with management recommendations in December, 2004, to communicate a basis for "integrating wildlife protection and mitigation criteria into the Bureau of Land Management's (BLM's) resource management planning and implementation processes" (Wyoming Game and Fish Department, 2004). For state wildlife agencies, giving this type of best practice advice is not a solution to the problem.

***Capacity of staff to be involved in planning processes and advising*:** Having wildlife and habitat biologists in the field is crucial to maintaining habitat integrity in the face of the multitude of human impacts. Wyoming's 2001 Strategic Habitat Plan acknowledged this need as well, and called for hiring several habitat biologists in order to build the capacity of the agency to monitor conditions and advise land managers and users. Habitat production and utilization surveys, in addition to population monitoring, may be used to drive management actions on federal lands, but this requires significant state resources to collect the data and then coordinate actions. In the case of private development advising, it is the same capacity issue; enough staff is needed to comment on projects.

Incremental decision-making in environmental impact review: As described in California's Wildlife Action Plan, "The local project-by-project approval of new development, without measures to address cumulative effects of projects over time and across the region, leads to the slow dismantling and fragmentation of important wildlife habitats, migratory corridors, and ecosystems" (Bunn, 2007, p.72). This problem is highly evident in the case studies in both the Round Valley and Pinedale areas. In both cases, as development impacts from growing towns has spread into important routes for deer or pronghorn, mitigation measures have considered to what extent migrating herds could be forced to take a new path around the new development. As the area for wildlife to move through shrinks, environmental impacts become more difficult, and then impossible to mitigate.

Chapter 8
Non-governmental Organization Conservation Strategies

Introduction

In previous chapters we examined threats faced by each population of migrating ungulate and the roles of governmental entities. In this way, we review practices and strategies through the lens of legal accountability and on-the-ground practice. In this chapter, we explore the strategies employed by non-governmental organizations (NGOs), in reference to the three case studies.

NGOs are a diverse group of players in the context of natural resource conservation. They perform with great agility relative to their governmental counterparts because they can move through projects relatively quickly, with flexibility to alter projects, and a willingness to take on a new venture (Endicott, 1993, p. 5). Additionally, many NGOs have the capacity to influence policy-makers and bring constructive ideas to management agencies. From the vantage point of conserving long distance ungulate migrations, what sets the conservation priorities are found in the NGO positions or missions, and available resources. In each case study, we see dynamic relationships between public and private entities and opportunities for NGOs to initiate conservation strategies.

NGOs working on conservation issues are typically nonprofit organizations (Breckenridge, 1999, p. 694) rather than for-profit groups or corporations. Thus, this chapter will almost exclusively discuss nonprofit interests and programs. Nonprofits are structured as either nonprofit corporations or charitable trusts and are prohibited from distributing residual earning to individuals retained by the firm such as board members or staff (Hansmann, 1987, p. 28). Conservation-focused nonprofits working on a particular issue may operate by different guiding principles and maintain different functions or roles regarding the conservation issue. As stated by Lee P. Breckenridge (1999), "In the environmental arena, nonprofit organizations have traditionally served three key functions." These functions are broken into categories by the basic interests, actions, and implemented strategies of the organization. They can be seen broadly as *policy*, *stewardship* and *research* functions (Breckenridge, 1999, p. 694). In addition to these key functions, *financing* of conservation projects is a role of some NGOs. This activity might be expressed by supplying funds or capital to enable other groups (both governmental and non-governmental) to execute projects. This function will be discussed in relation to the other key functions.

Different functions by individual nonprofits generate unique opportunities, partnerships, and conservation goals and strategies. This chapter will illustrate how functions and partnerships by NGOs have driven strategies and relative conservation success stories. Through the context of the three case studies we examine *where* NGOs focus conservation efforts (public or private lands); *why* nonprofits decide to work on wildlife migration or land connectivity issues; *how* they are able to implement conservation strategies; and *what* elements either facilitate or constrain the implementation and possible success of conservation strategies.

NGO Involvement

Of the three case studies, the pronghorn migration from the Red Desert region of Sublette County to Grand Teton National Park (see map 3.1) has had the most attention by NGOs with the most diverse interests and relative conservation and public outreach strategies (see figure 9.1). Over the last decade many local, regional, and national NGOs have invested time and resources to the preservation of the pronghorn migration, commonly referred to as Path of the Pronghorn. These elements make Path of the Pronghorn compelling and an excellent case to analyze how nonprofits have created momentum around an issue and gained public support. Their conservation strategies have ranged from education-based projects, to policy-focused campaigns, and private land conservation. Path of the Pronghorn has historical and cultural importance, ecological significance [as the longest overland migration in the continental United States], and further value by taking place in the picturesque and ecologically diverse Greater Yellowstone Ecosystem (Taylor, 2006, pp. 178-179). Additionally, much of the migration and the entire winter habitat for the pronghorn is in Sublette County, an area which has experienced a surge in natural gas exploration since the mid/late 1990's (Jacquet, 2006).

Unlike Path of the Pronghorn efforts, the other two migrations we have examined, Round Valley mule deer and the Clark Fork and Cody elk, have not received the same level of interest from the non-governmental sector. Yet, conservation of each particular long-distance migration has benefited from NGO involvement that is occurring. By examining the different strategies employed by NGOs, we can more broadly see where NGOs fit into the puzzle of conserving long-distance ungulate migrations.

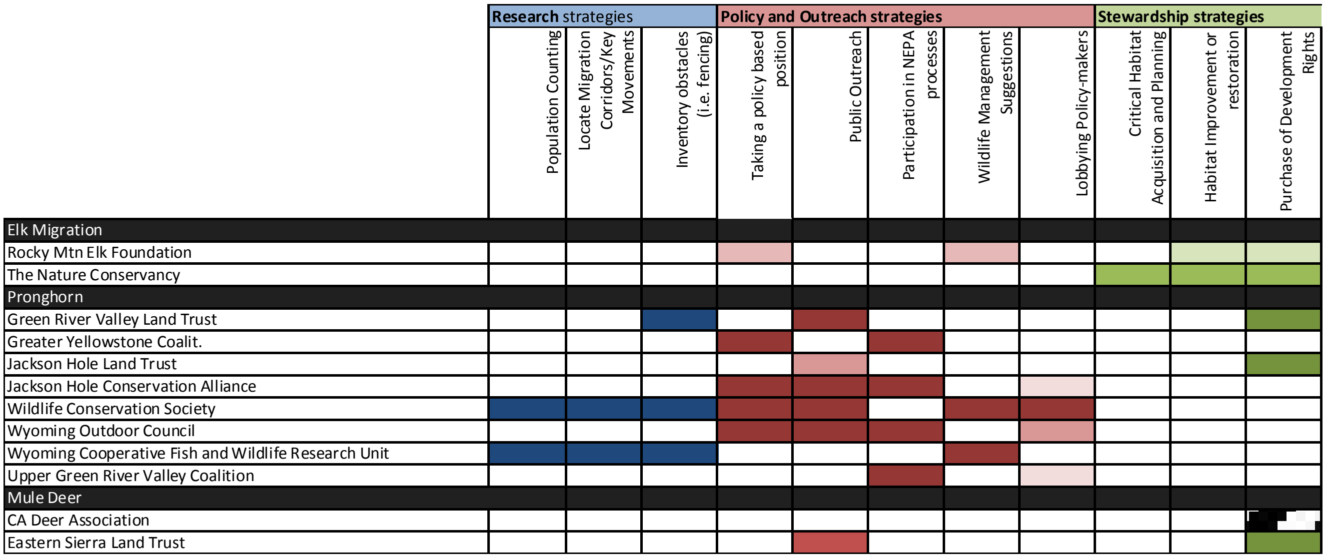

Figure 8.1, This is a subjective allocation of involvement by researcher based on interviews and information on websites. Dark color indicates more involvement while lighter colors indicate less involvement. The diagonal stripes indicate involvement only through the use of financing.

<u>Research Strategies</u>

I. Function and Motivation

When the main priority for an NGO is to execute scientific research or study a particular issue they are performing a research function (Breckinridge, 1999, p. 694). In this way, research can be seen as an implicit strategy used to define or substantiate a particular conservation issue. Often universities or other academic institutions take on this function; however, increasingly NGOs like the Nature Conservancy have been involved in conducting studies and circulating information (Ibid.). The research itself provides invaluable information by presenting empirical evidence to support conservation agendas. Research identifies a potential conservation issue or establishes credibility about a particular conservation issue. In this way, research information helps guide management decisions, program planning, and policy-making decisions (Endicott, 1993, p. 92). Of the three broad categories of functions and inherent strategies identified earlier (policy, stewardship, and research), research might be considered the most important because it often is the first step to frame the problem. However, researching and conducting scientific inquiry is often the most time and resource intensive, requiring the development of theory, creation of methods, collection of data, and synthesis of information (Haila et al., 1996, pp. 323-324).

Research as a strategy for wildlife migration conservation is typically expressed through studies or guidance documents based around a particular ecological question. This can be beneficial to decision makers and managers so that they can more effectively protect valuable ecological conditions and habitat. Increasingly, research initiatives are taking on a more holistic form—meaning, ecological analysis combined with geospatial analysis, and policy initiatives and management recommendations. An integrated approach can lead to conservation plans that address a greater landscape, and connectivity issues related to migration conservation. Groves et al. (2002) discusses a framework which can be used to address conservation planning for regions that need to be protected for the ecological values they possess and the threats to the ecological integrity of specific regions. In the context of NGO conservation strategies, conservation plans allow NGOs to exercise a level of influence over wildlife and land managers through a comprehensive planning document.

In regards to single species protection, Path of the Pronghorn illustrates how research can answer a question and frame a problem regarding a single species migration. While many residents in Western Wyoming knew of the biannual movements of the pronghorn through the Upper Green River Basin since the late 1890's (Taylor, 2006, p. 178), little was empirically known in regards to actual distance or the exact route traveled. Scientists did not engage in substantive research into the status of the migration until the late 1990's. The initial study, by the Wyoming Cooperative Fish and Wildlife Research Unit (WCFWRU) at the University of Wyoming was released in September 2000, and entitled "Jackson Hole Pronghorn Study." The study proposal and idea were developed by individuals at the National Elk Refuge, Teton Science School, and WCFWRU (Sawyer et al., 2000, p. 1). The overview of the study states the following: "Extensive natural gas development in southwestern Wyoming, proposed gas exploration in the Bridger Teton National Forest (BTNF), and subdivision development on private lands may threaten winter ranges and migratory routes in the Green River Basin. The objective of this study was to provide the information necessary to develop a conservation strategy for pronghorn that summer in GTNP and GVRD [Gros Ventre River Drainage]" (Ibid.). This statement of purpose relates the need for the study and could be seen as the impetus for the proceeding conservation efforts by mostly local and regional nonprofits working on the ground and in the community.

II. **Lesson Learned: Facilitating Research**

In order for an organization to exercise research strategies, the NGO needs to have the resources to conduct research projects. Resources include technical equipment or other devices to empirically measure data, and employees with skills to execute research and analyze results. The need for research can facilitate the formation of partnerships between dissimilar NGOs. For example, if a nonprofit with a policy or stewardship function needs information about a particular ecological concern, then the non-profit may contract another NGO to do this work. Research can assist a policy and stewardship-based group to formulate conservation strategies based on the identified threat; thus more accurately formulating solution-based strategies by framing conservation issue, implanting public outreach or education campaigns, or persuading policy-makers. Often partnerships (whether direct or indirect) are a means to align groups with similar interests and increase the efficiency which the needs of the partnering bodies can be met and conservation goals achieved. In Wyoming there is considerable collaboration between state agencies and private groups.

The major research project directed towards the Clarks Fork and Cody Elk Migration comes from the Absaroka Elk Ecology Project headed by the Wyoming Game and Fish Department. This project has support from NGOs like the Sportsmen for Fish & Wildlife, Bowhunters of Wyoming, Cody Country Outfitter & Guides Association, the Pope & Young Club, and the Boone & Crockett Club (WGFD, 2007). Some of the objectives of the study are to determine the proportion of migratory to resident elk in the Clark's Fork Elk Unit (Ibid.). Some of their findings show that, "In the last 20 years a dramatic eastward shift in elk distribution has occurred, with more elk frequenting low elevation areas along the Absaroka Front. Most of these areas are on private land" (Ibid). Information like this can influence groups like RMEF to construct and implement conservation strategies around available information. In this specific case, RMEF does focus much of their conservation efforts on private lands by using strategies such as conservation easements to conserve private lands (Rocky Mountain Elk Foundation, n.d.).

Research can require considerable financial capital. While funding can pose an obstacle to implementing research projects, it could also create an opportunity for partnerships with other entities such as corporate partners. In the case of the "Jackson Hole Pronghorn Study" the majority of funding for the study came from Ultra Petroleum (Sawyer et al., 2000, p. 1.), an oil and gas company operating in Sublette County, Wyoming.[1] In this study, the scientists used radio collaring techniques to collect information about the migratory path (Sawyer, et al. 2000). This was the first study performed that used technology-based methods to determine where the pronghorn traveled. Before this study, observations and local knowledge were used by WGFD to manage pronghorn populations.

Because oil and gas development was a suspected threat, it encouraged research to occur and through the financial support of a gas operator. This research might not have taken place without funding from Ultra Petroleum. In a similar vein to Path of the Pronghorn, a study on the Round Valley mule deer herd occurred due to possible expansion of a ski facility, located by Mammoth Mountain, CA (V. Bleich, personal communication, February 2009). Funding for this study came from the ski resort. Although the ski resort never expanded, the research has since been used by others in the conservation community.

In essence, it was the initiators of the implicit or projected threat which supplied the capital needed for the research to occur. While the research was needed to know the scale (or *projected* scale) of impairment to populations and/or habitat due to development actions, it also provided a long-term record about the migratory populations. Approaching a company or industry working within or in approximation to a long distance migration route to fund research is a lesson derived from these cases. Because research answers a conservation question and can either frame a problem, or conversely nullify a perceived problem, the company or industry may see scientific research as a needed corporate strategy.

Policy-based and Advocacy Strategies

I. **Function and Motivation**

When environmental strategies play out through legal and political channels or in public venues with a purpose of promoting a policy objective, it represents NGOs operating under policy or advocacy function. Advocacy/policy-based functions and the inherent strategies (discussed in this chapter) frequently represent the conventional view of environmental groups

[1] Funding by corporations, like oil and gas companies is not unusual. All studies on pronghorn in Sublette County and Grand Teton National Park have been completed with substantial support by natural gas operators in Sublette County. Natural gas extraction began in the mid/late 1990's in Sublette County and has increased over the last decade (Jacquet, 2006). To learn more about the history of drilling in Sublette County, reference "A Brief History of Drilling 1995-2005: The Socioeconomics of Gas" by Jeffrey Jacquet, prepared for Socioeconomic Analyst Advisory Committee, 2006.

by the general public. These NGOs are sometimes limited to issues on public lands or addressing the public good, and represent the environmental issue as litigators, advocates and lobbyists (Breckinridge, 1999). By participating in administrative proceedings, "Nonprofit organizations have ensured the non-governmental standpoints are considered in governmental decision-making, and that legal requirements are enforced even when government agencies fail to act" (Breckinridge, 1999, p. 694). Breckinridge (1999) suggests groups operating in this way sometimes set up an "adversarial manner with other parties." These groups often challenge judgments by governmental decision-makers or seek to influence them to favor the group's position. Groups that perform this function are often referred to as "advocacy groups" and this brand will be used to denote these organizations in this chapter.

Advocacy groups often have significant impact regarding public lands. Under the guidelines for the National Environmental Policy Act (NEPA), a law designed to require federal agencies to address adverse environmental impacts of their management decisions, these agencies (discussed in detail in Chapters 6 and 7) must initiate public scoping processes (Bass, et al. 2001, p. 23). Public comments gathered during the NEPA process may support or critique a management action, recommend an alternative action, or provide additional information concerning a natural or cultural resource (Ibid.). In this venue, environmental advocacy groups not only submit comments, but additionally might rally for member support or the general public to submit comments in favor of their position. For example, the Upper Green River Valley Coalition, a local environmental advocacy-based nonprofit in Pinedale, Wyoming, has a link on their website for the public to make comments. The link reads, "Take Action on the Pinedale Anticline Plan." Once you click the link, there is a form letter which states that gas development is occurring at too fast a pace and, "If it's done right, the Pinedale Anticline Project could be a prime example of balanced energy production and environmental stewardship" (Upper Green River Valley Coalition, n.d.).

In California, over 7,000 public comments in opposition to proposed construction of a road through mule deer winter habitat persuaded the Bureau of Land Management to withdraw its environmental assessment (Common Dreams, Jan. 30, 2008). Included in the concerns, Friends of the Inyo stated (in reference to the area proposed for road construction), "Healthy riparian areas are vital to local deer population…" (Friends of the Inyo, n.d.).

Partnerships between environmental advocacy groups are evident when reviewing public comments. Public comments to the Pinedale field office in regards to their resource management plan had one set of comments submitted by the Wyoming Outdoor Council on behalf of themselves and American Lands, Biodiversity Conservation Alliance, Defenders of Wildlife, Greater Yellowstone Coalition, the Jackson Hole Conservation Alliance, Natural Council Resources Defense Council, The Wilderness Society, the Upper Green River Valley Coalition, Wildlands CPR, the Wyoming Chapter of the Sierra Club, and the Wyoming Wilderness Association. Joining together around main goals or objectives can provide a powerful message to the federal agency reviewing the public comments.

Indirectly, the public comment period allows for an informal partnership to occur between the agency initiating public scoping, and the organizations which provide comments. Federal agencies can benefit in the long term from gathering public opinion on their management decisions. According to Toddi Steelman (1999), value based information gathered during the NEPA process is often difficult for agencies like the Forest Service to manage. However, incorporating value-based information can help reduce conflicts and lawsuits between NGOs and the federal agency (Steelman, 1999, p. 22).

II. **Policy and Research Interactions**

Advocacy can take on many avenues to urge conservation strategies or policy recommendations. As noted earlier, research about an issue may lead to advocacy actions around the issue. The “Jackson Hole Pronghorn Study” indirectly made significant contributions to advocacy efforts by identifying threats. One explanation for the indirect effect of the study on conservation efforts came from management recommendations directed towards governmental and non governmental entities. The authors suggested conservation efforts focus on bottleneck areas such as Trapper’s Point, discussed in Chapter 3. They also suggested a four-tiered approach to the preservation of the pronghorn migration including (1) federal and state land management planning, (2) County land use planning, (3) private land conservation, and (4) education and public awareness (Sawyer et al., 2000, p. 35).

Often NGOs can take on multiple functions, and one arm of their organization executing research can help shape the other part of their organization creating policy-based recommendations. A few years after the Jackson Hole Pronghorn Study, a national wildlife conservation organization, Wildlife Conservation Society (WCS), began working on a five year study about pronghorn and energy production in Sublette County (Wildlife Conservation Society, n.d.). The research by WCS has allowed them and other NGOs to influenced policy and community outreach initiatives. WCS not only invested time and resources to research pronghorn (both migratory and stationary) in Sublette and Teton Counties, but they have also played an important role in advocating for national protection.

In addition, WCS worked on the ground in the Upper Green River Basin to increase public awareness of the issue. According to a former WCS employee, she worked on a "Path of the Pronghorn" project from 2004 to 2007, she "held three public presentations, gave talks to both the Pinedale town council and the Sublette County Commissioners, and talked with the Tourist Bureau and Chamber of Commerce leaders" (L. Lasley, personal communication, April 13, 2009). Along with working with community leaders and decision makers, another strategy she employed was working and talking directly with property owners living within the migration route. During this time, Lasley wrote letters to all of the property owners and tried to drum up support by holding community meetings (L. Lasley, personal communication, May 16, 2008). She explained the pronghorn migration and the obstacles and threats the pronghorn face before they reach summer grounds in GTNP (Ibid.). Her main objective was to discuss the impact of impenetrable fencing, like sheep fencing, and how this fencing impedes pronghorn movement (Ibid.).

According to Lasely and others, her efforts did not receive very much support and she stopped working directly with property owners around 2006 (L. Lasley, personal communication, May 16, 2008; Sublette County 40-Rod Road Landowner, personal communication, August 10, 2008.). However, she was able to plant seeds of interest and knowledge about the pronghorn migration and helped to create changes in landowner behavior. For example, one subdivision close to the BTNF boundary changed some of their practices to reduce obstacles to pronghorn movement. This subdivision is located just outside the town of Cora and close to the BTNF boundary. It is dominated by second homeowners who usually spend time at their residences in the Upper Green River Basin only during the summertime. Many were unaware of the pronghorn biannual migrations through their backyards. When BTNF planned to reduce forest density for the pronghorn, many homeowners disapproved of this forest action in close approximation to their homes. Since becoming informed of the pronghorn migration by BTNF officials and WCS, many homeowners now keep gates open and some people removed impenetrable fencing. (L. Lasley, personal communication, May 16, 2008)

WCS's involvement, research, and scientific articles on the pronghorn migration by WCS biologists Joel and Kim Berger, also brought this issue to the national stage. WCS took scientific research into the advocacy realm so that policy decisions could be shaped. Many people in the advocacy community see WCS as leaders in Path of the Pronghorn conservation efforts.[2]

During the Western Governors Association (WGA) conference in Jackson Hole Wyoming, June 2008, Patagonia Company used almost exclusively WSC data during a presentation on migration preservation. This was a part of their Freedom to Roam Campaign[3]and also in conjunction with the WGA interest in preserving long distance migrations in the West. After the Patagonia presentation, Kim Berger talked briefly about WSC's involvement over the last 5 years.

WCS is not the only advocacy group to work on Path of the Pronghorn preservation. Other advocacy groups with interest in preserving the route include the Wyoming Outdoor Council, Jackson Hole Conservation Alliance, Greater Yellowstone Coalition, and Upper Green River Valley Coalition. Between 2002 and 2006 the Wyoming Outdoor Council (WOC), an environmental Wyoming-focused advocacy organization located in Lander, Wyoming, used educational-based strategies to advocate for Path of the Pronghorn preservation. For example, WOC planned field trips to the Trapper's Point bottleneck and held a symposium on the pronghorn migration (Wyoming Outdoor Council, 2003). They approached the issue with a keen interest in the historical significance of the route and referred to it as an "ancient corridor" (Taylor, 2006).

In the spring of 2006, the Wyoming Outdoor Council received funds through Wyoming Council on the Humanities to produce a WOC employee's video presentation on the pronghorn migration entitled, "Ancient Corridors" (Wyoming Outdoor Council, 2006). Until late 2007, Wyoming Outdoor Council and the Wildlife Conservation Society were the main groups working on conservation of the Path of the Pronghorn. Wyoming Outdoor Council frequently attended Wyoming Game and Fish Department meetings and talked about the migration corridor

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[2] From interviews with Teton Science School, May 2008, Upper Green River Valley Coalition, February 2008, and Greater Yellowstone Coalition, May 2008; all identifying WCS as a conservation leader.

[3] Website description of campaign: "F*reedom to Roam is Patagonia's current environmental campaign. Its goal is to create, restore and protect wildways or corridors between habitats so animals can survive. Patagonia's partners in Freedom to Roam include the Freedom to Roam Coalition, which includes other companies, conservation organizations, rural activists, recreation groups, and those who live on the land." From:* http://www.patagonia.com/usa/patagonia.go?assetid=1865 *Accessed: February 24, 2009*

(WGFD meeting minutes, 2002). WOC has not worked on Path of the Pronghorn since a key staff member working on this issue resigned (M. Taylor, Personal communication, March 2009).

III. **Lessons Learned**

A. **Considering the Audience**

In the beginning of NGO involvement on Path of the Pronghorn, many advocacy positions embraced the concept of a federally designated migration corridor (Anonymous NGO representative, Personal communication, May 2008). Although many advocacy groups like Natural Resource Defense Council (Natural Resource Defense Council, n.d) and some local groups still feel federal designation is appropriate for such a unique and historically significant route (Anonymous NGO representative, personal communication, May 2008), this idea has since stalled due to the vehement opposition by landowners and residents in Sublette County.[4]

Property rights are an important issue to many Wyoming residents. A lesson learned from the initial WCS efforts relates back to understanding your audience. After interviewing Louise Lasley, other WCS employees, and later landowners, it is clear the idea of national designation seemed like an affront to private property rights. Additionally, landowners needed incentives to retrofit fencing because of the cost. WCS could not provide any monetary or material incentives to individuals to improve fencing conditions. Not being able to provide incentives to retrofit private fencing was a constraint on WCS which limited their influence and ability to work with landowners. WSC tried to orchestrate a neighborhood event to encourage landowners to help each other retrofit fencing but this was also not well-received. If WCS had funds available to work more directly with landowners, the outcome might have been different.

Additionally it is important to explore the role of education while advocating a particular issue. As seen with Wyoming Outdoor Council's efforts to educate through outreach and education regarding Path of the Pronghorn, education can be a useful strategy to leverage funds from donors and gain broader support.

B. **Education Strategies**

Educational strategies can take on many forms and have the purpose to increase public understanding and awareness of a conservation issue. In the case of most migration issues many groups try to educate people about the animals needs, whether it is the need for penetrable

[4] This statement comes from the sentiments expressed on this issue from interviews with NGOs and residents in the summer, 2008.

[wildlife-friendly] fence, or raising awareness about the seasonal times people may encounter migrating wildlife on roads. For example, National Geographic Wild Chronicles (a television program) discussed pronghorn threats. In a program on Path of the Pronghorn, wildlife biologist, Hal Sawyer, stated "Every year between 1500 and 2000 pronghorn cross through this bottleneck [Trapper's Point] twice a year—once in the spring and once in the fall. Vehicle-wildlife collisions are a problem all across the state but they become particularly problematic during these migratory time periods." (National Geographic Wild Chronicles TV, 2009). This information was broadcast to a national audience to raise awareness of the issue and increase perception of human related threats. As discussed in the next chapter (Chapter 9), communicating the threats and the ways in which people can focus on solutions and reduce threats to migrating wildlife is important to the facilitation of strategies, and understanding or acceptance of an issue.

NGOs can influence public opinion through educational initiatives. In California, the Eastern Sierra Land Trust has a Wildlife and Plant Communities program (Eastern Sierra Land Trust, n.d.). Through this program the land trust researches citizens by providing information on how to live with wildlife, and important qualities of the wildlife around them (Ibid.). On their website, their link to mule deer informs the reader that the mule deer which migrate through their backyard have an extremely small winter range and that development can endanger this crucial habitat (Ingram, n.d.).

Some organizations take on educational initiatives because it helps bolster and advance their overarching goal—such is the case when a land trust with a mission to conserve private land through conservation easements takes on educational initiatives. However, often groups are formed with the sole purpose to educate the public on an issue. For example, Pronghorn Passage is a project created by University of Wyoming creative writing MFA student, Emilene Ostlind, and wildlife photographer and biologist, Joe Riis to educate people about the pronghorn migration. As described on the website, Pronghorn Passage "is a creative project that incorporates adventure, science, geography, and conservation with visual and written storytelling" (Pronghorn Passage, n.d.). They both seek to promote protection of the corridor by expressing to others the unique and important qualities of the route (J. Riis, personal communication, June, 2008; E. Ostlind, Personal communication, June, 2008). Their project has allowed them to talk to various groups, be featured on radio shows, and on film (J. Riis, personal communication, March 2009).

Educational institutions can also play a unique role in educating individuals about a particular issue. The Teton Science Schools, based in Jackson Hole and Kelly, Wyoming, are a non-advocacy environmental education organization (D. Gentry, personal communication, June 11, 2008). Their Graduate Program is focused on place based teaching and ecological field science (Ibid). During the spring semester of 2008, four Teton Science School graduate students worked on a weeklong project for their Ecological Inquiry class interviewing invested stakeholders on both sides of the issue including people living within the pronghorn migration corridor in the Upper Green River Basin. Their teacher, Dr. Dale Gentry, encouraged the students to identify the conflict and personal perceptions on the issue. He said, "Students found most people they interviewed thought the biggest threat facing the GTNP pronghorn population was natural gas development on their wintering grounds more than housing development along the migration route" (Ibid). Professor Gentry thinks the pronghorn migration case is a good illustration of the conflict inherent in wildlife management (Ibid).

Stewardship and Conservation Strategies

I. Function and Motivation

Nonprofits that manage and own property or hold conservation easements perform a stewardship function and employ strategies directed towards land conservation (Breckinridge, 1999, p. 694). A conservation easement is created when a landowner sells or donates his/her right to develop on his/her property to preserve the conservation value of the land in perpetuity. As described by Julie Ann Gustanski (2000), "Simply put, a conservation easement is a legally binding agreement that permanently restricts the development and future use of the land to ensure protection of its conservation values." Groups primarily responsible for land acquisition work almost exclusively on private lands, and are referred to as land trusts. (Endicott, 1993: 4) In our case studies some of the leading conservation efforts are being performed by land trusts. Some land trusts have a dual mission to protect environmental characteristics and preserve working landscapes. In Wyoming there is a strong connection to the agricultural sector. This cultural element often is the key factor in facilitating the conservation of agricultural ranchland. Thus, community value of their agricultural heritage and open spaces shape the nature of easements on private lands and builds a bridge between conservation and a community's character and cultural values.

Land trusts are a relatively recent phenomenon and as stated by Richard Brewer, "Land conservation, like jazz, is an American invention (Brewer, 2003, p. 13)." The first land trust was established in 1891 in Massachusetts, but the growth of land trusts and land acquisition programs occurred in the 1960's and 70's (Ibid.). In the early 1990's the land trust movement took off. The tool of land acquisition and purchase of development rights is seen by many in the conservation community as one of the "most effective components in the whole environmental movement" (Brewer, 2003, p. 1).

Presently the most work regarding Path of the Pronghorn is underway by the Green River Valley Land Trust, in Pinedale, Wyoming. The Green River Valley Land Trust (GRVLT) is working on private land conservation and with private land owners. This organization takes on the stewardship function, and is strictly non-advocacy. One of the main conservation objectives of GRVLT is to support agriculture along with open spaces and environmental features like wildlife habitat.

In the summer of 2008, GRVLT launched its Corridors Conservation Campaign (CCC). This campaign targets migrating species, and began by focusing on the pronghorn migration corridor. They are not only targeting potential conservation easements in the corridor, but they are also helping landowners retrofit fencing. This is possible due to a $1 million grant from the Jonah Interagency Office[5] for their fencing initiative which began with inventory of the fencing on private properties in the corridor (Green River Valley Land Trust, n.d.). Capital towards a project of this nature allows GRVLT to offer incentives to landowners to retrofit or replace fencing which is a powerful strategy other organizations were unable to utilize due to financial resource constraints.

Like the efforts towards the Grand Teton National Park Pronghorn, the Round Valley Mule Deer migration has considerable support by a local land trust, the Eastern Sierra Land Trust (ESLT). Both pronghorn and mule deer migrations have constrictions due to encroaching residential development and like GRVLT, ESLT also looks for opportunities to purchase

[5] Jonah Interagency Office, made up of Bureau of Land Management, Wyoming Department of Agriculture, Wyoming Game and Fish Department, and Wyoming Department of Environmental Quality; was created under the Jonah Project Record of Decision (ROD) to manage on-site and off-site mitigation activities as well as on-site monitoring.

development rights and set up conservation easements. ESLT has worked very actively to preserve the migration route, especially in areas like the community of Swall Meadows where there has been increased residential development (Eastern Sierra Land Trust, n.d.).

ESLT has been proactive in partnering with other groups to leverage funds and spread awareness about the Round Valley mule deer migration. ESLT bridges the divide which sometimes exists between stewardship and advocacy by creating financial partnering with Defenders of Wildlife and the California Mule Deer Association (Eastern Sierra Land Trust, 2007). Financial partnerships allow groups with different functions to collaboratively work on a conservation goal—thus combining monetary resources with expertise, community knowledge, and a willingness to implement projects.

Stewardship groups rely on large amounts of money to satisfy their mission of working with landowners and preserving private land. As stated by Thomas Michael Power, "It is clear market-like incentives and mechanisms can contribute significantly to the solution of environmental problems that threaten the wealth of nature" (Anderson & Power, 2008, p. 11). In this way land trusts can be very effective organizations to create conservation initiatives, but only when they are able to create capital and offer incentives for landowners to conserve.

Around Cody, Wyoming, the Rocky Mountain Elk Foundation (RMEF) has been performing a similar stewardship function to GRVLT and ESLT. Unlike the other NGOs, RMEF will take on an advocacy role in some of their conservation efforts by proposing policy recommendations. However, in regards to the elk migratory movements they have primarily taken on conservation projects such as easements without using policy levers (Rocky Mountain Elk Foundation, n.d.).

II. **Lesson Learned: Expanding the Options**

Purchase or donation of development rights to preserve private lands is not the only way land trusts can work with landowners. As seen with the Green River Valley Land Trust, they created a more holistic initiative which allows them to work with landowners in many different ways. They have the ability to protect the landscape and wildlife corridors in perpetuity through conservation easements, but they now have incentives to retrofit fencing.

Retrofitting or replacing old fencing for wildlife friendly fencing (mentioned in Chapter 3) is an expansive and time intensive burden on a landowner. Yet, fencing is seen as one of the greatest obstacles to pronghorn moving across the Upper Green River Basin. By expanding the options on the table, the GRVLT was able to work with more people and create new relationships with landowners in their community.

On the other side of the Continental Divide, The Nature Conservancy's (TNC) Heart Mountain Ranch is reducing grazing competition between cattle and elk or other wildlife. Approximately 30% of their deeded land is irrigated for a grass bank. TNC then worked with the Forest Service and the Bureau of Land Management to allow ranches with allotments in Shoshone National Forest to graze on Heart Mountain (Nature Conservancy, 2002). This then allowed the Forest Service to improve habitat for elk and other wildlife by doing selective burns in the previously allotted area (personal communication, Shoshone National Forest, 2009).

Conclusion

I. Overview of NGOs

In our case studies we see where different NGOs use their influence and function in diverse ways to implement strategies to conserve a specific ungulate migration. Groups interested in conserving migrations recognize the importance of protecting the habitat and reducing the threats or obstacles in the migration route by identifying threats; presenting management solutions; increasing public understanding; and implementing conservation strategies that are either research, advocacy, educational, or stewardship based. While not all groups approach the issue in the same way, they each are able to inform the public and raise awareness through their specific function.

As seen from our case studies, NGOs working on migration issues address the conservation need and implement conservation strategies according to their main identity or *function* as an organization; in combination with available resources, information, and funds and financial capital for projects. NGOs are not static entities—they can develop their mission and scope of work over time. Therefore, NGOs that utilize opportunities that present themselves might have greater conservation success. Non-profit organizations are often bodies that can facilitate the exchange of ideas and interest from community members with shared concerns. In this way, interested parties can use a NGO as a mechanism to join together and actively participate to find solutions. (Boris, 1999) The NGO can work as a channel for community members to voice concerns and be active in decision or planning processes (De Vita, et al. 2001).

Most NGOs operate under resource and capacity constraints (Bare and McPhee, 2001). Capacity, as it relates to the functions of NGOs, is seen as the ability of a nonprofit to fulfill the objectives of their mission effectively and efficiently (Ibid.). Therefore, it is important for NGOs to build strong relationships with community members who might have a stake in the issues addressed by the NGO.

II. **Partnerships**

As illustrated in this chapter, partnerships are important for many projects to succeed. Building and maintaining partnerships with other NGOs, individuals such as experts, or governmental organizations allows for information and resource sharing. Each function of an NGO creates different types of partnerships because of their specific needs. For example, large amounts of financial capital are needed for conservation projects (as to purchase development rights from a landowner). This apparent obstacle to implementing conservation projects, like the purchase of development rights, also creates opportunities. Needing funds for a specific project thus allows organizations to forge a number of partnerships with diverse individuals or organizations, including governmental or corporate entities that also benefit from conservation initiatives.

Partnerships between non-profit stewardship organizations and public agencies are consistently observed in conservation easement programs because, "Nonprofit organizations create an 'atmosphere of possibilities' (Endicott, 1993, p. 5)." According to Endicott, many landowners favor working with nonprofit organizations over public entities (Ibid). For this reason, public agencies may work with stewardship organizations by granting funds or giving public support. Jennifer Brinkerhoff author of *Government and-Nonprofit Partnership: A Defining Framework* (2002), says, "Partnership is a dynamic relationship among diverse actors, based on mutually agreed objectives, pursued through shared understanding of the most rational division of labor based on the respective comparative advantage of each partner" (p.21).

Often obstacles to implementing conservation strategies can encourage resources sharing. For example, the need for significant funding for research projects allows for public and private partnerships to occur around a specific research project. As described in Path of the Pronghorn example, a number of private and public partners pooled funds, resources, and expertise to conduct a two-year study ("Jackson Hole Pronghorn Study") of the migration by a non-governmental body. Similarly, when public entities undertake research initiatives, they also need the support of private partners as seen in the Absaroka Elk Project through the WGFD.

Advocacy groups can also create partnerships with stewardship organizations by allocating funds or resources for conservation projects. The Eastern Sierra Land Trust (ESLT) and the California Deer Association (CDA) have formed partnerships to protect migratory corridors and habitat for mule deer (Eastern Sierra Land Trust, n.d.). In the past, CDA has provided ESLT with funding for projects to obtain conservation easements. This partnership through fund-sharing allows both groups to meet their conservation objectives and show solidarity on an issue to the public.

The Heart of the West Conservation Plan, in the Intermountain West, is a program of the Wildlands Network and a collaborative effort by four conservation-focused nonprofits (Heart of the West, n.d.). This plan "applies conservation science while describing the development and implementation of a wildlands network that will guide land managers and users to act in deference to the needs of the land" (Heart of the West, n.d.). According to the Wildlands Network, this plan and others like it are needed to encourage managers to protect the ecological conditions of areas and take recommendations into account (Wildlands Network, n.d.). Presently the coalition of partners which developed the plan will "first, advocate protection for core areas of landscape linkages" and are "second, ensuring that revised agency land use plans are in line with our conservation plan; and third, affecting national policy that drives land management in the Heart of the West (Ibid.)." Although conservation plans are focused on multispecies efforts, plans of this nature can build off of single species protection efforts already underway can help further conservation initiatives surrounding that species.

The case studies illustrate importance of NGO strategies to build a base of knowledge (research), spread awareness of an issue and advocate for protection (advocacy), and conserve land and work with landowners (stewardship). Of these different strategies, it is important to begin with research to frame an issue to build or formulate strategies addressing threats (Groves et al. 2006). Strategies are designed to disseminate information or implement a conservation campaign and need to consider their audience; the message they want to share to their audience; and the best ways to bring that information to the general public. In a similar way, land trusts can create campaigns based around a particular issue and gain support by expanding the options they use to work with landowners and conserve land. All NGOs working on migration issues need to recognize that unlike other habitat conservation based initiatives, migrations usually involve a mosaic of land ownership and management oversight. For these reasons, multiple strategies are need to address the particular single or multiple species movement. Because NGOs working in a state or region will have different conservation goals based on their mission and organizational design (i.e. function), they have opportunities to work together and share resources like information. Additionally, focusing on threats and creating a variety of conservation strategies [by various NGOs] facilitates an atmosphere of possibilities around a given species migration (as exhibited by Path of Pronghorn efforts). Therefore seeking opportunities to create partnerships increase the ability to garner funds, and might provide outlets for creative approaches to working with communities to drive corridor conservation.

Chapter 9
Communication Strategies for Migrations

Introduction

Communication strategies in conservation efforts matter because the *perception* of the issue/problem is as important as the actual problem, and communication strategies and tools are useful in working to understand the perception of the problem, as well in helping to determine what actions if any are taken. The problem may have workable solutions and the policies may be in place, but without effectively communicating the issue and possible solutions, little success can be attained in favorable change on the issue. In communicating, one is attempting a process of exchanging ideas and imparting information. Communication can be defined as the successful transmission of thoughts and ideas, without significant distortion, so that *understanding* is achieved (Fazio & Gilbert 1986). The process is more effective when it is a two-way flow of information that allows both sides to learn about each other. The *audience,* the target of communication strategies, benefits when they learn about what the organization wants to do and the organization benefits from learning about what the audience needs. An important part of the process is to know if the strategies are "working" since, after all, conservation organizations[1] intend for their message to have certain effects and outcomes: to inform their audience about what they are doing, raise awareness of an issue, to reach potential funders, encourage people to care about an issue and/or to bring about behavior change.[2]

In analyzing the management policy process regarding the pronghorn migration corridor, David Cherney and Susan Clark (2008) state, "Understanding ecological factors allows managers to make technical decisions. Understanding decision-making conditions allows people to realistically target management and policy changes that secure shared interests, once these are clarified through democratic means." A useful addendum may be that understanding challenges and successes in communication strategies allows for an increased likelihood that the management and policy changes will be better informed and received and more effectively

[1] The term *conservation organization* in this chapter will refer to refer to non-governmental and governmental organizations, which include: non-profits, state and federal agencies, and other advocacy organizations. Although some advocacy organizations may be labeled or identified as *environmental* organizations, the focus here was on organizations involved in our case studies, which more of a conservation perspective. To a much lesser extent, comments from county planning departments and municipalities will be included as well. In general, the term refers to governmental and non-governmental entities working on conservation plans or campaigns.

[2] The behavior change being one that enables/facilitates conservation of the resource.

implemented. This distinction is important because communication efforts can succeed where regulations or disincentives for "negative behaviors[3]" have failed (Jacobson 1999).

Examining the range of communication strategies used by conservation organizations in the mule deer, pronghorn, elk, and caribou[4] migrations show the variety and similarities of efforts undertaken, as well as the challenges faced and the successes attained in working to raise *awareness*, to disseminate *knowledge*, to build *skills*, and to influence *attitudes* and *values.* These elements of communication strategies are communication goals, which can also be components of engagement through *education[5]*. They can also be aspects of *advocacy*. Education involves *the act or process of imparting or acquiring general knowledge, developing powers of reasoning and judgment, and generally preparing one or others intellectually*. Advocacy involves *portrayal of adversaries, a type of appeal, and the supporting, or recommending of specific interests* (Corbett 2006). The differences in definitions and processes, however, often blur in practice, with communication, education, and advocacy overlapping in the work of conservation organizations and at times all treated as overall communication strategies or "ways to inform the public and get them involved." In order to draw the lessons learned from communication strategies in the selected cases, this chapter is organized thematically, cross-cutting across the cases, focusing on what has been done, the successes and opportunities, the challenges and constraints and considerations for more effective communication strategies.

Current and Recent Efforts

The conservation organizations[6] involved in the mule deer, elk, pronghorn, and caribou migrations use a wide array of communication strategies, depending on their organizational capacity, abilities, and objectives. Mailings to members, information on websites, postings in the local newspaper, fliers, contacting partner organizations, youth education programs, field trips, and public presentations are some of the communication strategies used by organizations in

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[3] Negative behaviors being those that management and policy changes seek to change, such as uninformed decisions, overgrazing of a resource, polluting, etc.

[4] Our group initially started work on the Selkirk Caribou migration in the Selkirk Mountains as one of our case studies, but since it was an altitudinal migration, we discontinued it as a case study. However, for the purposes of comparison, initial work done on the Caribou will be used in regards to communication strategies due to the valuable thoughts and insights that could apply to migration corridors.

[5] Education as in a developed and implemented educational program. Simply disseminating information is not education in and of itself.

[6] Again, the term *conservation organization* in this chapter will refer to refer to non-profits, state and federal agencies, and other advocacy organizations.

trying to "get the message out" (*knowledge and awareness*), have people care about the issue (*attitudes and values*) and build support for the objectives and work of those organizations (*action/behavior*). Depending on the goals, needs, and resources of the organization, each of these strategies has strengths and weaknesses. For example, a goal where one organization attains success might be to raise awareness and spread information about the issue but not be as effective in influencing behavior change. Another organization may seek to influence attitudes and values but not have done an effective job of raising awareness. Overall, however, conservation organizations working on the migration corridors desire some type of participation, *action*, or support to bring about favorable change in the status of the issue.

The main target audience of the migration corridor communications strategies is the "general public" but specifically local residents and landowners in and near the migration corridors. To a lesser extent communications strategies are also in place to facilitate communication among conservation organizations. Local residents and landowners are an important target due to the threat of residential development on the migration corridors, and specifically for bottlenecks in the pronghorn and mule deer cases. To that end, all of the conservation organizations working on the migration corridors have focused on communication strategies to raise awareness, using some type of passive[7] information dissemination such as print and online media.[8] Some of the organizations have tried more engaging conservation education programs and/or field trips in order to raise awareness and attempt to influence attitudes. More difficult is the task of changing behavior, or providing the opportunities for people to change their behavior. In general, all organizations are doing a lot of what they already are familiar with that works for general conservation, given the reality and constraints of working with limited resources. Specifically, for non-governmental groups, efforts include e-mail alerts, mailings to members, producing newsletters, providing information on websites, etc. For agencies, this means what they are required by law, such as compliance with the National Environmental Policy Act (NEPA) that provides public comment periods including public notices and scoping sessions. Yet, often, agencies like the Forest Service and BLM go beyond

[7] Passive meant as in information being made available, to be merely received by the audience to be "informed".
[8] For example general information on websites, updates through newsletters, press releases, and informational brochures.

NEPA requirements and create interpretation activities[9], as is the case for the Bridger-Teton National Forest (BTNF) in Wyoming, and the Bureau of Land Management (BLM) in the Eastern Sierra Nevada in California. In order to get a snapshot of what conservation organizations are doing, in this section their efforts are organized by case study.

I. **Clark's Fork and Cody Herds**

Most of the Absaroka Range is within public land, dominated by the Bridger-Teton National Forest, the Custer National Forest, and the Shoshone National Forest. Largely undisturbed by the threat of residential development within these areas, large herds of elk roam the wilderness and backcountry. For the elk in our case study, the Clarks Fork and Cody elk migrate within Shoshone National Forest and in order to travel to preferred winter habitat they must migrate over the Absaroka Divide Mountains, navigating a patchwork landscape of surface ownership, land uses, and management jurisdictions to utilize forage at lower elevation. For the elk migration, the main non-governmental organization focused on communicating the migration issue is the Rocky Mountain Elk Foundation (RMEF).

In 2001, the RMEF helped launch the Absaroka Conservation Initiative, with the goals of "protecting land with high ecological values through creating voluntary conservation agreements with willing landowners within target areas" and "To conduct habitat enhancement activities on 45,000 acres within identified target areas" (RMEF 2008a). Bill Mytton, RMEF lands program manager for the Greater Yellowstone area, stated how the organization would "kick off a series of meetings with local landowners, ranchers, agency representatives and Elk Foundation staff to identify natural resource issues within the boundaries of the Absaroka Conservation Initiative area. The meetings will help build a strategy for future habitat projects in the area" (RMEF 2008a). It is unclear how well-attended the meetings were and continue to be, but initial success was measured by an increased level of interest from individuals in the surrounding communities. When the initiative began, Bill Mytton (RMEF) noted seeing the results, "The telephone started ringing once people knew that we really wanted to look at the issue…the initiative has opened up a dialogue with people we had never talked with before" (Delhomme 2004). RMEF noted how "A prime example [of success] is Tom and Brenda Yearsly, owners of 180 acres nine miles west of Cody on Breteche Creek, in the North Fork of the Shoshone River corridor. When they caught

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[9] *Interpretation* is **"**a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource" (National Association for Interpretation). Often done through guided tours and signage.

wind of the Absaroka Initiative, they contacted Mytton about donating a conservation easement on their land" (Delhomme 2004). From the perspective of the RMEF, the initiative was helping influence understanding of the issue and, if there was an increase in the donations of conservation easements, resulting in a change in behavior. In addition to the meetings occurring through the Absaroka Conservation Initiative, RMEF's other method of communicating the migration issue is through information provided on its website, and in newsletters. Though the RMEF has a host of conservation education programs and other communications and education strategies[10] for other issues and areas in which it operates, there is no structured conservation education program for the elk we studied (RMEF 2008b).

Other organizations that have carried out communication efforts in the Absaroka Range are the Shoshone National Forest, Wyoming Bureau of Land Management, and Wyoming Game & Fish. For the most part, these agencies are limited to comments received at public scoping[11] meetings and have few resources for mass communication. Destin Harrell, Wildlife Biologist for Cody Field Office, Bureau of Land Management, and (WY BLM) describes their standard procedure: **"**We have a Public Affairs Specialist…she deals with media. If we were to do a land exchange or something that would benefit wildlife, she'd write an article and release it" (personal communication, January 31, 2009).

II. **Round Valley Mule Deer Herd**

The most active non-governmental organization communicating the Round Valley mule deer migration issue in California is the Eastern Sierra Land Trust (ESLT). Founded in 2001, they are a relatively new organization, but they have taken a lead in communicating the migration issue in their efforts to conserve open spaces in the critical corridor bottleneck in the community of Swall Meadows. The majority of efforts are general public education and awareness, with some targets to influence attitudes. ESLT has conducted field trips for the local community and general public, created brochures with support from partner organizations, organized seminars and festivals, worked on developing curriculum for education programs, and disseminated information through mailings and newsletters distributed via mail and e-mail, as well as being available on its website.

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[10] Power Point presentations, art programs, media, etc.

[11] *Scoping* is "the types of actions to be included in an project, the range of alternatives, and the impacts considered" (Bass, Herson, & Bogdan (2001) The NEPA BOOK)

In field trips, ESLT makes use of the bottleneck quality of the migration corridor by taking groups to “walk” the corridor and in essence experience the migration where it is most threatened by residential development, in the community of Swall Meadows. ESLT has also partnered with organizations to bring in experts to talk with the community and to produce informational brochures. One example of partnerships is the Wildlife Migration Corridor Seminar, inviting experts and people with credentials from CDFG, Caltrans, Mono County Planning Department, and the California Native Plant Society to speak to the local community and the general public. This helped people hear the different aspects of the issue, from deer and traffic collisions, to how to plant natives beneficial for wildlife. The benefits of the seminar is that it provided a means for people to hear about the complexity of the issue (awareness), provide other viewpoints on how to think about the issue (attitudes), and also provide things that people could do to help (action). Another example of ESLT working with partner organizations is the annual “Living with Wildlife” Festivals, held in the local and surrounding communities, that bring together organizations and agencies to put up informative displays, provide hands-on activities, and distribute informational material about wildlife to inform the local community. Lastly, the Living with Wildlife brochure ESLT produced with CDA funding, helped with raising awareness, but more importantly provided action steps people could take.

ESLT has also engaged youth through outreach and education, developing a school program to teach students about the mule deer and migration. Karen Ferrell-Ingram considers it a success, despite funding constraints, stating that from her experience, “children love to hear about mule deer” (personal communication, January 14, 2009).

The California Deer Association (CDA) has been involved with the Round Valley mule deer herd mostly as a funding organization, but that role has been valuable for communication strategies. The CDA has partnered with the California Department of Fish and Game (CDFG) to involve elementary, middle, and high school students in mule deer capture and hands-on activities. As CDA notes, “The proximity of schools in communities of the eastern Sierra Nevada and the abundance of field projects conducted by CDFG in this region provide a unique opportunity to offer students hands-on instruction in wildlife ecology and conservation.” (Stephenson 2008). This approach not only provides knowledge and awareness of the issue, but also introduces skills that students can see using in future careers. As CDA further notes “Efforts are planned to further expand this educational program as teachers continue to express interest in incorporating local opportunities for field studies into their life science programs. After talking with and watching some of the students you could see that some may be thinking about a career in wildlife management" (Stephenson 2008).

Other organizations that have carried out communication efforts in the area are Inyo National Forest (INF), and the California Bureau of Land Management (CA BLM). As with Wyoming, the agencies mostly receive comments at public scoping meetings, following the requirements of the NEPA process. Also, as in Wyoming, resource agencies provide some interpretive services. Richard Perloff, INF District Wildlife Biologist states, "The majority of outreach has been through the NEPA process, through scoping, putting out press releases or talking to people if they ask. [We] explain to the public what the projects are and ask for feedback if they think it is a good idea or know of alternatives" (personal communication, January 23, 2009). Steven Nelson, Supervisory Natural Resource Specialist; Staff Chief for the Biophysical Resources Branch Bishop Field Office, Bureau of Land Management (CA BLM**)** adds, "We have some interpretive panels placed along HWY 395 that overlook the Round Valley winter range. It is a cooperative effort with Caltrans, the Inyo National Forest, and the county. It's an overlook of the northern portion of Round Valley winter range – with an interpretive panel specific to deer" (personal communication, January 23, 2009).

III. **Grand Teton National Park Pronghorn Herd**

Several organizations have been involved in communicating the GTNP pronghorn migration corridor issue.[12] The Wildlife Conservation Society provided some of the first data and information[13] that served as the basis for many other efforts (WCS 2006). In the upper part of the migration corridor, lead organizations have been the Jackson Hole Conservation Alliance (JHCA) and Bridger-Teton National Forest (BTNF), along with Grand Teton National Park (GTNP) and the Jackson Hole Land Trust (JHLT).

JHCA has sponsored[14] an annual "Party for the Pronghorn" since 2006, as a celebration of the Grand Teton National Park antelope herd's annual return to the Jackson Valley (JHCA 2007). The party is attended by supporters for the migration issues but, as a press release by JHCA stated, "We really want to welcome the whole community to join in this celebration of

[12] This has been mostly in raising awareness and providing information on websites, through press releases, and in articles for newsletters and magazines on a local and national scale.
[13] Other important work was done by Hall Sawyer & Fred Lindzey (2000).
[14] Co-sponsors also included BTNF, GRVLT, GTNP, and WFGD.

Jackson Hole's incredible wildlife, and of the people working to protect them" (JHCA 2008). The party serves a strategy to raise awareness funds for corridor conservation efforts but also to "highlight recent strides toward protecting the herd's threatened migratory path between Jackson Hole and the Upper Green River Basin" (JHCA 2008). During the 2008 Party for the Pronghorn, BTNF announced its forest plan amendment that recognizes the migration corridor, the "Path of the Pronghorn" within the national forest (USDA 2008; JHCA 2008). This recognition was one of the most significant outcomes of awareness and action on national forest land[15], following a long process of contact with organizations to gauge interest and test receptiveness to the amendment. Part of the outreach process involved the "Path of the Pronghorn" Pledge (Hatch 2008), which involved other agencies like the Grand Teton National Park Service, and the National Elk Refuge, as well as non-profits[16]. The pledge outlined the recognized importance of the migration corridor, stating, "We recognize the importance of this migration to Wyoming's wildlife and cultural heritage, and pledge to work together to help ensure its protection for the benefit of the area's ecology and enjoyment by current and future generations" (Hatch 2008). As a follow up to forest plan amendment, BTNF also worked to install interpretive signs regarding the migration within BTNF land at the boundary with GTNP and at the southern boundary where the pronghorn enter BLM and private land (USDA 2008b).

In the lower part of the migration corridor, the lead organization working with private landowners has been the Green River Valley Land Trust (GRVLT). GRVLT initially became involved with the migration corridor issue through contact by BTNF. Jordan Vana, Land Program Director for GRVLT, recalls, "Michael Schrotz at BTNF contacted us in early January 2008 regarding the BTNF's efforts to designate the pronghorn migration route on Forest Service land. We worked with Michael to build on those efforts on non-Forest Service land within the route in Sublette County." Conservation of the migration corridor connected with the overall mission of GRVLT and provided opportunities, as Vana stated, "To expand our range of services to customers within our mission (and thereby generate new sources of revenue). Our concern for this issue would differ if we couldn't meaningfully play a role in addressing it within our mission" (personal communication, February 25, 2009). GRVLT was successful in obtaining $1

[15] Concerns about the amendment were a communications issue, with some individuals concerned it imposed new restrictions, but the Forest Service stressed it imposed no new changes since current activities did not constrain migration.
[16] For example, the Green River Valley Land Trust

million in funds from the Jonah Compensation Mitigation Fund to initiate a wildlife-friendly fencing program (JHNG 2008). A key component of the program is working with other groups and agencies to increase success of overall conservation of the route. Lara Ryan, Executive Director for GRVLT, states “the project is meant to be a collaboration between agencies, companies and individuals, including the Green River Valley Land Trust, the Wyoming Game and Fish Department, Enercrest, the Bureau of Land Management, the Natural Resource Conservation Service, Bridger-Teton National Forest, Grand Teton National Park and others” (Hatch 2008b). The wildlife-friendly fencing program is part of GRVLT’s larger “Corridor Conservation Campaign” in which GRVLT “will work with landowners, land managers, and others to develop, fund and implement a set of voluntary tools that can be used to sustain agriculture and wildlife habitat in the face of increasing development” (GRVLT 2009). The Green River Valley Land Trust (GRVLT) did not specifically focus on awareness, but did use two specific evaluation criteria for its wildlife-friendly fencing campaign that focused more on motivation for conservation behavior change. Jordan Vana (GRVLT) states, “We motivated conservation behavior by offering and in fact installing cost-free wildlife-friendly fencing for interested landowners. The fact that the modifications were free and voluntary was an important consideration” (personal communication, February, 24, 2009). For GRVLT, *free* and *voluntary*, were key since that would guarantee a higher degree of success in having interested landowners want to install wildlife-friendly fencing and GRVLT being able to install it. It also provides a way for varying parties to become involved. Lara Ryan (GRVLT) stated, “We created what’s called the Adopt-a-Mile program, and the goal was to encourage individuals, groups of friends, businesses, families and others to have a means of getting involved. There are lots of ways to get involved” (Hatch 2008 b). As a measure of success, GRVLT states that on the fencing initiative they are “ahead of schedule and under budget” (GRVLT 2009). GRVLT has also conducted field trips for donors and potential funders. Throughout 2008 GRVLT hosted trips for the National Fish and Wildlife Foundation, Wyoming Wildlife and Natural Resources Trust, and several other stakeholders (J. Vana, personal communication, March 2, 2009). Field trips of the corridor and for conservation in Sublette County in general continue to be offered by GRVLT for funding purposes (GRVLT 2009).

Of important note, the Wyoming Outdoor Council (WOC) provided funding to produce a film, *Ancient Corridors*, which provided specific focus on the migration itself. Meredith Taylor recalls “I worked with federal and state agencies, private landowners, ranchers, civic groups, and other conservation groups in a campaign to raise awareness of how we should restore the wildlife movement patterns on migration corridors.” Part of that was hoping to influence planning that took the migration route into account. Taylor recalls, “ [After identifying the route, we] then informed the public about why these areas were important to protect through long range planning projects, like: Teton County Comprehensive Plan, Forest Plans, BLM Resource Management Plans, and Wyoming Game and Fish habitat strategy plans” (personal communication, February 28, 2009). The Wyoming Council for the Humanities provided funds for Taylor to present the film to the public (WOC 2004) and later, funds to produce a DVD for educational purposes (WOC 2006) (Ibid.). Meredith Taylor comments “The dog and pony show of taking the Ancient Corridors show and producing a DVD was very popular. It was successful because it engaged people and gave them something to get their hands around as a project that we could work on together” (Ibid.). WOC also hosted a symposium and a field trip, giving people an opportunity to see the bottleneck (WOC 2003, 2004).

The National Parks Conservation Association (NPCA) launched a Grand Teton Wildlife Initiative, which has a “preserving the historic pronghorn antelope migration” component. NPCA states that the goal of preservation “will be accomplished through work to secure funding for conservation easements, political and community advocacy work, and educational outreach to help reduce human impacts and incompatible uses within the migration route” (NPCA 2009).

Wyoming Game & Fish (WGFD) has and continues to provide input on the status and concerns regarding the migration corridor. The input has largely been during the comment period on the Resource Management Plan by the Bureau of Land Management. WGFD also applied and received funding for interpretive signs for the pronghorn migration corridor (One Percent 2008a, 2008b). In terms of other advocacy and awareness, the Upper Green River Valley Coalition (UGRVC) was one of the early groups raising awareness on the issue, although the focus was more on the winter habitat of the migrating pronghorn and to stop or decrease the fragmentation of the habitat caused by increasing gas development.

IV. **Selkirk Caribou**

The Selkirk Caribou is another case that can provide valuable insights for communication strategies in conserving migrating wildlife, though it was dropped from our larger case study analysis because it is an *altitudinal*[17] migration whereas the other cases are *latitudinal* migrations. For the Selkirk Caribou, the two main conservation organizations focused on communicating the issue are the Selkirk Conservation Alliance (SCA) and the Idaho Conservation League (ICL). These two organizations have faced the most challenges, as compared to the other migration corridors included in this study, and their communication efforts have been limited to information on their respective websites, newsletters and e-mail alerts to their members. In an effort to raise awareness, the Idaho Conservation League has been working on trying to set up field trips for the general public to see the caribou, attempting to replicate the successful field trips it had for sage grouse. Both the ICL and SCA have been active in litigation efforts, and along with a few other organizations[18] have been successful on that front. John Robison, ICL Public Lands Director, states that although it has a variety of communication strategies that it uses for general habitat issues and other wildlife, "For caribou it's been mostly with newsletters" (personal communication, January 9, 2009) due to the challenges and political climate in which they operate.

Table 9.1 summarizes some of the common communication strategies used in the different cases. The table is not meant to detail all activities, but to provide a general sense of what strategies are most common.

[17] Meaning that they migrate "up and down" across elevation on a mountain range.
[18] Mostly Defenders of Wildlife.

Table 9.1, Common strategies used by most active organizations for pronghorn, elk, mule deer, and caribou migrations

	Common Communication Strategies								
Main Organizations	Press Releases	Field Trips	Community Festivals	Website[19]	Symposiums	Conservation Education[20]	Newsletters/Articles	One-on-one	Partnerships
Pronghorn									
GRVLT	X	X		X		X	X	X	X
JHCA	X		X				X	X	X
BTNF	X						X	X	X
WCS	X			X			X	X	X
WOC	X	X		X	X		X	X	X
WGFD	X					X	X	X	X
WYBLM	X	X						X	X
Elk									
RMEF	X			X			X	X	X
SNF	X							X	X
Mule Deer									
ESLT	X	X	X	X	X	X	X	X	X
CDFG	X					X	X	X	X
CABLM	X					X		X	X
INF	X							X	X
CDA	X			X		X	X	X	X
MDF	X						X	X	X
Caribou									
SCA	X			X				X	X
ICL	X	X		X			X	X	X

[19] Meaning information about the issue can be easily found on the website
[20] Meaning formal and informal structured education activities that involve *education* strategies

Successes

Conservation organizations working on the migration corridors self-identified several successes with their communications strategies. These successes provide models that can help others in similar situations overcome or rethink the challenges faced in communicating similar issues. Success can be defined in several ways, from a feeling of accomplishment to tangible results on the ground or measurable outcomes as defined in an evaluation. Several organizations have found some key ways in which to address the challenges and constraints they face. The areas of success are outlined here across the cases, so as to highlight the commonalities.

I. **Taking People out into the Resource**

Taking people out to physically experience the resource is a powerful communications strategy that has been used by conservation organizations in general. Field trips can help in increasing knowledge and awareness, helping to make the issue concrete. Field trips can also influence attitudes and values as the resource speaks for itself. According to Destin Harrell (WY BLM), they are also popular with the public. He states, “We do interpretive hikes a lot. The months of April and May are just almost packed solid with interpretive hikes. We do that on Saturdays, National Public Lands Day or National Trails Day. We have been having people show up more and more” (personal communication, January 21, 2009).

For the Round Valley mule deer migration corridor, taking field trips to “see the deer on the land” can make the issue tangible for some. Karen Ferrell-Ingram (ESLT) notes that a migration corridor can be different than just habitat preservation because “you can really grasp it, see it and it’s distinct…you can see the bottleneck” (personal communication, January 14, 2009).

John Robison (ICL) notes that although the caribou migration has mostly been communicated through newsletters, they have been looking at ways to take people out to see them, noting the success they have had with other species. He states, “We have offered tours, in cooperation with the [Idaho] Dept of Fish and Game for sage grouse. That has been a very popular tour with members. But it doesn’t work quite well for caribou because of their reclusive nature. When we can tailor that to a specific animal, we do it. We have them for wolves and do wolf hikes. What makes them a success is having people experience the magnificent natural heritage we still have here in Idaho. A lot of time people do not realize what they have. But if you give them some tips and hints in terms of where they can go…then people are extremely excited and proud of what is in their backyards” (personal communication, January 14, 2009).

For the GTNP pronghorn migration corridor, field trips have been used by the Green River Valley Land Trust (GRVLT) for potential funders, allowing them to see and experience the corridor. Another example is the work of the Upper Green River Valley Coalition and Sky Truth, who produced a video of a "bird's eye view" of development on the winter Habitat (Sky Truth 2007). The Wyoming Outdoor Council (WOC) also hosted a field trip, giving people an opportunity to see the bottleneck. The field trip attracted more than 120 conservationists, ranchers, hunters and other interested citizens with the WOC declared it a "resounding success" (WOC 2003). When it is not possible to get people the resource, Meredith Taylor (WOC) took the issue to the people with her "Ancient Corridors" presentation because, based on her experience, it is a way to make the issue concrete, "to get their hands around" (personal communication, February 28, 2009).

II. **Providing Accessible and Credible Information**

Providing accessible and credible information is another important communications strategy component used by conservations organizations. When the information about the issue is seen as credible, it helps the communication process and builds trust. John Robison (ICL) notes the importance of first establishing the science and to "talk to the specialists themselves", meaning those with the credentials that make the information credible. ESLT provides a model in providing credible information, noting the importance of working with partner organizations to bring in experts. Through the Wildlife Migration Corridor Seminar and the "Living with Wildlife" Festivals, ESLT is connecting the experts from CDFG, Caltrans, Mono County Planning Department, and the California Native Plant Society with the community. When done in a social, non-formal environment that allows question-and-answer sessions and interactive displays, this communications strategy helps people process the complexity of the issue.

III. **Providing Education to Youth**

Outreach and education to youth is also an important component. Destin Harrell, (WY BLM) points out how they are involved in education, "We do other outreach, like participate in kid's days/field trip days with 6th graders to teach about wildlife habitat and various things." He also notes how reaching out to local schools is beneficial in more ways than one, stating that "being involved with educational opportunities where you do help out with high school or the elementary school – it seems like if you do a lot of work there, your agency will get a lot of recognition or publicity and you engage the public really well" (personal communication, January 21, 2009). Susan P Douglass (SNF) also comments how “we get asked a lot to talk to kids and do school programs” (personal communication, January 26, 2009).

For the Round Valley mule deer, youth outreach has been done through the local schools by the California Deer Association (CDA) and the California Department of Fish and Game (CDFG), as well as the Eastern Sierra Land Trust (ESLT).

IV. **Being Persistent, Reaching out One-on-One**

Talking to people one-on-one, though time consuming, can be very effective. Susan P. Douglass (SNF) puts it succinctly, “People really like one-on-one: a human being talking to them” (personal communication, January 26, 2009). Doug McWhirter (WGFD) notes that even with big efforts, it is still about connecting one-on-one. He recounts, “There was an initiative called the Absaroka Elk Initiative…by the Rocky Mountain Elk Foundation. That effort was designed to get everyone talking. Even with that kind of umbrella effort, it all comes down to individually talking to these private landowners.” Currently, he notes that for the elk, “We (BLM) have nothing to that level. We try and raise these issues in our interagency discussions with the BLM and Forest Service and private landowners. But to date it’s been mostly a one-one type of communication” (personal communication, January 20, 2009). Nonetheless, taking the time to reach out and being persistent pays off. Destin Harrell (WY BLM) points at how it is all worth it and sums it up, stating, “Just try to be persistent at scoping; letting the public know that there are issues out there. I would probably recommend just trying to engage the public as much in the process that way**.** It just all starts with knowing that they can have…they can be a part of the process” (personal communication, January 21, 2009). The benefits of one-on-one relationships also translate into trust. Jordan Vana (GRVLT) notes that although a challenge is “establishing and maintaining trust with certain landowners”, there is incredible benefit in establishing and maintaining that trust. In response to what is an important resource for ideas and help, he states that it is “Our customers (the landowners we work with). It’s always better to listen to their ideas” (personal communication, February 25, 2009).

V. **Connecting with Other Organizations, Seeking Other Resources**

Where conservation organizations can turn for ideas and resources varies. ESLT provides one of the best examples of relying on being well-connected to land management agencies and communicating with their biologists and other experts to increase their capacity and provide credibility on the science and management. This can be seen in the content of their newsletter and other information they provide, constantly referring to the ways in which ESLT and agencies cooperate when possible. As a land trust, ESLT also relies on the land trust community, such as the Land Trust Alliance and the California Council of Land Trusts. Karen Ferrell-Ingram (ESLT) also notes the benefits that can come from partnering with agencies that may have a limited capacity to do public outreach. Non-profits can provide the staff and greater ability to do public outreach where agencies are lacking. In addition, partnering with other organizations such as the AmeriCorps Program can increase an organization's capacity.[21] Karen Ferrell-Ingram notes that the AmeriCorps partnership is "the reason we are able to do this…they serve as outreach and education specialists" (personal communication, January 14, 2009). Scott Burns, Planning Director Planning Division, Community Development Department, Mono County also notes how they work with ESLT, "especially on some of isolated parcels…we encourage developers to touch basis with the land trust" (personal communication, February 2009).

The success of the Green River Valley Land Trust (GRVLT) in obtaining the $1 million in funds to initiate its wildlife-friendly fencing program (JHNG 2008) is both a product and part of the process in working with other groups and agencies to increase success of overall conservation of the route. Jordan Vana (GRVLT) states that in communicating the issue of conserving the corridor, it should be an effort done "all together" (personal communication, February 25, 2009).

The Wyoming Outdoor Council also noted its cooperation with other groups, providing the resources needed to develop and promote the message of its Ancient Corridors program and video. Meredith Taylor, states how "we got a lot of help from unconventional resources, like the Wyoming Humanities Council, Wildlife Groups, civic organizations, etc" (personal communication, February 28 2009).

VI. **Being Creative**

One creative way of communicating the migration corridor, and connected to taking people to the resource, is the use of art. ESLT notes an interesting approach that includes the use of art for communicating the value of environment where they work. The ESLT website states, "We need artists. There is no better way to convey to the importance of our work than through artistic expression" (ESLT 2009). Art can be another way to connect with people and capture

[21] Capacity refers to the ability of an organization to implement a chosen policy (The Midwest Political Science Association).

their attention, providing the entry point to further awareness and education. The benefit can also be in connecting to a new audience through art. Art is valuable in that it can provide an emotional input that makes a learning experience more memorable and exciting, more so than presenting facts alone (Jacobson, McDuff & Monroe 2006).

VII. **Making Use of Volunteers**

Volunteers can be an invaluable resource to increase communication resources. They can be helpful because they both increase the capacity of the organization and foster a greater understanding of and investment in the goals of the organization. Through volunteer work, much like educational activities, people can also build skills. The skills are useful to volunteers and they can be skills that further the goals of the organization.[22] ESLT uses volunteers for fundraising, plantings, and organizing events.

Agencies also benefit from volunteers, providing the labor and funding to carry out restoration projects. For the Round Valley mule deer, the effects of fire require the replanting of an important food source, bitterbrush. Steven Nelson (CA BLM) comments on the use of volunteers to help with habitat restoration, "Typically we use volunteers like the California Deer Association, Quail Unlimited, school groups, boy scouts, etc. We'll do a weekend planting day" (personal communication, January 23, 2009).The volunteer plantings also serve as an educational opportunity as groups learn about the value of what they are doing in a tangible way. The planting activities serve as the main education activity that BLM does specific to the Round Valley mule deer.

VIII. **Bringing the Spotlight, Raising Awareness**

The most successful case in building awareness and disseminating information is the pronghorn migration corridor. Jordan Vana (GRVLT) notes, when they began their work on wildlife-friendly fencing, "Awareness (of the migration corridor issue) was relatively high to begin with" hence their focus on providing tools for landowners instead of more awareness (personal communication, February 25, 2009). GRVLT describes the tools: "One of the 'tools' in our toolbox is to purchase easements from those who do not have the income to offset the tax benefits associated with donating a conservation easement. Another tool is cost-free, wildlife-friendly fencing" (GRVLT 2009). The high level of awareness on the pronghorn was the product of conservation organizations succeeding in nationalizing the pronghorn migration corridor issue

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[22] For example, being able to identify and remove invasive species.

by increasing the number of channels through which to convey the message. Articles appeared not only in local and regional print media, but also through national organizations. A glimpse of the organizations that have provided some coverage of the issue illustrate the success in raising awareness that is not available to the other migrations: Christian Science Monitor, National Wildlife Federation, National Parks Conservation Organization, Nature Conservancy, National Geographic, Smithsonian Magazine, Natural Resources Defense Council, Audubon, Wildlife Conservation Society, National Parks Conservation Association, Patagonia, Defenders of Wildlife[23], U.S Forest Service, Grand Teton National Park, Wyoming Governor's Office and Western Governors Association.

IX. **Making the Issue Understandable to the Audience**

For the Absaroka elk, Doug McWhirter (WGFD) notes success in framing the message in a way that works for the area. He states, "I've personally had success talking to people about the habitat issue. You can talk about elk, but that open space will benefit any number of other species" (personal communication, January 20, 2009). Thus, while working on something that benefits particular wildlife, such as elk, one connects with the audience through another angle.

Work on the Round Valley mule deer shows how it is important to be aware of the audience according to content expertise, knowing if what you are producing is for the general public or specific interested parties. Vern Bleich, who was the California Department of Fish and Game research director for the Round Valley mule deer study, notes two goals the research team had when communicating the results of their work. He states, "The primary goal was to let interested parties know what we were doing, and second, to increase public support for what we were doing." For specific interested parties that specifically meant other researchers. Bleich notes that for that audience, "We published a number of scientific papers. The main objective was to do good science and get knowledge into the literature." For a more general audience, Bleich states, "We wrote several popular articles for the Mule Deer Foundation magazine, the California Department Fish and Game conservation magazine *Outdoor California*, and several articles for the California Deer Association magazine" (personal communication, January 8, 2009).

[23] Many of the national advocacy and non-governmental organizations have been involved in the pronghorn corridor issue as members of the Upper Green River Valley Coalition.

X. **Spotlighting the Uniqueness of the Species and the Place**

The pronghorn corridor had a simple "catchy" title, the "Path of the Pronghorn", that helped in raising national attention. The message also had key words that resonated with the public. The words used in the awareness messages referenced to its nature as an *ancient* corridor, and the *only* herd that migrated to the popular destination of Grand Teton National Park. Steve Cain, senior wildlife biologist for Grand Teton National Park, stressed the urgency created by those key terms. He stated, "The Park Service remains concerned about the long-term presence of this migration corridor because it is a life link to our pronghorn population. We would not have a pronghorn population if something happened that made that corridor impassible" (Hatch 2008). Those key words take advantage of the heuristic of scarcity[24], prompting people to want to act. For the same success to be matched by the Round Valley mule deer herd, it would be the equivalent of it being the only mule deer that migrated to Yosemite National Park and also having the archeological evidence of having existed for thousands of years. The use of National Parks also help in communicating the issue because they are recognizable destinations and are linked as areas of preservation in the public mind. The length of the GTNP pronghorn migration was also easily popularized and appealing, being the longest non-avian migration in the lower forty-eight states (Berger 2003). The animal itself, also is the fastest land animal in the western hemisphere. All of these aspects led to a viable ambassador specie for migration in the area, and which was picked up by the media.

XI. **The Role of Litigation**

The Selkirk caribou migration issue illustrates one strategy that has been successful when other options are very limited and it is difficult to overcome some challenges: *litigation*. In connection to communication strategies, sometimes an organization wants to communicate with an audience to change behavior, but the challenges of the political environment makes that difficult. Litigation in such cases becomes a way to raise awareness on the issue not just through the use of press releases announcing the need for a lawsuit, but by getting the attention of some of the groups involved, and providing the starting point for further communication to happen. In attempting to be heard, Jerry Boggs (SCA) clearly states how litigation is a tool that brings attention, given that otherwise that the messages of his small organization would not be listened

[24] Heuristics are "shortcuts" in thinking, strategies using readily accessible, though loosely applicable, information that we used in problem solving. The *heuristic of scarcity* is frequently used in advertising when we are implored to buy something because "it's the last one left" and "supplies are running out fast".

to. He notes, “Though I’m partial to collaboration and working with others, if other organizations could, they would like to ignore us…we’re a small organization, maybe 200-400 members. If maybe we were 10,000 we would have more clout. But the threat of a lawsuit brings people to the table. Unfortunately that seems to be the how environmentalism is in the Northwest” personal communication, February 13, 2009). John Robison (ICL) agrees, stating, “We have worked out a deal with snowmobile community to some open recreation areas (don’t have to stay on trails), but we have found that unfortunately it takes the threat of a lawsuit to bring people to the table.” He also notes that “After launching a lawsuit, we reached an agreement with FS and snowmobilers on scaling back some trails and on state lands, we have gone into court and subsequently settled regarding timber sales in winter habitat” (personal communication, January 14, 2009). Thus, in such cases, litigation provides the opportunity for groups to communicate, communication that otherwise may not happen. It is important to note that though Jerry Boggs and John Robison use litigation as a tool, it is not the first and preferred tool of choice, and use it when other efforts fail.

XII. **Evaluation: How do we Know it is Working?**

Evaluation has become a more important aspect of conservation especially when programs and staff positions are funded through grants that require evaluation to determine if the allocation of limited resources is worth it. Deciding exactly how to gauge success in *communication strategies*[25] can be difficult and even the most promising approaches can be successful in some areas and need a lot of improvement in others. There can be “successful” awareness campaigns, but the question to answer is: does that result in changes in behavior and in outcomes that keep the migration corridors open? Most of these successes have been self-identified, but structured evaluation was not specifically evident for communication strategies on the migration corridors.

The Absaroka Conservation Initiative is an example of how a communication was self-identified as an initial success, but then be unclear on how that success is evaluated or carried later on. Initially, success in communication was measured by an increased level of interest, with RMEF noting how participants called the office to hear more about the initiative and how they could participate. However, it is unclear how success is still being measured or evaluated. Jerry Altermatt (WYGM) recounts, “Unfortunately, that effort (The initiative) has not been pursued

[25] Evaluation here is of *communication goals and objectives*, and not evaluation of a program as a whole.

fully due to changing priorities within the Elk Foundation. But public outreach, public education needs to be a big component of that initiative" (personal communication, January 20, 2009). Without an evaluation plan, it is difficult to assess the success of the initiative and the effectiveness of communication strategies on the issue.

John Robison (ICL) notes that the Idaho Conservation League has not done any targeted evaluation of their efforts on the migration corridor other than member surveys. Member surveys can provide qualitative information in the form of quotes and comments, and quantitative information in the form of number of participants in specific programs. For its member surveys, the ICL asks about the type of services members want the ICL to provide. From that, Robison states, "We find out that getting people out in the woods is popular." More general feedback is received from conferences "where we have guest speakers about programs the ICL has and ways to get involved. We've also hosted public meetings" (personal communication, January 14, 2009). However, it is still difficult to assess exactly how communication strategies for the migration specifically have been evaluated and how successful they have been.

For the Round Valley mule deer migration corridor, the situation is similar for the Eastern Sierra Land Trust. Karen Ferrell-Ingram states, "We don't really have a specific evaluation method for our outreach. I think it is a combination of attendance at the event, media coverage, and new memberships" (personal communication, February 23, 2009).

For the pronghorn migration corridor, the question is to evaluate how that success in awareness, as identified by the number of organizations who have publicized the story, translated into conservation of the corridor and/or how it has continued. There has been no designation of a National Migration Corridor, as many organizations wanted, and development of the bottleneck is still a risk. The clearest changes "on the ground" of the migration corridor in Green River Valley has been carried on by the Green River Valley Land Trust with its wildlife-friendly fencing program. Also for the pronghorn, WGFD identified success of its interpretation signs in a quantitative form, tied to the number of the pronghorn herd. Their evaluation response for their grant states that success was based as a "Measure whether the base herd of about 350 increases or decreases. The data gathered by the WCS and JH Conservation Alliance provide unambiguous measurable criteria on an annual basis to determine the base number of pronghorns returning to GTNP in the spring. If those numbers increase, by that measure we have success" (One percent 2007b). However, at the present moment, it is unclear if success has been attained and how an interpretive sign translates to number of pronghorns in a herd. The assumption may be that awareness leads to a behavior change in people or change in attitudes and values, which results in support or action that increases the number of the herd.

Challenges and Constraints

Despite being able to highlight successes, there are still challenges in developing and implementing successful communication strategies for migration corridors in the West. Getting the message out to people and getting them interested and involved is not easy. As John Robison (ICL) states, "People can get overwhelmed", and if one is not careful, one can "put off" the people one is trying to reach. Karen Ferrell-Ingram, Executive Director of the Eastern Sierra Land Trust (ESLT), echoes that sentiment, recognizing the challenge of having people "inundated with information." Looking at the four cases, there are some challenges that particularly stand out, from dealing with how the problem is perceived and if it should be acted upon, to the political climate of dealing with resource issues in the West. In order to highlight those challenges, they are organized thematically in this section.

I. Challenge of Shared Values and Objectives

In communicating a conservation message, there is the challenge of not having shared values and objectives. There may be agreement that something needs to be done, but much less agreement on what the outcome should look like. For the pronghorn migration corridor, which exemplifies success in attaining awareness on a national level, there were failed efforts in other areas. Doug McWhirter (WGFD) recounts, "I previously worked in Western Wyoming in the Pinedale area. When we first started looking at some of the bottleneck issues for mule deer and antelope we formed a migration corridor working group composed of county commissioners, planning folks, NGO, FS, BLM, and private residents…the effort was to elevate the issue of migration corridors and talk about what could be done when opportunities presented themselves. However, the effort was not maintained. That may have been perhaps by talk of designation for national migration corridor" (personal communication, January 20, 2009). For the pronghorn migration corridor, the objective of a national designation of the migration corridor was not a shared objective of all the conservation organizations involved. Some saw it as adding to the difficulty of incorporating the local community, while others saw it as a necessity for permanent protection of the corridor.

II. **Perception of the Problem: Is there a Problem and Does it Warrant Attention?**

How the audience defines the problem is directly tied to how they understand it. Understanding the *problem definition* is important because the perception of a problem is a main challenge for communication strategies on migration corridors. Some people may not see a problem, see the problem differently, or not see a need why it warrants attention and/or action. Karen Ferrell-Ingram (ESLT) notes that although people do *like* the deer, it is sometimes difficult to make the case for a deer herd when people do not see deer threatened in general and they see a large availability of public lands. She states, “there is kind of laissez-faire attitude to preserving private lands because we already have so much public lands…getting people really supportive of preservation here is a challenge because people take it for granted. It is a challenge to get residents really concerned about the deer. I hear people say ‘well we don’t really need to worry about the deer, they’re just out there eating my roses…there is no problem with subdivision and migration corridors’. There is this anecdotal kind of knowledge out there that deer aren’t impacted by subdivisions” (personal communication, January 14, 2009). There is a problem of perception due to a lack distinction between the migration and the route versus the population of the species.

The perception that there may not be a problem, and whether it warrants attention, is also observed with the GTNP pronghorn in Wyoming. As a useful example, Cherney and Clark (2008) broke down the problem definition for the pronghorn migration corridor into three different definitions: *the ecological-scientific definition, the local rights issue definition, and the cultural value definition*. This disaggregation is useful in understanding how competition among the different definitions results in a need to effectively communicate each other’s interests but also to understand where that position comes from, how and why they frame the issue the way they do, understanding more about that audience. If one is communicating with people that hold an ecological-scientific definition of the issue, the message used can be different enough than the message used for someone holding a local rights issue definition. From an interview, Cherney and Clark note, “[The interviewee] continued that, ‘the best way to change how decisions are made in the region is through education,’ referring to teaching people how to ‘‘correctly’’ interpret positivistic derived biological facts. Such statements imply an expectation that people who do not hold her worldview will be swayed if presented with the ‘‘right’’ scientific information, often enough, and persuasively” (Cherney & Clark 2008). Such expectations that part of the solution is a matter of "swaying" another to one's own worldview can pose a problem. In such case, an important question is "what does one need to understand about "the people" so that the education works, if that is the intended approach, especially when "the other" holds a different view than you.

Another example comes from Sublette County commissioners stating that the "pronghorn migration is not a problem" and that in dealing with fencing obstacles, "fencing along roads doesn't hinder movement – sometimes there are places where the wire is too low but the pronghorn will just move until they find a place to get through – sometimes they just get scared because of traffic but they could actually get through" (Sublette County Commissioner, personal communication, May 19, 2008). This perception conflicts with that of Wyoming Game and Fish officials, who note that maneuvering through fencing is a significant obstacle entailing energetic costs, risks of injury, and increased exposure to predation (B. Holz, personal communication, May 2008). Like the mule deer in California, the statement by the county commissioners illustrates a common misperception that there are enough pronghorn in Wyoming. Cherney and Clark (2008) find similar responses in their study, stating, "The quote by a Pinedale rancher, 'if we have 500,000 antelope in Wyoming, what difference does a few hundred make,' illustrates this point. To this third generation rancher, the migration serves little practical purpose… He does not see the need to spend additional resources on protecting one small antelope herd." Such perceptions of the problem are a challenge for conservation organizations trying to frame a message that connects. Cherney and Clark (2008) also note how the effectiveness of communication efforts drops when conflicting definitions of the problem arose. They state, "However, all the advocacy work appears to have minimal impact on formal decision making to date. In fact, there has been a backlash by people who subscribe to the local rights problem definition."

For the Absaroka elk, Doug McWhirter (WGFD) notes how one can spend time arguing about an issue deeply attached to some values, but can approach it from another angle. For example, he notes an example from wolf predation on elk. He states, "We get a lot of concern about the impact of predation. There are people that latch on to that issue so tightly. We can argue all day about the impact of predation, but it doesn't matter if we don't have habitat in the first place, it's a waste of time to talk about of impact of predation" (personal communication, January 20, 2009). Even if predation may not be the real issue, it is important to recognize the challenge, again, by how people perceive the problem and what they think are causes.

In order to better understand differences in perception of the problem it is important to listen to various audiences. Destin Harrell (WY BLM) states, “A challenge would be the various ideas that they have, their perspectives, and balancing them. People have different ideas of what should go on. We try to take their input and figure out a way to accommodate the public and make a good decision when it comes to our projects” (personal communication, January 21, 2009). Bill Mytton (RMEF) puts it simply regarding the Absaroka Conservation Initiative, “It’s a matter of what fits what holes when. No two initiatives will be the same” and the reason why, PJ Delhomme writing for the RMEF Bugle magazine, notes “seated at the table there were ranchers, landowners, representatives from the Wyoming Department of Game and Fish, the Bureau of Land Management and U.S. Forest Service, and Elk Foundation staff and volunteers. They have come to listen to what each other has to say” (Delhomme 2004). Hearing the differences leads to better understanding of why the problem may be perceived differently.

III. **Perceptions of the Messenger Affecting the Message**

There is a challenge in how the perception of the messenger affects the message, especially regarding resource issues in the West. Particularly for federal agencies, communication is hindered by how the agency is seen, or what knowledge or misconceptions about the agency exist. For example, many people misunderstand or do not know the role of the BLM. [26] This may put people on the defensive when it comes to interacting with them or they do not engage at all. Destin Harrell (WY BLM) states, “There is a perception out there sometimes…with BLM allotments out there, there are fences all over the place and that those fences mean private property so it’s a challenge to educate the public about their public lands” (personal communication, January 21, 2009). However, Harrell does note the change that can happen with continued outreach to change the perception of the messenger, “Once the public knows more about the BLM and knows what they do, they can become more involved” (Ibid.).

Bridger-Teton National Forest (BTNF) also encountered questions on its intent with the Forest Plan amendment recognizing the Path of the Pronghorn. As Kniffy Hamilton, BTNF Supervisor stated, “This amendment is to ensure that the Forest Service activities do not interfere

[26] This can be due to historical and/or cultural reasons: People from the East moving in and not having had exposure to the BLM (less BLM in the East due to availability of public land), and/or perception of locals on how the land should be used and opposition to federal regulation.

with the pronghorn migration. As of now, Forest Service activities and the migration peacefully coexist, so there should be no changes in how we do business" (USDA 2008b). However, there was concern from some groups and individuals that the amendment could be restrictive and was not clear about what the amendment would and could do. Mary Cernicek, BTNF Public Affairs Officer, worked to change the perception, stating "Some groups were concerned that the proposal could negatively affect livestock operations. However, the Bridger-Teton assured them that because current grazing operations coexist with the successful migration; these operations will not be affected by this amendment. The only change will be that future grazing operations will need to be designated to allow successful migration (Ibid.).

IV. **Politics**

The political environment can pose a major challenge for communication strategies. Though this section is not a political analysis, it is important to stress how important it is to be aware of the politics of conservation issues in the West. As Fazio and Gilbert (1986) note, "no matter how scientifically-sound or technically correct, all actions are confined within the guidelines established throughout the political system." The importance of understanding the politics is a common thread mentioned by several practitioners, and how politics can be a challenge to communication strategies. In communicating the value and importance of the pronghorn migration corridor, Meredith Taylor, who was a Wyoming Outdoor Council field office director, notes, "The politics of energy development is the greatest challenge because although people want to see these ancient corridors protected, the administration and industry prevailed in preventing it" (personal communication, February 28, 2009). Jerry Boggs (SCA) feeling the constraints of communicating the caribou migration asks, "How can we communicate this issue outside this area?" in light of a general lack of political support. He states, "I wish we had political support, any level of political support. Politicians are anti-environmental, yet they live in a beautiful environment. They probably love it when they are out here, but politically they won't support it" (personal communication, February 13, 2009). John Robison (ICL) notes the same challenges, stating "Idaho is an extremely conservative state and is not on the forefront of conservation" (personal communication, January 9, 2009).

Scott Burns, Planning Director for the Planning Division, Community Development Department, Mono County notes how in their area, "the public is generally supportive of mule deer efforts, being in California, but we also border Nevada so sometimes they have pretty conservative attitudes too – depends on what part of the county you're in" (personal communication, January 15, 2009). Linda Gillett, Planning Coordinator, Planning & Zoning Department, Park County, Wyoming, sums it by saying, "As in many areas of the west that are developing quickly, I think we have a dichotomy of people and interests" (personal communication, January, 14, 2009). That dichotomy can manifest itself in the politics and also influence the perception of the problem.

V. **Terminology**

Communicating terminology can be challenging, in particular for land trusts, trying to communicate the purpose and function of a *conservation easement*. Karen Ingram-Ferrell (ESLT) notes that an important part of the job is helping people understand what a conservation easement means, because the language is important and people may see a conservation easement as more restrictive than it actually is. Both ESLT and GRVLT have detailed information on their websites about the purpose and function of a conservation easement. GRVLT includes a "myths of conservation easements" page, recognizing and noting the need to address misperception of what a conservation easement is and what it does.

Jerry Altermatt and Doug McWhirter, biologists with the Wyoming Department of Game and Fish (WGFD) also stress the importance of the terminology when talking about conservation easements. Jerry Altermatt stresses:

> "Be clear on the terminology. What you are really doing is buying a right from that person that has value. For a conservation easement, you need to convey in clear terms that it's a voluntary deal. If you want to give up this right, we are going to compensate for that right. There is a lot of fear from landowners when you talk about something that is perpetual, permanent. When you are going to give up a right forever, there is a fear to do that. So you have to be really sensitive to that issue. And make sure it's something they really want to do and that you are not pressuring them to do something that they might regret later." He adds, "It's really two sell jobs. You have to sell it to landowners which is that one-on-one piece, and you have to sell it to whichever entity makes that purchase possible (public funds, or private NGO's funds)" (personal communication, January 20, 2009).

Altermatt notes that the clarity on conservation easements is not just for land trusts to communicate to landowners, "I think we need to spread the message to the hunting public as well. I don't know if the majority of hunters realize how important private lands are to elk and other wildlife. I think many feel that it's the landowners' obligation to support wildlife, ranchers shouldn't expect compensation, and the threat of habitat loss is minimal. We need to spread some realism on that perception" (Delhomme 2004).

VI. **Communicating Complexity**

As is the case with many natural resources issues, there is the challenge of communicating complexity, to deliver a message that connects and is understandable with the audience. There is also the question of the message connecting and if it is "catchy", something that the public can easily latch on to. Jerry Boggs, Executive Director of the Selkirk Conservation Alliance (SCA) notes that part of the difficulty in communicating the caribou migration is because organizations have not made it resonate with the public. He states, "I don't believe any of the organizations working on this issue has a successful outreach process that excites the public" (personal communication, February 13, 2009). Part of the difficulty in making the message connect is again, if there is some difficulty in understanding the value of the migration corridor or the wildlife that need it. Jerry Robison (ICL) states, "Because the caribou is a sub-species, the importance of protecting the sub-species is lost on some people, it's a challenge of perception, especially if there are many caribou in Canada. The caribou are also not where they are 'supposed to be', people say 'I don't see any caribou' so we have to make the case to give the caribou some space and people tell us 'I don't see any caribou now, can you prove they are coming back here?'" (personal communication, January 9, 2009).

VII. **Lack of a Baseline for Understanding Attitudes and Values**

A challenge in communication strategies is having a baseline for understanding attitudes values that provides a starting point. People can demonstrate a similar value for the outdoors, but disagree on the management[27], hence the importance of understanding the values and attitudes of the audience. For example, a 2008 Colorado State University study examined the preferences and values of residents living near the Shoshone National Forest. The results demonstrated a strong preference and value for wildlife and a dislike for overdevelopment. However, no such study exists specifically for the Absaroka elk, the GTNP pronghorn, or the Round Valley mule deer. So, while groups working on conservation of the migration can point to an overall support for wildlife, there is no explicit quantitative measure of the attitudes and values to see if efforts

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[27] And the disagreement can manifest itself through politics

are working. Much of the information on gauging attitudes and values comes from the experience of practitioners in the field and has not been captured in a study.

VIII. **Limited Resources**

Conservation organizations face other constraints. A common constraint on more effective communication for many conservation organizations in general, and not surprisingly for those working on the migration corridors, is a lack of resources, particularly in funding for services and staff. In response to an area where they could use more support, Jordan Vana (GRVLT) provides the pithy answer “money” (personal communication, February 25, 2009). Karen Ingram Ferrell (ESLT) indicates that although they consider their nascent school program a success, the primary limitation to taking their education program to all schools in the area is due to funding and a lack of staff to do it regularly. In response, non-governmental organizations such as ESLT, GRVLT and SCA work to communicate the message to potential funders so as to increase funding and capacity.

Destin Harrell (WY BLM) shares similar comments as non-governmental organizations on having sufficient funds for services and staff, noting, “I could see if I had another staff person who was just dedicated to more outreach…we have just one person zoned between two field offices. I think just like any specialist or field degree of specialty, there is always more to do, and you can always do more with more people. “If had one to two more people we probably could make a really good educational effort that would not take away from other specialist’s time to educate the public about the BLM. Staff is always going to be limited to the amount of accomplishments that we can provide” (personal communication, January 21, 2009). Susan P Douglass (SNF) also feels limited by a lack of funds. She states how she “would love to have a conservation education program here…but the money is not there” (personal communication, January 26, 2009). Such a comment also points out that education and outreach programs are not always a priority, may be considered marginal to the core functions of an agency and are usually the first cut given budgetary constraints.

Simply having access to more resources can also be a challenge to having an effective communications strategy. Douglass points out how she would love to have access to a university and be able to utilize the internet to a better effect because, as she notes, “for many people, the Shoshone National Forest website is the face of the forest’ that they get to see” (Ibid.). Lorna Bernard (CDFG) also notes how lack of money is a limiting factor to use their website more effectively in communicating messages. Jerry Boggs (SCA) adds, "As a small organization we do not have the capability to take out ads, do major presentations, etc" (personal communication, February 13, 2009).

IX. **Other Constraints**

Other constraints mentioned by conservation organizations involved the need to have a structure in place that facilitated communication. Jerry Boggs (SCA) mentions how "Effective communications take time and energy. Organizations need to be structured to provide that. You need to have the funding to provide that position and someone with the personality for it" (personal communication, February 13, 2009). Susan P. Douglass (SNF), states the difficulty in communicating with the public for SNF issues with the available communication channels, "Sometimes there is no way to get info out right away. We have no TV station, only newspapers and the radio. The radio will play our messages for free, but because they are public service announcements, they will play at 2 a.m." (personal communication, January 26, 2009). She adds, "We are trying to get the website to be a resource for people, but not a lot of people here are wired (connected to the internet)" (Ibid.). Destin Harrell (WY BLM) adds, "It is also hard to reach people for scoping; I know there is definitely interest out there, and sometimes people don't show up because it is hard to get the word out. Newspapers are our primary media and radio. It's hard sometimes to get the input you would want" (personal communication, January 21, 2009).

Summarizing Advice and Considerations

Though there will certainly always be challenges and constraints in conservation communication, effective communication strategies are invaluable to conservation efforts. Effective communication strategies increase the likelihood that plans are implemented and that affected parties in the issue are on board. Looking at the pronghorn, mule deer, and elk cases, conservation organizations may be understaffed, lacking funds, and facing other constraints, but given that reality, they are doing the best they can with the resources they have. The successes identified also fall within what generally works in conservation communication, and though there was no specifically new and unique strategy looking at these migration cases, they do show how some unique qualities of migrations (e.g. bottlenecks) are used within strategies that work (e.g. field trips). Thus it is recommended that conservation organizations working on the migration corridors continue to do what they are doing while building upon the successes and trying to new things to reach new audiences or connects in new ways, as demonstrated by efforts to incorporate art in conservation.

To continue to have the support of their membership and new audiences, conservation organizations need communication strategies that take the audience into account, that have a message that connects, and that are understandable and credible to the audience. John Robison (ICL) provides some summary advice for organizations working to craft communications strategies around conservation of a migration corridor. He states, "Establish the science, announce the threats, ask who are the decision makers, who do they listen to, and then launch your public outreach campaign" (personal communication, January 14, 2009). This aligns with what research has shown to be persuasive in communications; when they come from several highly credible sources, have a simple message that relates, and arouses personal relevance and involvement in the conservation issue (Jacobson 1999). Karen Ferrell-Ingram (ESLT) highlights other key points, stating, "make it a multipronged approach, don't do it all on your own. Work with different organizations---advocacy, agencies---and work with experts in their own field. Then do the fieldwork where you take people out on the land" (personal communication, January 14, 2009). Lastly, Jordan Vana (GRVLT) reminds one that through it all, it helps to "keep it simple and use common sense (don't over-think things)" (personal communication, February 25, 2009).

Section V
Conclusions

Chapter 10
Summary of Challenges and Best Practices

The purpose of this study was to examine contemporary, on-the-ground efforts aimed at the conservation of long-distance ungulate migrations in the Western United States to identify challenges and opportunities for ensuring their long-term continuation of ungulate migrations. Ten central challenges and corresponding best practices were developed and distilled from the strategies and challenges identified in the cross-case analysis chapters. The best practices derive from the most successful strategies utilized by managers and non-governmental organizations in the case studies and are intended to identify opportunities and inform the efforts of individuals, organizations, and agencies concerned with conservation of over-land migration corridors.

- Challenge: **Prioritization of the critical habitat**
    - From an ecological standpoint the winter range is the most critical habitat because species use it when they are most resource-limited. In all of the case studies portions of the winter range face potential for private development.
- Best Practice:
    - Habitat managers should, and do, focus their restoration and forage improvements efforts first on the winter range. Similarly conservation organizations, such as land trusts, should focus their habitat protection campaigns on critical winter range. Birthing areas are also of critical importance and should likewise be prioritized over other areas.
- Example: Eastern Sierra Land Trust and winter range conservation
    - The Round Valley mule deer have a very small winter range that is highly threatened by development. The Eastern Sierra Land Trust has purchased Crowley Hilltop Preserve to protect winter range and migration corridor habitat for the Round Valley mule deer.

- Challenge: **Management for bottlenecks**
    - Ungulate migration corridors are, for the most part, wide enough to allow the animals to select routes that limit their contact with stressful anthropogenic stimuli. Migratory bottlenecks are the exception to this rule. These narrow stretches often force ungulates to navigate potentially harmful impediments to complete their migrations. Bottlenecks often result from the interactions of topographic features and human infrastructure. Wildlife managers lack the tools to address these threats directly.
- Best Practice:
    - The first step in addressing migratory impediments is the identification of current and potential future bottlenecks. Through the application of knowledge about the "areas of effect" of anthropogenic structures, managers can precisely define the boundaries of these bottlenecks and implement mitigation strategies to alleviate the pressure on migratory ungulates
- Example: Trapper's Point right-of-way modifications
    - The Trapper's Point bottleneck, west of Pinedale, Wyoming, is created by the convergence of two riparian areas and highway US-191. Pronghorn antelope must cross two fences and a heavily traveled roadway to continue their migration. WGFD worked with WYDOT to move right-of-way fences further from the highway, allowing pronghorn buffer zones on each side of the road. WYDOT also partnered with the BLM to install a seismic and motion detection system to alert motorists of wildlife crossing. These agencies and other groups are considering further mitigation strategies to further reduce the effects of this impediment on migratory pronghorn and mule deer.

- Challenge: **Access to critical ecological and management information**
    - Ecological and management data is collected at a local level, but it is often applicable at a landscape or even regional level. Managers are currently duplicating each other's efforts, needlessly utilizing valuable resources.

- Best Practice:
    - There is a need for authoritative organizations to act as leaders in the push for the standardization of research methodology. Leaders can organize the disparate efforts of locally focused actors into a common framework, thereby decreasing duplicative research and incongruent methodologies.
- Example: Western Governor's Association data standardization and access
    - The respected Western Governors Association has called for a national clearing house for data on ungulate migrations. They have proposed cross-state standardization of research methods to facilitate cross jurisdictional comparisons of management outcomes. Organizations like the WGA, with far-reaching credibility play important leadership roles in the push for information sharing and standardization.

- Challenge: **Reconciling single species and ecosystem management**
    - There is little debate that ecosystem management is superior, from an ecological standpoint, to traditional single species management. Comprehensive approaches allow managers to better understand the underlying processes that are responsible for simplified measures of population viability, such as herd counts.
- Best Practice:
    - The results of our study suggest that single species management remains the best strategy to address some of the issues unique to long-distance migration. Management for biodiversity alone is incapable of addressing the concerns unique to migratory ungulates. In order to sustain long distance migration routes, connectivity concerns must at times outweigh directives to maintain the highest quality habitat. However, we found many single species management practices borrowed heavily from ecosystem approaches. The active adaptive management of a population necessarily entails collecting data on a wide variety of ecological information, which is used to address ecosystem-level management concerns.
- Example: The Absaroka Elk Ecology Project
    - As part of this project, researchers from the University of Wyoming and the Wyoming Game and Fish Department (WGFD) are currently collecting data on

the Clarks Fork elk to help them understand habitat utilization and the impacts of wolf recolonization on the herd. This is an example of single species management, however, the results of this study will be integral in helping managers improve their models of how wolf recolonization will affect this and other parts of the Greater Yellowstone Ecosystem (GYE). Modeling wolf recolonization as part of active adaptive management is further covered in section 5 of the Threats chapter.

- Challenge: **Management under uncertain conditions**
    - Wildlife managers are faced with ever-increasing uncertainty as development and climate change irreversibly alter the ecosystems migratory ungulates depend upon. There is a feeling of helplessness in the management community, stemming from an inability to address the root causes of these threats.
- Best Practice:
    - Our review of adaptive management strategies reveals that current monitoring and modeling techniques can rapidly incorporate new information into management plans as it becomes available, providing managers with a powerful tool to address ecological uncertainty. Adaptive management allows managers to proactively incorporate predictions of future climate and development scenarios into their plans. Our analysis of legal and policy mechanisms available to address development reveals that the tools exist, but capacity and political will may be currently lacking.
- Example: Wyoming Game and Fish Department calculation of Elk Hunting Quotas
    - Every year the WGFD compiles their most up-to-date information on the population size, calf/cow ratios, hunters' success rate and harvest amounts for all elk herds, and then considers data on weather and habitat quality for each area to determine hunting season dates and quotas for each herd. This is an example of active adaptive management that will allow the WGFD to make informed decisions on management of hunting as future development and climate change scenarios unfold.

- Challenge: **Resource limitations**
    - NGOs, state and federal agencies, and academic institutions are universally constrained by resource limitations. These constraints can generally be classified as limitations in money, knowledge, and/or capacity.
- Best Practice:
    - Each of these organizations possesses a unique suite of capabilities. Forging bilateral partnerships and multilateral coalitions allows each partner access to the pooled resources of the group. These partnerships can efficiently and effectively address problems that are either too complex or too large to address individually.
- Example: Jonah Interagency Office
    - The Jonah Interagency Office was able to expand the resources of the Green River Valley Land Trust by providing grant money to GRVLT for a wildlife-friendly fencing initiative. In this way, GRVLT is able to expand resources to landowners and JIO meets its set agenda to help mitigate wildlife off the Jonah Field. Additionally, the JIO project funding required matching funds, thus increasing the resources for GRVLT and creating multiple partnerships through sharing financial resources.

- Challenge: **Working within multiple-use mandates to prioritize wildlife**
    - The multiple-use mandates under which the USFS and BLM operate are broadly-enabling and gives these land management agencies discretion to determine what land uses to prioritize in specific areas. The legal mandates do not, however, dictate when agencies have to prioritize specific uses, such as wildlife, so this choice is left to individual offices of both agencies.
- Best Practice
    - Management strategies implemented by individual offices of both the USFS and BLM indicate that both agencies have flexibility within their mandates to prioritize wildlife as a use in designated areas, specifically, to prioritize important habitat for migrating ungulates. The best practice associated with this flexibility is the leadership and innovation of individual managers in deciding to address recognized threats to migrating ungulates.

- Example: Bridger-Teton National Forest, USFS and Bishop Field Office, BLM
  - Bridger-Teton National Forest amended its forest plan to “designate” the migration corridor of the Grand Teton National Park pronghorn. The amendment requires that any future actions the forest authorizes in the route allow for the migration of the pronghorn herd, successfully prioritizing the habitat needs of the migrating ungulate over other uses.
  - The Bishop Field Office of the BLM recently made its lands within the migration route of the Grand Teton National Park pronghorn, as well as some portions of herd’s winter range, unavailable for future natural gas leasing. This decision has, in effect, prioritized the use of the important ungulate habitat area for wildlife above that for mineral development, a common use on BLM lands in Sublette County.

- Challenge: **Addressing impacts to migrations from residential development**
  - Local planning bodies operate under specific state directives that may expand or limit their ability to address the impacts of residential development on wildlife. These laws may, for example, require a planning body to include mitigation measures or create exemptions for certain types of development from regulation. Additionally, the relative permanence of residential development and the possibility that climate change will alter habitat availability heighten the need for taking sufficient action today.
- Best Practice:
  - The best practice is the resourcefulness of planning bodies to work within their directives to either require mitigation when possible or to seek out the cooperation of developers in achieving habitat conservation goals.
- Example: Mono and Inyo Counties in California
  - Both Mono and Inyo County have integrated CEQA’s requirements for assessing environmental impacts of permitted development into their procedures for reviewing subdivision and development project proposals. In requiring that developers implement mitigation measures to protect Round Valley mule deer

habitat, both counties have successfully applied the law to conserve the habitat of a migrating ungulate.

- Challenge: **Conflicting values and objectives**
    - There is a broad array of stakeholders involved in the conservation of species that move long distances. Challenges arise when the objectives of groups are incongruent. These conflicts can lead to stalled conservation efforts, frustration, and even hostility between groups.
- Best Practice:
    - In cases where differences in groups' values and management objectives prevent either from achieving their objectives, a third party may be able to provide an option or additional flexibility that makes cooperation possible. When beginning efforts such as these it is important to employ strategies in which everyone can share in the success.
- Example: The Nature Conservancy's Heart Mountain Ranch
    - The Forest Service needs to balance multiple uses of its range lands, which sometimes causes conflicts between ranching livelihoods and wildlife habitat needs. For example, Shoshone National Forest needs to manage for good winter elk forage, while also allowing ranchers to graze their cattle on their allotted lands. When SNF needed to do habitat enhancement projects where grazing allotments existed, they worked with The Nature Conservancy's Heart Mountain Ranch and allowed cattle to graze on the Ranch's grass bank. Having cooperative agreements between SNF and TNC allowed SNF to improve habitat while still meeting the needs of local ranchers.

- Challenge: **Communicating the need for conservation to the public**
    - Many of the ecological concepts associated with the conservation of migratory ungulates are difficult for the public to comprehend. People frequently see traveling ungulates and may therefore assume their migration routes to be functional.

- Best Practice:
    - Conservation issues should be made concrete to the public through interactive and engaging techniques that take people to the resource. This includes presentations, volunteer opportunities, and field trips. Community members respond positively to participatory activities that allow them to visually experience the impediments that migratory ungulates face. Educational activities can be particularly useful to foster an early interest in conservation for children and they can serve to positively affect the image of the organization.
- Example: Ancient Corridors
    - Wyoming Outdoor Council worked with federal and state agencies, private landowners, ranchers, civic groups, and other conservation to raise awareness of how wildlife movement patterns on migration corridors might be restored. A DVD titled Ancient Corridors was created, which explained the pronghorn migration to public audiences. Additionally, WOC also hosted a symposium and a field trip, giving people an opportunity to see the bottleneck.

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