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A Policy Analysis of Large Carnivore Responses to Habitat Fragmentation and Human – Carnivore Conflicts in the High Divide

Katherine V. Woolley
kawo4778@colorado.edu

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**A Policy Analysis of Large Carnivore Responses to Habitat
Fragmentation and Human – Carnivore Conflicts in the High
Divide**

**Kate Woolley
Ecology and Evolutionary Biology
March 29, 2016**

**Advisor: Dr. Deserai Crow, Environmental Studies
Dr. Piet Johnson, Ecology and Evolutionary Biology
Dr. Carol Kearns, Ecology and Evolutionary Biology
Dr. Carol Wessman, Ecology and Evolutionary Biology**

Abstract:

The Northern Rockies contain upwards of 10 million acres of the most pristine land left in the Lower 48 states. A continuous landscape is necessary to preserve the function and beauty of the ecosystems found in this area. The High Divide is an essential wildlife corridor that enables the movement of organisms to and from three of these major ecosystems in the Northern Rockies. In recent years, residential development has increased fragmentation of the High Divide, impeding animal movement through the area. This restriction is especially significant for gray wolves (*Canis lupus*) and grizzly bears (*Ursus arctos horribilis*) as they are apex predators that have large movement patterns and major roles in ecosystem function and biodiversity. This project analyzes the issue by mapping predator ranges and residential development data using ArcGIS to visualize the extent of overlap. It then investigates the effectiveness of current and alternative management schemes through a policy analysis to determine what strategies are most effective in conserving wolves and grizzly bears with minimal landscape fragmentation while also protecting people and their property.

Keywords: Gray wolf, grizzly bear, conservation, management, policy, conflict.

Introduction:

Residential development in the High Divide wildlife corridor between the Crown of the Continent, Salmon-Selway-Bitterroot, and Greater Yellowstone ecosystems in the Northern Rockies has resulted in fragmentation of the landscape. Fragmentation reduces land connectivity and thus impedes the movement of animals that use the High Divide both as primary habitat and to travel between suitable areas. For animals that have large territorial home ranges such as gray wolves and grizzly bears, connectivity is necessary for them to carry out their ecological roles as apex predators. Reduction in connectivity can push gray wolves and grizzly bears out of their preferred habitat, which in turn can have a significant impact on trophic interactions. Reduced connectivity as a result of residential development can also increase the likelihood of interactions between large carnivores and humans, which can be potentially detrimental.

In this paper I review the available literature on apex predator ecology, with specific attention paid to gray wolves and grizzly bears. Next, I review the ecological impact of fragmentation, and then put it in the context of the High Divide corridor in Montana and Idaho. Finally, I review the residential development that has caused this fragmentation, as well as the human-carnivore interactions that have occurred as a result.

Then, in Section 2, I provide a policy analysis in which I use Eugene Bardach's Eight-Fold Path (2000) to consider policy alternatives that address the different management approaches to this issue. I analyze the different ecological and social impacts of each alternative, and then offer commentary on which alternative would be best to implement.

Apex Predator Ecology

Gray wolves and grizzly bears are apex predators within the Northern Rocky Mountain ecosystem, meaning they play a major role in the subsequent trophic interactions and biological structure of the ecosystem (Crooks et al, 2011). The presence of carnivores in a landscape is often correlated with high ecological integrity because of their regulation of the food web (Noss, 1996). This in turn can result in the conservation of as much as 90% of biodiversity in an ecosystem (Foreman, 1992).

Their position at the top of the food chain means wolves and bears have a significant impact on prey abundance, or the number of prey animals in an ecosystem (Treves & Karanth, 2003). Predation regulates the number of individuals within a prey-species population, while anti-predator behavior determines interactions between prey and predator species (Heithaus et. al, 2007). Predation by apex predators inflicts a top-down control on species abundance within an ecosystem, meaning they directly regulate mid-level consumer (or meso-consumer) populations. This is done either through direct predation of prey species or through food-resource competition with lower level predators. Removing apex predators can result in a trophic cascade (Crooks, 2011). This is the liberation of meso-consumers from the top-down pressure of the apex predator, which can result in population expansion and possible changes in resource species abundance (Brook, Johnson & Ritchie, 2012). Resource species are those that are eaten by mid-level consumers in ecosystems, and are generally primary producers (Heithaus

et.al, 2007). In the High Divide, reduction or removal of gray wolves and grizzly bears would cause such a cascade through the subsequent increase in meso-consumers such as coyotes (*Canis latrans*) and elk (*Cervus Canadensis*). Through hunting and grazing, the growth of mid-consumer populations would eventually lead to the destruction of resource species, such as aspen (*Populus tremuloides*) and whitebark pine (*Pinus albicaulis*) (Ripple & Beschta, 2011). Changes in resources species abundance and reduction in the diversity of primary producers has a significant negative impact on the productivity of the community, and would jeopardize current biodiversity and species composition (Montana Fish, Wildlife & Parks, 2015; Cardinale et.al, 2011; Heithaus, 2007).

Removal of apex predators out their preferred habitat has become a significant threat in the High Divide due to development. Humans, wolves, and grizzly bears have similar lifestyle characteristics and needs; the competition between these species suggests the availability of habitat they share is being compromised. It is likely that the High Divide habitat will be degraded or, potentially, the predators will be pushed out of the habitat entirely, resulting in the aforementioned trophic cascade (Paquet, 1996).

Wolf Ecology

Gray wolves are pack carnivores that largely rely on ungulates (hoofed mammals) for their prey. They have large territorial home ranges that can cover 25mi² to 1500mi², depending on the abundance of prey species in the area (US Fish & Wildlife Service ECOS, 2015). Although they are habitat generalists, optimal wolf habitat generally consists of forested mountainous areas that have low density of human population, low livestock density, high density of elk and other prey, and minimal agricultural development (Washington Fish & Wildlife Office, 2012; Oakleaf et. al, 2006). The average litter size for gray wolves is about 5 pups. The mother and other pack members care for these pups until they are approximately 1 to 2 years old, at which point they leave the pack in an attempt to find a mate and new pack (US Fish & Wildlife Service, 2003).

Throughout the 1900s gray wolves were hunted to near extinction in the Lower 48 states largely because they preyed upon livestock, resulting in their classification as an endangered species and their protection under the Endangered Species Act on January 4,

1974 (US Fish & Wildlife, 2015). At the time, the only remaining populations of gray wolves in the Lower 48 were in Michigan and Minnesota until the establishment of Nonessential Experimental Populations (NEP) under the 10(j) rule of the Endangered Species Act, which allowed for the reintroduction of wolves outside of their current range and into what used to be their historic range. In 1995, a NEP was established in the Greater Yellowstone Ecosystem in Wyoming through a reintroduction into Yellowstone National Park. In 1996, wolves were released into central Idaho as well. Over the next two decades, the gray wolf has successfully recovered within the Northern Rocky Mountains, which resulted in the delisting of wolves within Montana and Idaho, and parts of Utah, Oregon, and Washington in 2011. Their respective state governments now manage these populations. The population in Wyoming was delisted in 2012, but the ruling was vacated in 2014 as a result of a U.S. District Court decision, when it was listed again as a federally-regulated endangered NEP (US Fish & Wildlife Service, 2015).

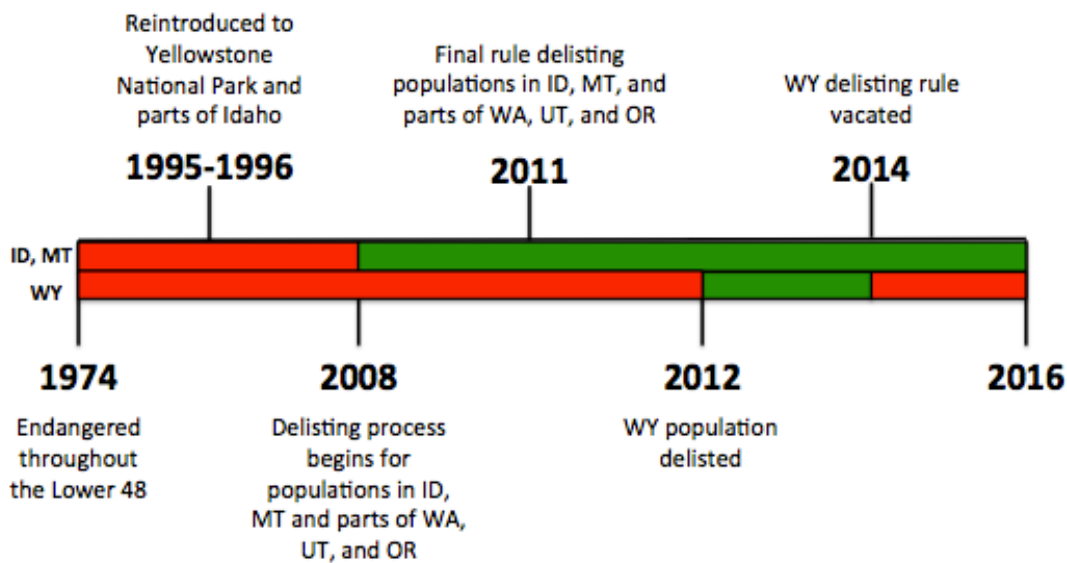


Figure 1. Gray wolf's Endangered Species Act Timeline. The top bar represents the populations in Idaho and Montana. The bottom bar represents the population in Wyoming. The red bar designates time periods during which the populations were listed as Endangered, and the green bar designated time periods during which the populations were removed from the ESA.

The gray wolf populations in the Northern Rockies are stable, with the populations in Montana, Idaho, and Wyoming approximating 1,657 individuals in 2014. However, the numbers of individuals within these states have demonstrated a slight downward trend since 2011 (US Fish & Wildlife Service, 2014). It is suspected that this

is due to a longer established hunting season as well as a more aggressive anti-predation policy for residents that experience threats to their livelihood and livestock (Montana FWS, 2014; Idaho Department of F&G, 2014). Long-term wolf recovery goals in the Northern Rockies include maintaining an average population of 1000 individual wolves, with a minimum of ten breeding pairs in each recovery zone (Greater Yellowstone, central Idaho, and southwest Montana) (US Fish & Wildlife Service, 2015). The majority of wolf packs in Montana, Idaho, and Wyoming are centralized around the Crown of the Continent ecosystem in Montana, the Salmon-Selway-Bitterroot ecosystem in Idaho, and Greater Yellowstone ecosystem in Wyoming (US Fish & Wildlife Service, 2014). The High Divide serves as a linkage between these three ecosystems, and therefore is vital for the movement of the wolf packs that inhabit the area.

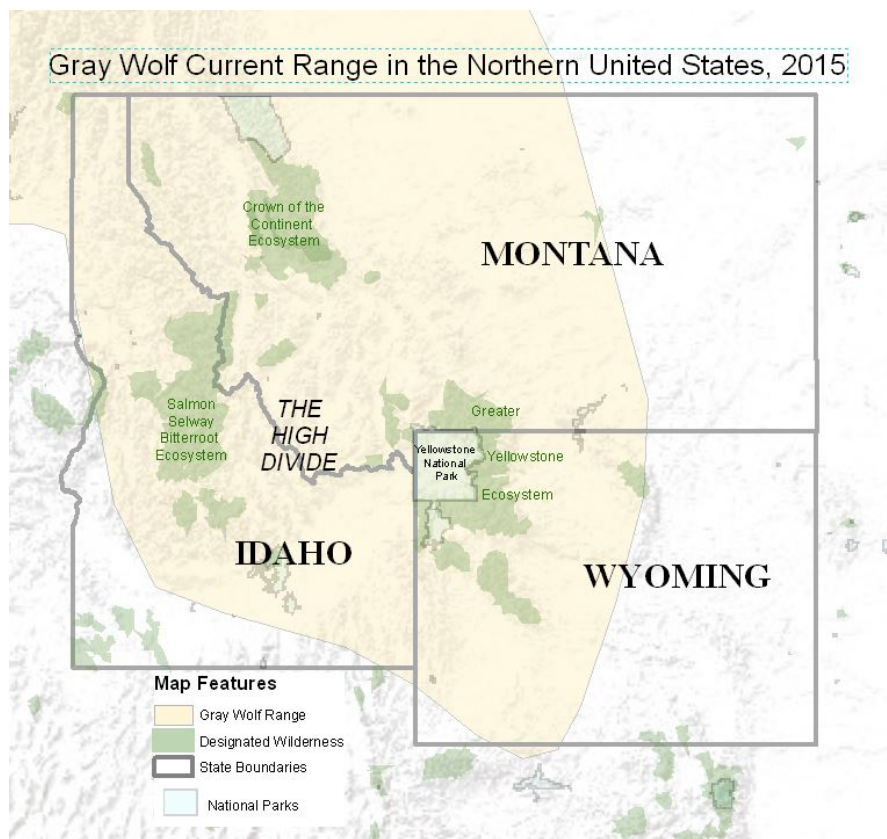


Figure 2. Map depicting the current gray wolf range in the Lower 48 states in the context of the High Divide.

Grizzly Bear Ecology

Grizzly bears are able to adapt to multiple different habitat and ecosystem conditions, and the availability of certain resources influences their diet and habitat-use patterns. Their diet reflects this adaptability as they are opportunistic omnivores (US Fish & Wildlife Service, 2015; Servheen, Waller, Sanstrom, 2001). Optimum grizzly bear habitat consists of a combination between forested and flat land that makes for a structurally diverse landscape (Servheen, 1983). Home ranges differ between sexes, with females having an average home range size of 50mi² to 300mi² and males having an average home range of 200mi² to 500mi² (US Fish & Wildlife Service, 2007). Grizzly bears have an average of one to three cubs per litter that will remain dependent on their mother for approximately 3 years. They will not become reproductively mature until they are anywhere from 4.5 to 8.5 years, at which point females will breed once every 3 years while males will breed annually (US Fish & Wildlife Service, 2007).

Throughout the 1900s grizzly bears were hunted to near extinction in the lower 48 states, resulting in their protection under the Endangered Species Act as a threatened species in July 28, 1975 (National Park Service, 2016). State and federal agencies then employed a management plan that involved limiting hunting, establishment of recovery areas, and creation of the Interagency Grizzly Bear Study Team and the Interagency Grizzly Bear Committee to monitor and research populations through a cooperative management scheme (National Park Service, 2016). These efforts have been successful, and have resulted in the U.S. Fish & Wildlife Service proposition of delisting grizzly bears in the Greater Yellowstone Ecosystem from the Endangered Species Act (USFWS, 2016). However, grizzly bears still only occupy 2% of their former range in the lower 48 and are prone to conflicts with livestock and humans because they can become habituated to human presence (US Fish & Wildlife Service, 2007).

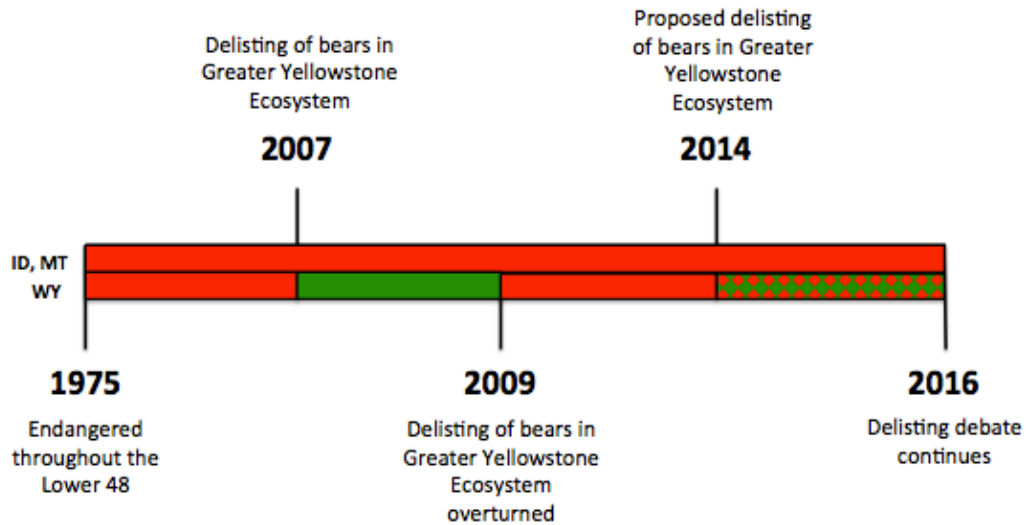


Figure 3. Grizzly bear’s Endangered Species Act Timeline. The top bar represents the populations in Idaho and Montana. The bottom bar represents the population in Wyoming. The red bar designates time periods during which the populations were listed as Endangered, and the green bar designated time periods during which the populations were removed from the ESA. The checkered bar represents the current debate regarding the grizzly bear’s ESA status.

Grizzly bears in the lower 48 make up a meta-population, meaning there are multiple distinct populations in the area that are connected via habitat linkage corridors (Serhveen, Waller & Sanstrom, 2001). These populations are primarily distributed between five main recovery zones in the Northern Rockies, three of which are contained within the Crown of the Continent, Salmon-Selway-Bitterroot, and Greater Yellowstone ecosystems. Among these, the Crown of the Continent and Greater Yellowstone ecosystems are home to approximately 1,345 bears. The Bitterroot ecosystem is not presently home to any grizzly bears, although plans for reintroduction have been discussed for years (Interagency Grizzly Bear Committee, 2012). Landscape connectivity between these populations is vital for minimization of genetic drift and thus the preservation of the gene pool.

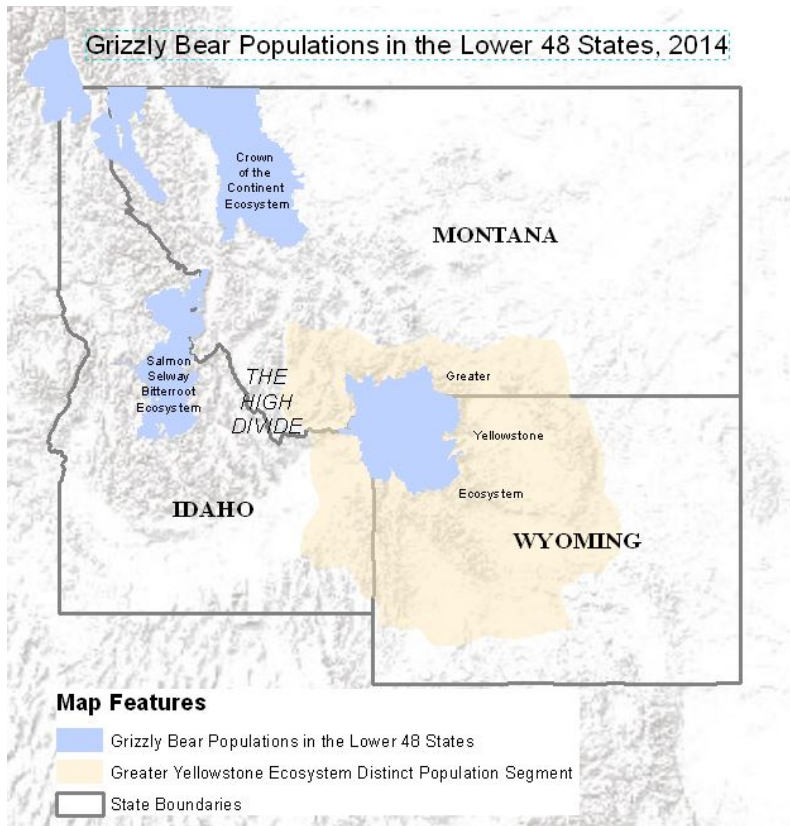


Figure 4. Map depicting the current grizzly bear habitat in the Lower 48 states in the context of the High Divide.

Fragmentation

Fragmentation is the breakup of continuous habitat into smaller patches of habitat, resulting in habitat loss and a decrease the connectivity of the landscape (Mitchell et al, 2015). It is linked with the overall decline of healthy habitat, and is considered to be the leading cause of global ecosystem degradation and loss of biodiversity through area loss, increased patch isolation, and greater exposure to human exploitation (Haddad et. al, 2015; Wilson et. al, 2016). As a result, fragmentation poses a threat to the connectivity of landscapes and therefore the movement of organisms across landscapes, as well as increases the risk of extinction (Crooks et. al, 2011; Mitchell et. al, 2015). Land-use change and housing development are two major causes of habitat fragmentation because of road development, land clearing, and fence building. These changes challenge and prevent the movement of organisms between areas of vital habitat and expose them to higher probability of coming in contact with humans (Mitchell et al, 2015). The position

of the High Divide between the Crown of the Continent, Salmon-Selway-Bitterroot, and Greater Yellowstone ecosystems make it critical in maintaining connectivity to preserve its function as a wildlife corridor.

The ecological impact of fragmentation of a landscape on large carnivore populations has not been extensively studied. Data gathering can often be precluded by the relatively steep topography of the region, the complicated positioning of public lands, as well as the simple difficulties associated with monitoring carnivore populations due to their large home ranges (Beckmann, 2006; Crooks et al, 2011). Despite these difficulties, it is expected that large mammalian carnivores like grizzly bears and wolves are more susceptible to the negative impacts of fragmentation because of their low population numbers, large habitat ranges, and general incompatibility with humans (Crooks, 2002). In the case of gray wolves and grizzly bears, a large swath of continuous landscape is necessary to support not only their biological needs, but also those of many other species found in the ecosystem. In other words, they are umbrella species, or those whose habitats contain many other species habitats such as wolverines, coyotes and ungulates (Noss, 1996). Their importance in determining and regulating the health and biodiversity in the ecosystem depends on a healthy landscape. In recent years the development in the High Divide has culminated in an increase in fencing, driveway and road construction. These barriers can effectively create terrestrial islands that prohibit movement from one patch to another or isolate patches from less-healthy surrounding matrix (Crist, Wilmer & Aplet, 2005). Roads in particular are especially dangerous for wolves and grizzly bears as they increase their exposure to motor vehicle collisions and create easier access for hunters and poachers (Noss, 1996).

In an area such as the High Divide where apex predators serve as regulating forces within the ecosystem, reduction of their populations would result in dramatic ecosystem changes. Protecting connectivity corridors for carnivores and maintaining fluidity within the habitat are necessary for this area to continue facilitating the passage of organisms through the High Divide.

Significance of High Divide:

The High Divide is a 500 km² wildlife corridor that allows for the movement of organisms between three major ecosystems in the Northern Rockies: the Crown of the Continent in northern Montana, the Salmon-Selway-Bitterroot ecosystem in central Idaho, and the Greater Yellowstone Ecosystem in Wyoming (Yellowstone to Yukon Conservation Initiative, 2015). Together, these areas represent some of the most pristine lands in the lower 48 and provide vital habitat for many species. Bridging the eastern border of Idaho and the southwestern border of Montana, the High Divide provides a linkage zone between these ecosystems that facilitates the flow of individual animals and their genes in the Northern Rockies. Such movement is necessary to maintain healthy ecosystems and populations of species within these ecosystems through the preservation of biodiversity and genetic variation (Mitchell et al, 2015; Headwaters Economics, 2015). However, in recent years there has been a high demand for land for homes because of the growing human population. The Northern Rockies has proven to be a desirable location due to an abundance of recreational opportunities and growing economies in the service and tech industries. While private land was historically distributed as large ranches, recent population growth has resulted in the division of these ranches and farms into smaller residential developments (Worldwatch Institute). This increase in division of the land has subsequently resulted in further fragmentation of the landscape.

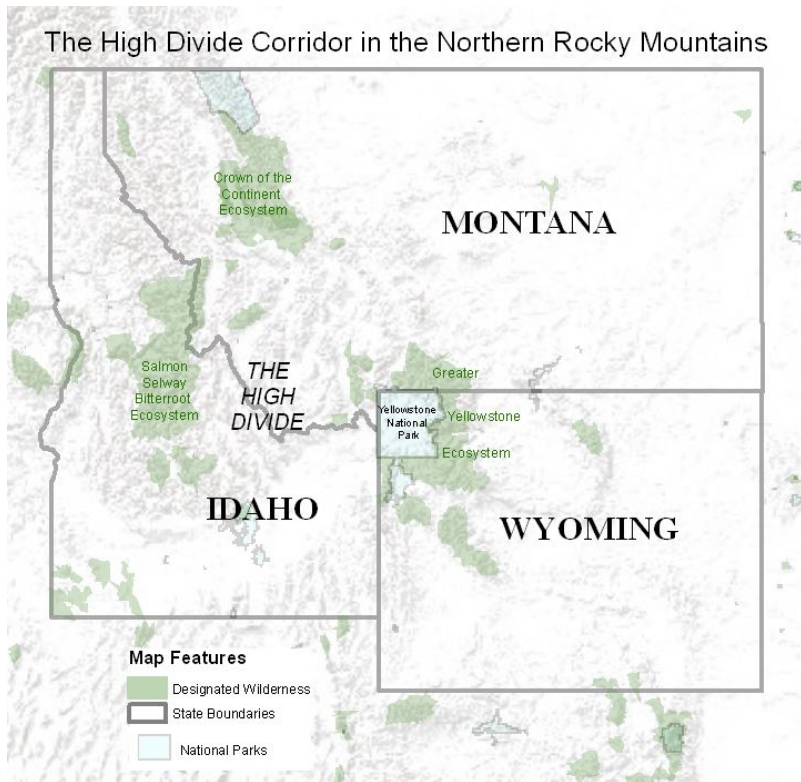


Figure 5. Reference map of the High Divide corridor in the Northern Rockies

Research Question

Based on the literature above, I expect that human-carnivore conflict can have significant impacts on communities within the High Divide. Habitat fragmentation might add to this conflict, as well as inflict ecological and trophic changes within the ecosystem. I seek to answer the question of what policy and management suggestions can be made that will limit further fragmentation of the High Divide while also reducing the impacts of human-carnivore conflicts in the area.

Methods:

This analysis was conducted largely through reviewing and synthesizing existing literature on the subject. Materials and data from existing published scientific studies, state and federal organizations, and private research groups were compiled to obtain a thorough and multidisciplinary report regarding human development in the High Divide and its subsequent impact on gray wolf and grizzly bear populations.

Searches for published scientific papers were conducted primarily through Google Scholar. In most searches the key words and phrases that were focused upon were “gray wolf populations”, “grizzly bear populations”, “human development”, “High Divide”, “fragmentation”, “impacts”, and “management strategies.” I primarily focused on articles that specifically had to do with the general Northern Rockies ecosystem and the High Divide, however studies outlining general behavior and ecology of both gray wolves and grizzly bears, and apex predators in general were taken from less geographically specific sources. Articles focusing on fragmentation, connectivity and the subsequent ecological impacts were also taken from sources not necessarily focused on the High Divide ecosystem in an effort to glean lessons from relevant research conducted elsewhere that can be applied to this geographic region. From these searches, I collected publications from journals such as *Conservation Biology*, *Ecology and Society*, and *Animals and Society*. Information on wolf and grizzly bear population and management was collected from the Montana Fish, Wildlife, and Parks, Idaho Fish and Game, the U.S. Geological Survey, as well as the US Fish and Wildlife Service. Information on human development and growth within the High Divide was gathered from Headwaters Economics, an independent nonpartisan research group. The management tool Zotero was used to organize and make notes regarding the articles collected.

I approached the policy analysis using the eight-step framework outlined by the political scientist and University of California, Berkeley professor emeritus Eugene Bardach in his book *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving* (2000). The steps acted as a guide for my thought process when synthesizing the literature and data for the policy analysis. The eight steps are as follows:

1) Problem Definition

The problem definition involves determining what factors are contributing to this issue, and how this issue is presenting itself in an ecological and social setting.

This will also involve defining what stakeholders have a vested interest in this issue, and what their viewpoint on said issue is.

2) Assemble Some Evidence

Assembling evidence consists of collecting data and information regarding residential development and gray wolf and grizzly bear ecology, as well as providing social context behind the issue.

3) Construct Alternatives

Constructing the alternatives involves coming up with multiple policy regimes that take different approaches on how to address and mediate fragmentation and human-carnivore conflicts in the High Divide.

4) Select the Criteria

Selecting the criteria is essentially establishing what values will determine if a policy alternative is effective in addressing the problems being analyzed in the High Divide

5) Project the Outcomes

The fifth step predicts how each policy alternative will impact the selected criteria and stakeholders within the High Divide.

6) Confront the Trade-Offs

Step 6 compares the policy alternatives in the context of the selected criteria. It addresses the positive and negative social and ecological impacts of each alternative, and then compares each policy's outcomes to the others.

7) Decide

After analyzing each alternative in the context of the selected criteria, this step determines which alternative would best address the defined problem.

8) Tell Your Story

The eighth and final step is simply describing how you came to your decision using the eight-fold path. Essentially it is reporting how the process was applied in the context of fragmentation and apex predator ecology in the High Divide.

FINDINGS AND APPLICATIONS

Problem Definition:

This is an issue of regional interest in the Northern Rocky Mountains with a focus in the High Divide wildlife corridor. Gray wolves and grizzly bears are essential in the

function of the Northern Rocky Mountain ecosystems. Both species have been or are currently protected under the Endangered Species Act, making them focal species for management and recovery programs. Also, the growing human population has encroached on historical wolf and bear habitats, making human-carnivore confrontations an increasingly common threat to human safety and property, as well as carnivore populations and conservation goals.

Residential Development in the High Divide

Over the last 50 years, the High Divide has seen dramatic growth in population and home development. According to the independent non-partisan research group Headwaters Economics, the number of single-family homes in this region has grown from approximately 28,000 homes in 1963 to 75,000 homes in 2013 (Headwaters Economics, 2015). While these numbers do not suggest massive urban development compared to most other areas the United States, they do represent nearly a 260% increase in the number of homes in the High Divide. Historically this land was home to large rural ranches, but recently parts of these ranches have been set aside for residential development projects (Barrera, Worldwatch Institute). As a result, most of this relatively extensive development is occurring in unincorporated areas of the counties within the High Divide, meaning people are moving away from more concentrated populations in town centers and building on previously undeveloped land. This trend has recently accelerated, with 63% of new home construction from 2010-2013 occurring in such areas (Headwaters Economics, 2015). Much of the home building within the High Divide is on valley floors, making them linear in shape and thus an obstruction to animals moving to and from areas of higher elevation (Servheen, Waller & Sanstrom, 2001). In the South Madison Valley, Montana, for instance, residential subdivisions and small parcels are available for building in many key areas that currently allow for the movement of animals between conservation easements and public lands. While many of these parcels have not yet been built on, they would not require further permits or approval to do so. If these areas were to be developed, they would jeopardize the movement of animals and the investments that Madison County and conservation groups have put into protecting these

linkages, as well as potentially reduce the value of the remaining protected land (Yellowstone to Yukon, 2015).

Residential development in the High Divide has increased dramatically within the last 50 years, and has resulted in increased landscape fragmentation through construction of fences, roads and highways, and building on previously undeveloped land. This negatively impacts wildlife such as wolves and grizzly bears by reducing the connectivity of the landscape, making movement from one ecosystem to another difficult. Such reduction of suitable habitat threatens the health and biodiversity of the ecosystem. It also increases the risk of conflicts between these large carnivores and humans simply due to closer proximity as well as competition between the two for similar spatial and food resources. These conflicts can endanger people's property and potentially threaten gray wolf and grizzly bear populations.

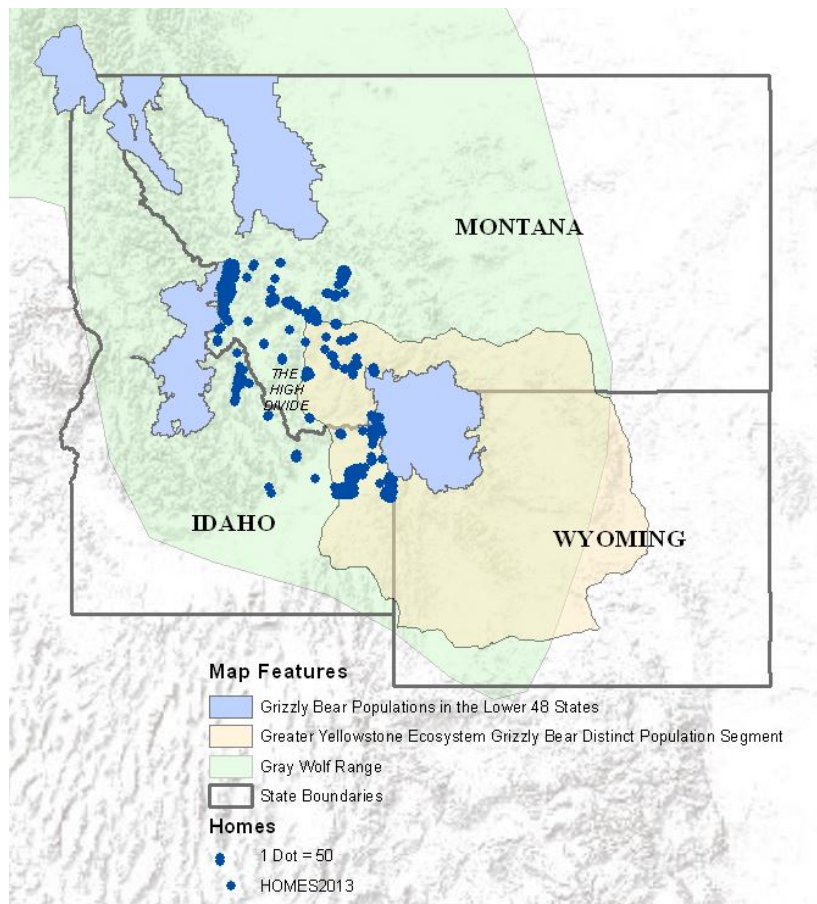


Figure 6. Map depicting overlap of gray wolf and grizzly bear populations with the density of homes in 2013 in the High Divide.

Human-Carnivore Conflicts

As humans have an increasing presence in the High Divide, conflicts between large carnivores and residents will also continue to increase. For example, wolves and bears tend to compete with humans for resources such as space and protein-rich food sources (Treves and Karanth, 2003). Due to the growing human population and expanding wolf numbers, the number of human-caused wolf mortality has also increased and was responsible for approximately 98% and 99% of total wolf deaths in 2014 in Montana and Idaho, respectively. The majority of these kills were legal public harvests via hunting and trapping or lethal control kills, which is the management removal of a problematic animal. While it is rare for a wolf to attack a human, when they do so it is largely because they have been food conditioned and used to human presence (Montana Fish, Wildlife & Parks, 2014). The demonstrated trend of increased overall mortality of the wolf populations in this area suggest that humans and wolves are in closer proximity now than in previous years. If people continue to build in areas where there are wolf packs, the nature of the conflicts may evolve from livestock predation and impacts on elk herds to predation of domestic animals or an overall lower tolerance for wolves due to fear within communities (Lawhon, 2016).

Nearly 80% of grizzly bear deaths in the Northern Rockies are human caused. Since bears are not part of a legal public hunting program, these deaths are most often caused by management removal due to cattle predation, or vehicle collisions (USGS NOROCK, 2015). Being omnivorous, grizzly bears have been known to scavenge around neighborhoods and even break into houses in search of food. In 2015, 12 out of the 59 grizzly bear deaths in Wyoming, Idaho, and Montana were management removal cases resulting from anthropogenic interactions, food rewards, and habituation to human presence. Human encounters with grizzly bears have even turned fatal, with at least one bear euthanized in 2015 for killing a person (USGS NOROCK, 2015).

Historically, wolves and grizzly bears have been persecuted by local residents for killing livestock and jeopardizing many ranchers' property and lifestyle. In 2014 gray wolves were responsible for approximately 194 livestock kills in Montana and Idaho (Fish and Wildlife Service, 2014). In 2015, out of the 59 known grizzly bear deaths, 13 were removed for cattle depredation (USGS NOROCK, 2015). As the quality of wolf and bear

habitat decreases due to fragmentation, the quality and availability of food for these animals also decreases. This often results in wolves and bears turning to alternative food sources. Habitat fragmentation caused by residential development might increase human-carnivore conflicts on smaller, more developed parcels of land and may result in predation of domestic pets, or damage to small-scale orchards, gardens, and beehives (Gunther, 2004). The availability of natural bear food resources is inversely correlated with the number of human-bear conflicts and incidents of property damage. This means that decreases in food availability due to habitat degradation correlates with an increase in conflicts such as damage to local agriculture and domestic beehives kept by residents (Gunther et. al, 2004). The risk of human-carnivore conflict is directly tied to wildlife and humans occupying the same land and competing for the same resources. Either fatal interactions between humans and the carnivores or the movement of carnivores out of their preferred habitat will result (Paquet, 2006). In the High Divide, increasing residential development and habitat fragmentation will result in more conflicts between people and wolves or bears, as well as threaten the conservation and recovery efforts tailored to these species.

	Grizzly Bears	Gray Wolves
Human-Caused Mortality Percentage	80% (2015)	98-99%(2014)
Most Common Conflicts	Lethal Control Vehicle Collisions	Permitted Hunting Lethal Control
Reasons for Lethal Control	Livestock Predation Nuisance Food Habituation	Livestock Predation

Figure 7. Comparison of conflicts between humans, gray wolves and grizzly bears (*Northern Rocky Mountain Wolf Recovery Program 2014 Interagency Annual Report*).

As the High Divide experiences more fragmentation and residential developments, conflicts between humans and carnivores will increase, posing a threat to carnivores, their conservation, and the safety of residential communities. This could result in higher mortality for these animals, or the movement of wolf and bear populations out of the High Divide and into new habitat. The conservation and protection of the High Divide as a connected landscape is essential to maintain its function as a

wildlife corridor in the Northern Rockies, and to allow for the movement and occurrence of gray wolves and grizzly bears between the three major ecosystems and within the High Divide itself.

Current Management Practices

Instances of human-carnivore conflicts are widespread throughout the United States, and have been the recent focus of many communities, policy makers, and conservation groups. Often, conflicts take shape in the form of livestock depredation or food availability or habituation, which have been met with a plethora of different management strategies.

Like wolves and grizzly bears, the Florida panther (*Puma concolor coryi*) is also recovering after near-extinction and is dependent on habitat conservation, especially on private rangelands in Florida. However, livestock depredation has threatened local ranchers and thus resulted in the killing of panthers (Pienaar, Kreye & Jacobs, 2015). Recent management practices have focused on how to promote coexistence and reduce conflict between ranchers and panthers. The United States Fish & Wildlife Service has implemented a program that financially incentivizes panther habitat management and protection on privately owned ranchland. It also offsets the cost of livestock depredation for ranchers as both the panther population and the need for habitat grow (Pienaar, Kreye & Jacobs, 2015). Management efforts made by the Non-Governmental Organization Defenders of Wildlife have also culminated in improved road safety for panthers including reduced night speeds, underpass and fencing installation, and motion sensor devices that alert when large animals are near the road, as well as distribution of panther resistant enclosures for livestock and increased community awareness (Defenders of Wildlife, 2016).

In the arctic village of Kaktovik, Alaska, human-carnivore conflicts are most often with polar bears (*Urus maritimus*) that enter human settlements in search of food. Melting permafrost has compromised the function of traditionally used ice cellars for food storage, resulting in the attraction of polar bears. The Non-Governmental Organization Defenders of Wildlife has partnered with the World Wildlife Fund to test and implement a more effective food storage method that will protect the community

from resource loss and polar bear encounters. They have also employed diversionary tactics in which potential attractants for polar bears are moved to a safe distance from the community to reduce human-bear conflict, as well as a program for distributing science-based information to the public regarding polar bear conservation and coexistence (Defenders of Wildlife, 2016).

Community involvement has been a priority in many conservation management plans, including that put forth by the Keweenaw Bay Indian Community (KBIC) in the Upper Peninsula of Michigan regarding gray wolf conservation. Gray wolves were delisted from the endangered species list in the Great Lakes region in 2011, after which management rights were given to state and tribal agencies. KBIC's management plan is community oriented, and draws heavily on the input of the citizens. The plan has implemented techniques such as surveys to poll management preferences within the community, partnerships with other agencies to ensure effective monitoring, field assistance, and resource use, as well as community education to promote conservation and debunk myths surrounding wolves. The conservation strategies detailed in the plan include not only monitoring wolf numbers and populations, but also include protecting the habitat of prey species such as white-tailed deer, restricting disturbances around active den sites, and implementing nonlethal methods to reduce and prevent conflicts (KBIC, 2013).

In the Northern Rockies, current policies allow for citizens to kill problematic wolves and bears if they are threatening the safety of a person or property. However, tactics have recently been implemented in certain areas to reduce the likelihood of conflicts and improve overall landscape conservation for wolves and grizzly bears. In 2012, Montana Fish, Wildlife & Parks released a guide on how to build wildlife-friendly fences that included guidelines on proper materials, structure, and visual additions to protect wildlife movement, secure livestock, and even deter carnivores. Such fencing has been implemented on ranches throughout Montana and reportedly has increased the connectivity of the landscape (Montana Fish, Wildlife & Parks, 2012). Other actions that can be taken are, similar to the actions taken in Kaktovik, removal of carnivore attractants. This often includes creating enclosed carcass pits, making it so dead animals are not left to be scavenged upon by predators (Defenders of Wildlife, 2016). While these

strategies are small scale and are implemented by individual ranchers, larger community-wide actions are also being developed.

The Great Northern Landscape Conservation Cooperative (GNLCC), located in Bozeman, Montana, has focused on community based conservation efforts in the High Divide that work on building trust between all stakeholder groups and allowing for a platform of open communication. They have successfully restored hundreds of thousands of acres in the region through fee title acquisitions and the establishment of conservation easements. Stakeholder involvement is encouraged through workshops and opportunities to plan future conservation projects (GNLCC, 2015). Forming management plans that include partnerships between stakeholder groups, or at the very least represent their ideas, is critical in creating policies that will not only be effective, but also affordable (KBIC, 2013). Understanding social issues regarding wildlife conflicts among and within stakeholder groups is also necessary in order to implement cooperative and effective management plans (Marshall, White & Fischer, 2007).

Community involvement has become a focal point in resource and land management practices, largely because such involvement is the most practical way to include all stakeholder groups in the decision making process (Zhang, Li and Fung, 2012). On an individual level, humans are less likely to come up with sufficient alternatives or clarify issues compared to humans working in a group who introduce multiple perspectives and solutions to the management process (McDaniels, Gregory, Fields, 1999). Community involvement is considered to be more sustainable than other approaches because it provides a platform for stakeholders to resolve conflicts through institutionalized guidelines and local knowledge, and it often has a conservation focus implemented through social and political methods. (Kellert et.al, 2000). However, due to the complicated nature of community and stakeholder involvement, successful management of resources in this manner can be complicated and perhaps even disappoint some stakeholders in the extent to which it can be applied (McDaniels, Gregory and Fields, 1999). To reduce the disparity between expectations versus reality in such situations, Zhang, Li, and Fung in 2012 created a Spatial Conflict Resolution in an effort to help stakeholder develop acceptable land-use principles through mutual understanding of the issue (Zhang, Li and Fung, 2012). Such frameworks can be created and applied in

many community management cases, and can help stakeholders create a functional decision making process that focuses on what is deemed important by the stakeholders.

Based on the literature above, I argue that approaches focused on community involvement will be more successful in creating a management plan that incorporates all stakeholder perspectives and local knowledge.

Mapping

To help define this problem, I used ArcGIS to visualize the ranges of the gray wolf and grizzly bear and how they overlap with the recent population growth in the High Divide. In order to do this, I took home development data from Headwaters Economics Research Group and species range data from United States Geological Survey and ArcGIS online to create figures 2, 4, 5 and 6. To translate the home growth data into the proper format, I downloaded the housing data on each county within the High Divide (Lemhi, Butte, Jefferson, Madison, Teton, Fremont, and Clark counties in Idaho, and Ravalli, Granite, Deer Lodge, Silver Bow, Jefferson, Madison, and Beaverhead counties in Montana). I then added all of these counties as layers on a base map of the United States provided by ArcGIS online. Once these layers were downloaded and represented as dots (one dot is equivalent to 50 homes), I downloaded and overlaid the ranges of the grizzly bear gray wolf from ArcGIS online and USGS as visualization of the overlap of the species ranges and home development in the area.

Goals:

The goals of this analysis are to determine what management schemes would be best to implement to reduce further gray wolf and grizzly bear habitat fragmentation, increase landscape connectivity within the High Divide, and to reduce the number of conflicts between humans and carnivores

Evaluation Criteria

The proposed policy alternatives will be evaluated based on the three criteria below.

- 1) How effective the alternative is in conserving gray wolf and grizzly bear populations.
- 2) How equitable the alternative is among the different stakeholders.
- 3) How cost effective the alternative is.

Each policy alternative will be assessed in relation to each of the three evaluation criteria.

Stakeholders:

There are many stakeholders that have an interest in this issue, adding to its complexity. Below is a consolidated list that represents the most common perspectives on the issue, as well as some examples of the groups that hold that perspective. This list was compiled based on actors who are currently involved in the conflict as based off research from the literature and media.

- Federal Government: Federal agencies are responsible for conserving and protecting the nations resources and wildlife for the benefit of the American people. They regulate which species are protected by the Endangered Species Act and enact management and recovery plans for those species.
 - USFWS, USGS
- State Governments: State governments manage the states' natural resources for the benefit of the general public and future generations. In Montana and Idaho they are charged with managing the delisted gray wolf populations in their respective states. This includes monitoring population dynamics and regulating population numbers through control kills and the wolf-hunting season.
 - Idaho Fish & Game (2016); Montana Fish, Wildlife & Parks (2016)
- Local Governments: County governments are geared toward representing the wants of their citizens, which are often defined by their lifestyles and occupations.
 - Madison County Board of Commissioners, Lemhi County Commissioners, Ravalli County Commissioners
- Conservation Groups: Non-profit organizations that generally are focused on protecting and connecting land and communities to ensure people and nature can thrive together.

- Yellowstone to Yukon, Future West, Defenders of Wildlife, the Wildlife Conservation Society
- Local Conservation or Community Groups: Conservation efforts from these groups are focused on a much smaller, more local scale. Often they prioritize conservation issues in a single valley or other small region. Community groups may be less conservation-centric, but they represent the local opinions and ways of life with the aforementioned valleys or small areas.
 - Madison Valley Ranchlands Group, Ravalli County Fish & Wildlife Association, Teton Regional Land Trust
- Ranchers: Ranchers are private property owners that raise livestock and or produce agricultural goods. Their main priority in the High Divide is protection of property and livestock in an economically practical way.
 - Idaho Cattle Association, Montana Stockgrowers Association
- Residential Neighborhoods: Residential development in the High Divide has increased largely because of the growing economy in the Northern Rockies as well as a recreation-centered lifestyle. Typically residents in these areas appreciate the presence of wildlife but also are prioritize the safety of the community.
- Housing Developers: Housing developers in the region are the driving force behind the residential development in the High Divide. In recent years, there have been strides toward more conservation-friendly practices, but residential development is still increasing and expanding into rural areas.
- Hunters and Hunting Outfitters: Hunters and hunting outfitters seek out the inclusion of their hobbies and businesses in legislative decisions and often encourage increased hunting license distribution. Protection of their rights and preservation of the outdoor heritage of this area is paramount to this group's viewpoint.
 - Montana Outfitters Association, Idaho Outfitters and Guide Association
- Tourists and Recreationalists: Tourism is founded on the abundance of natural beauty and wildlife found in the Northern Rocky Mountains. Tourists like

landscapes that correlate with their ideas of what the Rockies look like, which is generally a wild landscape that is undeveloped.

Certain stakeholder groups have similar conservation priorities, such as ranchers, hunters, and housing developers that are more focused on their economic gain or preferred pastime rather than conservation efforts. Similarly national and regional conservation groups, as well as the tourism and outfitter companies prioritize conservation and preserving natural world. However, it is important to recognize that these similarities are very generalized and many of the stakeholder groups have variations in their reasoning for their priorities. For instance, while ranchers and housing developers might be more focused on economic return, ranchers may tend to value maintaining their property for raising livestock, while housing developers might be more interested in dividing up ranchers into smaller parcels for residential development. In the same vein, conservation groups presumably want to preserve the landscape for ecological reasons, while the tourism industry may like to see it preserved to maintain business.

Alternatives

Alternative 1: Status quo

The first alternative would have the situation remain as it is currently. Wolf management would remain under the control of Montana Fish, Wildlife & Parks and Idaho Fish & Game, while grizzly bear management would remain federally regulated. This alternative includes many different stakeholders attempting to find solutions, with little successful cooperation and partnerships between groups. Many of the local conservation and community groups represent different perspectives on the issue, and there has been little cohesion between them and their actions on the ground. This is especially true for conservation groups such as Yellowstone to Yukon that have pushed for the establishment of conservation easements and protection of riparian areas in places like the Madison Valley, MT, compared to ranching groups that prioritize ranchers' rights and are not as conservation-minded. Some of the organizations that promote the protection of ranchers' rights and property have dedicated limited time and money to

conservation practices and groups, but it is not ubiquitous. Intermittent community involvement, education, and meetings with federal agencies regarding the issue will also take place. This alternative represents what would happen if there were no policy change regarding fragmentation and carnivore conservation in the High Divide. While it does not establish the most equitable decision making process for conservation management, the state and federal governments have been fairly successful in managing the recovery of the gray wolf and grizzly bear populations within this region, and have largely left major conservation projects in the hands of large and local conservation groups.

Evaluation:

Conservation Effectiveness: Wolf populations in Montana and Idaho are reproductively stable, with approximately 1,657 wolves (238 packs with 60 breeding pairs). Grizzly bear populations are still under careful watch under the Endangered Species Act with approximately 1,345 bears in the Crown of the Continent, Greater Yellowstone, and Salmon-Selway-Bitterroot Ecosystems. These numbers are promising concerning recovery of wolf and bear populations. However, with the lack of partnerships between the numerous conservation and community groups within the High Divide, a cohesive decision regarding habitat fragmentation policies (such as establishing conservation easements and wildlife passages through private properties) would be hard to come by. In summary, this approach has worked thus far in managing carnivore populations, but has had little cooperative action in addressing and reducing habitat fragmentation.

Equity: Disagreement exists between many groups. Ranchers rely on the right to shoot wolves dangerous to their property or herd. Hunters and hunting outfitters witness the reduction of ungulate species as a result of a larger wolf population. Homeowners have the right to build on some land without further permission and dislike predators threatening the safety of their neighborhood. Conservation groups promote the security and safety of the wolves, bears, and other wildlife. Conflicts exist between groups that are business and economically oriented (such as ranchers and home developers) and groups that are more ecologically oriented (such as conservation groups and state and federal agencies at times). This can result in increased tension and even acts of disobedience, such as the intentional killing of carnivores (Treves & Karanth, 2003; Musiani & Paquet, 2004).

Cost Effectiveness: In 2014, the federal government, state governments, and tribal agencies spent approximately \$2,688,322.00 on wolf management, monitoring, and research in the Northern Rocky Mountain region (USFWS, 2014). In 2013 the Montana Fish, Wildlife & Parks and Federal government spent approximately \$188,500.00 on the Southwest Montana Grizzly Bear Management Plan (Montana Fish, Wildlife & Parks, 2013). In 2002, Idaho Fish & Game constructed a Yellowstone Grizzly Bear Management Plan that reported their current spending on grizzly bear management to be at \$20,550.00, but predicted future spending to increase to \$144,250.00 (Idaho Fish & Game, 2002). This is dwarfed by the \$110, 577, 783.00 spent by conservation groups on many different conservation projects within the High Divide alone in 2013 (Future West, 2013). This approach is moderately cost effective for the state and federal agencies funding conservation and management plans for wolves and grizzly bears, but extremely cost inefficient for the more locally based conservation groups that fund myriad projects within the High Divide. Due to the many conflicting interests, it can be assumed that some of the projects being funded by these groups are counteracting the effects of other projects.

Alternative 2: Top-Down Approach

The top-down approach would leave all decisions regarding conservation and residential development to federal and state agencies. Gray wolf and grizzly bear population control and monitoring would still be regulated by the Montana Department of Fish, Wildlife & Parks in Montana and by Idaho Fish & Game in Idaho. Landscape conservation actions would also be authorized by these agencies rather than smaller scale organizations. These governmental organizations would use their available resources to implement conservation strategies within the High Divide such as mandated wildlife corridors between developments. This approach would also restrict local involvement in management decisions.

Conservation Effectiveness: If conservation and land management were to be carried out solely by state and federal agencies, the methods of maintaining the population numbers through permit hunting and lethal control would remain the same. As previously stated, both populations of wolves and grizzlies are stable currently. While grizzly bears are still

protected under the Endangered Species Act, the state governments in Montana and Idaho have long-term recovery goals set at a mean of 1000 bears every year, which they are currently exceeding (USFWS, 2014). While the federal and state recovery and management plans for gray wolves and grizzly bear have been successful, they are not as involved or as invested in other conservation efforts that are vital to wolf and bear success, such as preserving wildlife corridors or restricting building around vital riparian habitats.

Equity: This policy alternative would not produce an equitable result among stakeholders, as the only groups with any real power in this situation would be the state and federal governments. A top-down approach would require these agencies to make executive conservation decisions in communities and landscapes from which they are removed. This marginalizes local communities and their knowledge about the landscape that they live in, and potentially challenges their power to control the property they own. It would effectively take away the political voice of all other stakeholder groups and their ability to express their opinions and subject them to the whim of the state or federal agencies making the decisions.

Cost Effectiveness: The cost effectiveness of this approach would vary depending on which stakeholder is being analyzed. If state and federal agencies would want to continue carrying out the current conservation initiatives, they would be charged with picking up the current projects led by local conservation groups, as well as their cost. As stated earlier, these local organizations spent approximately \$110,000,000.00 on conservation projects in the High Divide in 2013. If the federal and state governments assumed the responsibilities of continuing such projects, they would also assume the costs associated with them. They would also likely have to increase their spending to enforce landscape conservation measures such as preserving vital habitats and corridors. Therefore, this approach would be very expensive for the governmental agencies, but it would alleviate those costs from local communities, organizations, and economies.

Alternative 3: Middle Ground Approach

The third approach requires cooperation not only between local groups but also between local and federal organizations. This approach would require community

involvement and input in management decisions that will be partially regulated by state and federal agencies. Community meetings, education, and fundraising for specific projects or topics would provide the basis for community participation and increase their involvement and investment in the issues. Primary conservation topics may include establishing conservation easements through private lands, or implementing Home Owners Association fees dedicated to certain landscape conservation strategies such as protecting riparian habitats. This approach offers a diversity of funding options, including community fundraising or being funded by NGOs. This allows for flexible community use of funding and resources to raise money for the projects they decide to establish. The projects and conservation measures that the communities decide upon will be vetted by experts and managers to ensure that the agreed upon actions will achieve the established conservation goals, is plausible, as well as meet conservation goals as defined by existing laws such as the Endangered Species Act. Communication with the federal or state agencies would be done through a liaison that attends community meetings and reports back to the federal government.

Conservation Effectiveness: The middle ground approach would be moderately effective in conserving gray wolves and grizzly bears. This approach is dependent on the cooperation of stakeholders at local levels to voice their opinions to stakeholders at federal levels. However, due to a variety of conflicting interests, it is rare that such coordination actually takes place. However, if the community is able to find middle ground, this approach can be very effective in conserving wolves and bears. Some approaches may include the expansion of conservation easements that essentially donate or sell the usage rights of private land or resources on private land. This ensures that that as long as the land is under private ownership the usage rights that were given up will remain untouchable, thus protecting the land from further exploitation or development. Another option could be the usage of HOA fees to fund conservation projects like protecting vital habitat resources such as water bodies or riparian habitats that wolves and grizzly bears require. Community decision-making ensures that the people who are making the decisions are those that live in and interact with the High Divide and it's wildlife on a daily basis.

Equity: This approach is very equitable among the stakeholders. Because it is centered on the idea of community involvement, stakeholder groups such as county commissioners, hunting outfitters, residents, local and regional conservation groups, and others have the opportunity to voice their opinions and influence the decision making process. The community meetings and cooperation provide the platform for local ideas regarding land conservation and predator population monitoring to be turned into successful conservation measures with the help of large NGOs or perhaps even the state or federal government. Because community involvement relies on an open-forum concept, the stakeholder groups will be able to keep power dynamics in check and have their voices heard.

Cost Effectiveness: The community involvement aspect of this approach has an important financial implication as it provides flexibility. Fundraising allows for communities to raise money for conservation efforts and projects that they deem important and in line with their values. In this alternative, money that communities raise for a landscape conservation plan can be applied directly to that specific purpose. However, depending on the proposed project, communities can partner with NGOs that have more resources and funds available. This would alleviate the financial stress within the community and address the potential issue of disagreement among stakeholders regarding what conservation efforts should be focused on.

Alternative 4: Extreme Conservation

The extreme conservation approach would include mandated building restrictions around areas such as water bodies or riparian zones that are vital for preserving wildlife and its movement across the High Divide. Limiting further residential development and implement building regulations such as cluster housing, or buildings constructed very close to each other while leaving other areas in the development as open space, would be another important factor in this alternative. It would also call for private property owners to establish wildlife throughways through their land to facilitate the movement of animals. This approach would be administered a partnership between local governments and local and regional conservation groups.

- 1) This would be the most effective policy alternative for conserving gray wolves and grizzly bears, as it puts their needs before humans and is therefore eco-centric. The extreme conservation alternative would heavily restrict further building and development in the High Divide. This would look like enforcing mandatory (rather than voluntary restrictions within communities or conservation easements) building restrictions near vital riparian zones, necessitating permits to build on pre-zoned residential plots, or limiting further buildings to cluster development where buildings are constructed in very close proximity to each other while leaving ‘untouched’ open space in other areas of the area being developed. These actions would prioritize conservation and the needs of the animals above those of humans, resulting in wolf and grizzly populations occupying a less fragmented habitat. However, it should be noted that the ability of state governments and conservation groups to legally implement this alternative would be limited.
- 2) This approach would have a strong conservation lens when analyzing which projects to fund. In general this would mean most of the selected projects would be leaning toward supporting conservation groups. This is not to say that other stakeholder groups would be completely disregarded, but rather their interests would not be met without some focus on conservation. This alternative would provide a strong bias toward eco-centric groups rather than those that are not as focused on habitat conservation.
- 3) Funding would come from a combination of local governments as well as environmentally oriented NGOs. However, policies under the extreme conservation alternative would not be cost effective because there would need to be some sort of compensation for those who are denied or limited in their right to own or build on property. This compensation would be in the form of tax breaks from the state organizations. For other stakeholders, however, the majority of the costs that accrue would most likely be in the form of legal fees, especially for those that have a vested interest in protecting ranchers and residents’ property rights. The blatant bias towards certain stakeholder groups

would most likely draw political opposition from the marginalized groups, which could in turn result in costly legal battles.

Policy Matrix:

To compare the different policy alternatives, I constructed a policy matrix. A policy matrix allows the reader to visually compare how effective each alternative is in meeting the evaluation criteria, which in this case were conservation effectiveness, equity among stakeholders, and cost effectiveness. I subjectively ranked the alternatives based on my knowledge and research on the three criteria from the literature review, with 1 being the least effective in meeting the criteria and 10 being the most effective in meeting the criteria. The ranking of each alternative was then tabled for ease of comparison. I then provided a brief explanation of the ranking as well as a summary column that displays the sum of the approach's ranking out of 30, which represents the score if an approach was the most effective in all three categories.

Alternative	Conservation Effectiveness	Stakeholder Equity	Cost Effectiveness	Summary and Recommendations
Laissez-Faire	6 Multiple stakeholders carry out current conservation management, often with varying priorities. Residential development has resulted in a more fragmented landscape. However, gray wolf and grizzly bear populations have successfully recovered under the current management practices.	5 Federal and state governments are currently responsible for population management in Idaho and Montana. Most other stakeholders operate on a more local scale and tend to have less influence in decision-making processes.	6 Current wolf and grizzly bear management practices are relatively cheap for federal and state agencies. National and regional conservation groups spend significantly more money on various conservation projects throughout the High Divide.	17/30 Overall, current management practices have succeeded in recovering the gray wolf and grizzly bear populations in the High Divide. However, with continued growth of these populations as well as residential areas, conservation efforts will have to consider adapting management regimes to ensure the High Divide's function as a vital wildlife corridor.
Top-Down Control	7 Federal and state agencies have been successful in recovering the gray wolf and grizzly bear populations in the Northern Rocky region. However, they are less invested in landscape conservation efforts and projects.	2 This approach inherently marginalizes all non-governmental stakeholder groups. It also provides little opportunity for these groups to provide feedback to the governmental agencies.	6 Current management plans for wolves and grizzly bears are relatively cheap for federal and state agencies. However, incurred spending on conservation projects will likely increase this cost.	15/30 The top down approach would be effective in managing wolf and grizzly bear populations, but would likely fall short in addressing local concerns and smaller scale conservation efforts. It would also reduce stakeholder equity and likely cause tension.
Stakeholder-Driven Conservation	7 This approach depends on the cooperation between stakeholder groups and governmental agencies in order effectively conserve. However, if this does take place, this approach would have the most coordinated conservation efforts and available resources between all stakeholder groups.	8 Community involvement and communication between all stakeholders is central to this approach. It offers the platform for all groups to be effectively heard and have a role in the decision making process.	7 Fundraising within the community or partnering with larger organizations for funding allow for flexibility when determining the cost of this approach. Groups can be financially invested in projects while also potentially sharing some of the associated economic burdens with better-funded organizations.	22/30 The middle ground approach is the most well rounded approach. However, the success of this approach depends on the cooperation among and between stakeholder groups with different priorities, meaning compromise will often be necessary.
Extreme Conservation	9 Conservation efforts will be the main focus of this approach, meaning protecting the growing wolf and bear populations will be paramount, as will the preservation of vital corridors and habitat within the High Divide.	3 Eco-centric conservation groups and projects would be strongly favored under this alternative. Other stakeholder groups would have to adjust their focus to be more conservation oriented.	5 Local governments and Non-Governmental Organizations would provide most of the funding for this approach. However, stakeholder opposition could result in legal expenses.	17/30 This approach would be the most effective in conserving carnivores and the landscape of the High Divide. However, it has the potential to marginalize certain groups and could face costly opposition from such groups.

Recommendation

Based on the above literature review, policy alternative analyses, and the above policy matrix, I would recommend implementing a policy structured on alternative number three, or the middle ground approach. This approach involves the community and its local knowledge in the policy and management process, allowing for it to ensure that conservation practices are focused on projects that are deemed important by those who live there. While there is still conflict of interest between many stakeholder groups, providing a forum in which they can openly discuss these issues in a community setting increases the likelihood of cooperation between groups. Partnering with larger, more powerful organizations like conservation NGOs or perhaps even state or federal governments would be a viable option for communities to diversify their funding and tailor project details to better fit the specific situation of each project. This management scheme would promote landscape connectivity through local promotion of conservation easements as well as vital resource protection. These practices both approach the issue of landscape connectivity on a local level and can be negotiated on a local level. Wolf and bear management would also be in the hands of the community, but the presence of state and federal liaisons as well as management experts would guide community decision making in order to ensure that wolves and bears would still be receiving the protection they need and will remain stable populations.

This approach would be the best option for integrating an effective management and conservation plan in the High Divide corridor while also promoting equity within the community and stakeholder groups. If implemented, it would help reduce the threat of habitat fragmentation to gray wolves and grizzly bears through community based conservation projects, while also promoting the safety of both the residents and wildlife in the area.

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