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Economic Consequences of the Wolf Comeback in the Western United States

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Abstract

Gray wolves were eradicated from most of the United States in the 1940's but have made a comeback in parts of their historic range over the last two decades. First reintroduced into the Greater Yellowstone Ecosystem and central Idaho in the mid-1990's, wolves have subsequently dispersed into at least 7 western states. Coloradoans became the latest state to take interest in bolstering wolf populations, as residents passed a ballot initiative in November 2020 to reintroduce a self-sustaining population of gray wolves by the end of 2023. Conflicts between people in rural areas that might incur costs (such as livestock loss) and people in urban areas geographically removed from direct contact with wolves suggest that the distribution of benefits may not align uniformly with the distribution of costs. Given that Colorado will imminently make many policy decisions that have an impact on costs and benefits, we review available literature to better understand the magnitude of gainers and losers from wolf reintroduction in western states. Although no single study has included all possible economic values, the magnitude of impacts can be inferred by assembling a broad range of estimates for different types of values into a single space. Our review of existing valuation literature from western states indicates that the magnitude of economic benefits of wolves is many times higher than what it costs to manage wolves and to reduce or compensate for losses to livestock producers and others.

Introduction

A thriving population of wolves that once freely roamed throughout most of the continental United States was effectively eradicated by the mid-twentieth century, except for small remnant populations in northeast Minnesota and Isle Royale National Park in Michigan (Mech 2017). Both federal and state governments provided financial incentives - in the form of bounties- to those who killed wolves to facilitate eradication. The primary justification was to reduce wolf impacts to the livestock industry, reduce impacts to native game populations, and a general disdain for native predators. However, societal attitudes have changed, and wolves are recovering and spreading in parts of the continental US (primarily the upper Midwest and Western US). Most recently, Colorado voters passed a referendum to add their state to a growing list of Rocky Mountain States with a sustainable wolf population.

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Wolf recovery is not without conflict. Many livestock producers, hunters, and rural residents view wolves as a threat, while others view them as an integral part of natural ecosystems. The political reality that wolves generate conflict has stimulated research about how people with disparate interests envision and/or tolerate coexistence between wolves and people. Ways to reduce conflicts, such as management systems that reduce livestock predation and/or financial compensation for livestock losses, are also needed. Can economic research help address the ultimate question: is coexistence worth the conflict?

One way to address this question is to assess the economic costs and benefits of landscapes where people and wolves coexist. To our knowledge, no prior studies have fully calculated these values for any single example. Given renewed interests associated with wolf reintroduction in Colorado, our purpose is to explore what we already know about the monetary net value people place on wolves. We evaluate the economic attributes of wolves by assimilating data from published, but disparate, studies. This represents a preliminary step toward full understanding, given that data from different studies cannot be directly compared. Nonetheless, our compilation of existing economic information is complete enough to help decision makers improve their understanding of total economic tradeoffs regarding coexisting with wolves. We begin with a review of how gray wolves have recovered in parts of their historic range in the United States in recent decades, followed by a discussion about the economic benefits and costs of such recovery.

The Recovery of Wolves

Public attitudes towards wolves started changing in the mid-20th century, with increased interest in the preservation of wilderness more broadly (George et al., 2016; Kellert et al., 1996). Wolves became a federally protected species in the United States in 1970's through the passage of the Endangered Species Act (ESA). Surveys in the last two decades found generally positive public attitudes towards wolves and wolf reintroduction. For example, a 2014 survey of U.S. residents found 61% of respondents had positive attitudes towards wolves (George et al., 2016). Across 38 quantitative public opinion surveys conducted between 1972 and 2000 in the U.S., Canada, and Europe, an average of 51% of all respondents had positive attitudes towards wolves and 60% had positive attitudes towards wolf reintroduction (Williams et al., 2002).

The U.S. Fish and Wildlife Service (USFWS) is responsible for the management and eventual recovery of threatened and endangered species, including wolves. To help recover the gray wolf, the USFWS and the National Park Service reintroduced them into the Greater Yellowstone Ecosystem (GYE) in Yellowstone National Park and in central Idaho in the mid-1990s. The reintroduction was considered successful by most standards and the wolf population grew and expanded. Due to this recovery, over the past decade, gray wolves were removed ("delisted") from the ESA in Montana, Idaho, Wyoming, eastern Oregon and Washington, and parts of Utah. Wolf management authority was returned from the federal government to those states. Due to their relative abundance, wolves in Alaska were never added to the endangered species list. But in many other states - including Colorado and the Great Lakes states – gray wolves were still federally listed as endangered species under the ESA. The USFWS has concluded that the gray wolf is not in danger of extinction and thus has removed them from endangered status. As a result, in March 2019, USFWS proposed to remove all gray wolves in the continental United States from protection under the ESA. This policy decision

was finalized in January 2021, which then turned management of gray wolves back to individual state wildlife agencies. As has been the case in the past, the delisting of wolves was challenged in court, and in February 2022, gray wolves in the lower 48 (except those in the northern Rocky Mountain states) were relisted on the ESA, returning management authority to the USFWS.

In November 2020, Coloradoans passed Ballot Proposition 114, a citizen-initiated ballot measure, to start reintroducing wolves to western Colorado by the end of 2023. Due to the controversial nature of the issue, Colorado Parks and Wildlife initiated a planning process that includes the formation of a Technical Working Group of experts as well as a public outreach process and a Stakeholder Advisory Group (SAG) led by a third-party facilitator. The SAG is tasked with developing recommendations for wolf management, which then will be considered by the Colorado Parks and Wildlife Commission, the citizen board, appointed by the Governor, which sets state regulations and policies for Colorado's state parks and wildlife programs.

Prior surveys conducted before the Colorado ballot initiative suggested high levels of public support. For example, a 1994 mail survey found that 71% of Coloradans would support wolf restoration (Pate et al., 1994), a 2001 phone survey found that 66% would support wolf restoration (Meadow et al., 2005), and a 2019 survey of an online sample recruited through an online survey recruitment platform found 84% support (Niemiec et al., 2020). However, the proposition passed with only 50.91% of votes in favor of wolf reintroduction to the state. Counties that voted yes were generally densely populated urban areas, primarily in the urban Front Range in Colorado, while counties that voted no generally had low population densities in rural areas in the Eastern Plains and Western Slope of the state.

Economic Benefits[5]

Some of the benefits a society receives from reintroducing wolves have markets and some do not. There are markets for fur and for hunting trips, but people do not have to pay anything just to know that wolves exist in the wild. Values for environmental goods can be divided into four basic groups: 1) direct values, including consumptive use (e.g., hunting) and non-consumptive (e.g., wolf viewing and research), 2) non-use values, including existence value (i.e., knowing wolves exist) and bequest value (i.e., retaining wolves for future generations), 3) option value (e.g., retaining the ability to hunt or view wolves for future generations), and 4) indirect values (i.e., values that transfer through some indirect means, such as habitat recovery if wolves help reduce overabundant big game populations). We know of no single study that reveals such a comprehensive understanding about the value of wolves. However, we can build a mosaic of what total value might look like by compiling examples from different published studies in the literature, as shown in Figures 1 and 2. The studies in these figures are not directly comparable since they cover different time periods, regions, and assumptions. So, we cannot just sum the values in either figure. However, these figures do provide an overall picture of the magnitude and totality of benefits related to having wild wolf populations and can be helpful when making decisions about how to manage wolves.

Consumptive and non-consumptive values that can be found through expenditures in markets are shown in Figure 1. Expenditures include what a person paid to travel to hunt or see a wolf, while

[5] Some of the information about benefits and costs comes directly from an unpublished extension information sheet written by Dana Hoag (2020) https://extension.colostate.edu/topic-areas/people-predators/wolf-economics-8-012/.

WTP indicates extra value that people receive from hunting or seeing a wolf. For example, non-resident hunters spent about $6,773[6] on gear and travel (ECONorthwest, 2014) to hunt wolves in Alaska (Figure 1), but would be willing to pay another $613 (Loomis, 2016) above their trip costs for the ability to hunt a wolf (Figure 2). Since they never had to pay that $613, that is considered a gain to society. That is, having wolves available to hunt produced an extra $613 for every non-resident hunter in Alaska. Expenditures, $6,773 in this case, represent the amount of money people are willing to transfer from some other use; they benefit the region where the transfer occurs at the expense of those regions losing the funds. Both consumptive and non-consumptive examples of expenditures are shown in Figure 1. For example, Duffield (2019) estimated that visitor spending related to wolves would generate $45.5 million per year in the GYE. Currently, the Yellowstone Wolf Tracker charges $700/day for a wolf viewing trip. Wolf hunting or trapping is also allowed in parts of Wyoming, Idaho, and Montana, and is under review in other states. Hunters and trappers spent over $400,000 just for licenses in Montana (Inman et al., 2019). Guided hunts in Idaho go for $3,800 (Richieoutfitters, 2020). Trapping generated over $200,000 to the regional economy in Alaska (ECONorthwest, 2014).

Figure 1: Expenditures related to wolves, based on disparate studies[a]

Consumptive	
Wolf Hunting	Examples:
• License Fees	• Hunt/trap license fees in Montana $432,2738 in 2018[I]
• Hunting Fees	• Guided hunting in Idaho $3,800/person per trip[R]
• Trapping	• $217,723/year in regional expenditures related to wolf trapping in Alaska[E]
• Travel/Retail	• Hunters spent over $6,773 on trip and gear to hunt in Alaska[E]
Non-Consumptive	
Wolf Viewing	Examples:
• Touring Fees	• Yellowstone wolf viewing tours $700/day[Y]
• Travel/Retail	• GYE state's annual visitation $45.5 million/year in regional expenditures related to wolf viewing[D]

a-Values adjusted to January 2022 CPI. GYE is Greater Yellowstone Ecosystem. Information provided is for illustration only and comes from disparate literature using different methods, different wolf or human populations, and different time periods. These values should not be added together.

Sources: I=Inman et al., 2019; E= ECONorthwest, 2014; CHCC, 2020; L=Loomis, 2016; Y=Yellowstone Wolf Tracker, 2021; D=Duffield et al., 2006 and Duffield, 2019; R= Richieoutfitters, 2020.

We also searched the literature for willingness to pay (WTP) studies about non-market values that we present in Figure 2. Figure 2 adds WTP studies to the consumptive and non-consumptive use categories found in Figure 1, and adds WTP for existence, bequest and option values, where markets have not been established. Economists have developed a variety of innovative methods to estimate non-market values, which are beyond our scope here;[7] most rely on surveys to illicit non-market values. We found only two such studies for the Rocky Mountain West. One older study calculated that the use and non-use value in the GYE would be $208 per household; 75% of that value, $156, is existence and bequest value (Duffield, 1991 as summarized in Loomis, 2016). The most recent study in Washington State (van Eeden et al., 2021) found that a typical household's

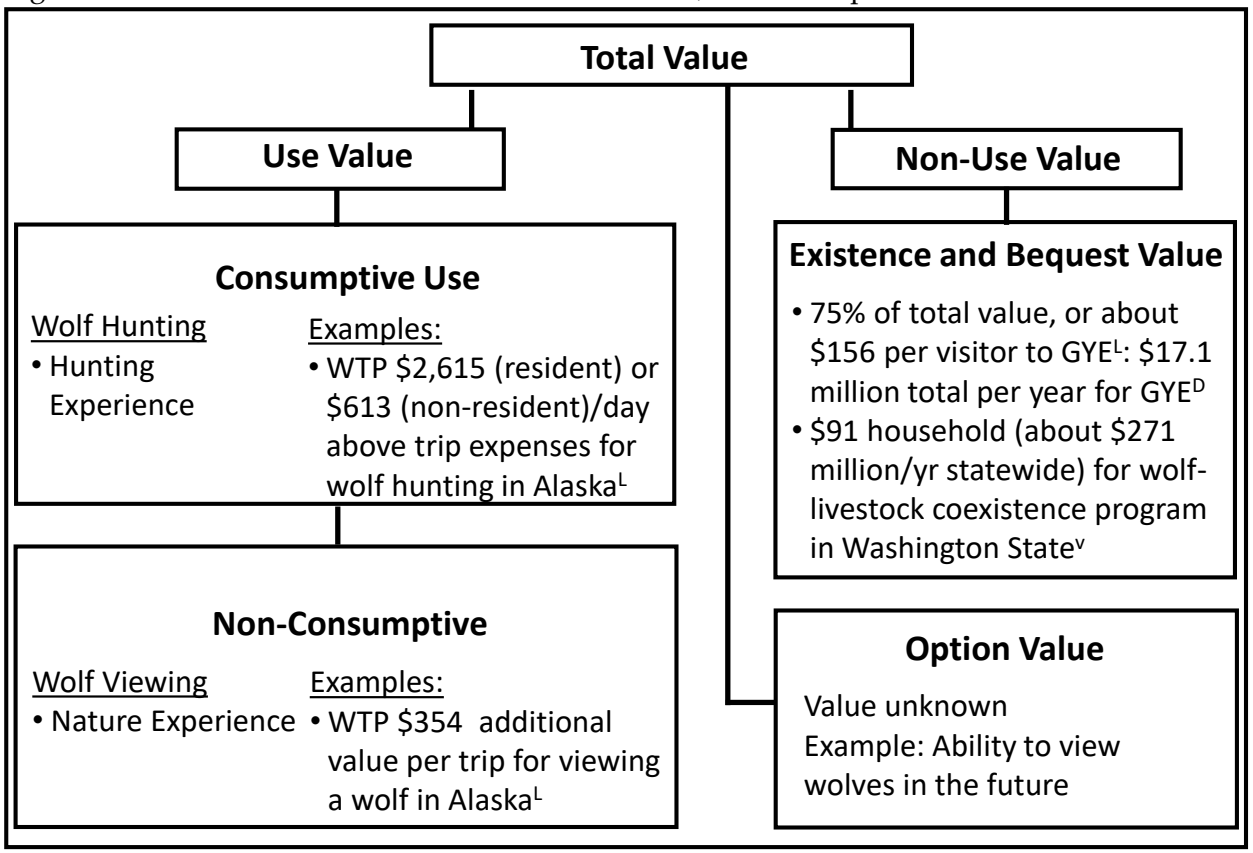
[6] All dollar values are adjusted by the Consumer Price Index to January 2022.

[7] See Champ, Boyle and Brown (2003) for a detailed description of non-market estimation methods, or the "Conservation Strategy Fund: Valuation of Ecosystem Services" for a simple description of non-market valuation methods (https://www.youtube.com/watch?v=0CHIs9dLvxA). Also consider Contingent Valuation, Choice Experiments, Hedonic Pricing and Travel Cost Method videos in the series.

WTP for a publicly funded wolf management program would be about $91/year, which amounts to about $271 million/year for the state. These authors estimate that the economic benefits are over 150 times the costs of the government program to manage wolves in Washington.

There is probably more opportunity to economically gain from non-consumptive uses of wolves than found in Figures 1 and 2, such as private viewing, commercial viewing, research, documentaries, photos, and artwork featuring wolves. While viewing opportunities in Yellowstone would likely be difficult to replicate in other regions, there may be opportunities in other states for more modest returns, especially when coupled with multiple forms of wildlife viewing.

Figure 2: Illustration of non-market values for wolves, with examples from diverse studies[a]



a- Values adjusted by CPI to January 2022. WTP is willingness to pay; GYE is Greater Yellowstone Ecosystem. Information provided is for illustration only and comes from disparate literature using different methods, different wolf or human populations, and different time periods. These values should not be added together.

Sources: D=Duffield et al., 2006 and Duffield, 2019; L=Loomis, 2016; v= van Eeden et. al., 2021.

Economic Costs

Costs generally fall into three categories: personal impacts, commercial production, and public management. Personal impacts occur when people have direct contact with wolves. There are no known studies about the costs of personal impacts, but there are indicators that costs occur. For example, some natural areas post warnings about the risk of wolf attacks when hiking, especially with dogs, which may raise alarm with some people. Although rare, people have been bitten, have experienced standoffs with wolves on the trail, and have even been chased away from campsites (MacKinnon, 2017). These potential negative encounters almost certainly lead some people to shift their recreational activities to other less preferred sites, e.g., further away or less scenic, but studies would be required to confirm their true impacts.

Commercial costs are incurred by livestock producers and commercial hunting outfitters through their influence on big game populations. Livestock producers incur direct and indirect costs. Direct cost is typically the fair market value (FMV) of any livestock killed by wolves. Indirect costs to livestock include: 1) non-lethal injuries, 2) lowered conception rates, 3) reduced weight, particularly of calves and lambs, at sale; 4) repairing fences; 5) repairing buildings; 6) silage and grain losses; and. 7) landowner's time (Harris, 2020). According to Harris' (2020) review of the literature, indirect economic losses are greater than the replacement cost of dead livestock (FMV). For example, one study found that calves in herds that experienced at least one animal lost to predation were 22 lbs. lighter and, when added across all calves in those herds, accounted for a greater loss than confirmed depredations (Ramler, 2014). Some studies found unverified and indirect losses to be up to 6 times that of verified losses (Steele et al., 2013; Sommers et al., 2010), while other researchers found these estimates to be overstated (Hebblewhite, 2011).

Although direct losses from wolf depredation on cattle and sheep accounts for less than 1% of the annual gross income from livestock operations in the Northern Rocky Mountains (Muhly and Musiani, 2009), these costs are unevenly distributed. Therefore, low average industry-wide costs mask high costs for some individual producers. Furthermore, low reported cost estimates do not include indirect costs. An accurate assessment of total costs to livestock is made more difficult by lack of depredation data. For example, the USFWS confirmed a total of 136 cattle (both adults and calves) and 14 sheep (adults and lambs) killed by wolves in 2014 in the Northern Rocky Mountain Region (U.S. Fish and Wildlife Service, 2015). In contrast, the National Agricultural Statistics Service reported 2,835 cattle and 453 sheep killed by wolves in the same region and year (USDA 2015a and b). The USFWS data likely understate losses because they do not include unfound or unreported depredation. The USDA estimates are likely high because they are self-reported by livestock producers. What is known is that mortality caused by wolves is a small economic cost to the livestock industry as a whole, but problematic to some individuals with large losses and high exposure to wolf populations. Finally, little is known about the cost tradeoff between losses and approaches to reduce or prevent livestock depredation.

The government also incurs costs to manage wolves. State government monitors wolves, prepares reports, and manages hunting licenses. The federal government also monitors and manages wolves where they are endangered. The government provides compensation payments through federal, state, and county programs, as do some non-governmental agencies. The USFWS estimated that, in 2015, almost $6.5 million was spent on managing wolves by state, federal, and tribal agencies

in a region composed of northern Wyoming, Montana, North Dakota, the Idaho panhandle, Washington and Oregon (U.S. Fish and Wildlife Service et al., 2015).

In Colorado, fiscal analysis of Ballot Proposition 114 forecasts annual costs to the state of $350,000-450,000 for the first 2 years of the planning phase of wolf reintroduction. (Colorado Legislative Council Staff, 2019). Costs are expected to increase as the plan is implemented and wolves are reintroduced. Future costs will depend on the details of the plan developed by Colorado Parks and Wildlife. In summer 2021, state law HB21-1243 was signed into law, appropriating General Fund dollars to support gray wolf reintroduction from sources other than hunting and fishing license fees. $1.1 million was appropriated for FY 21-22.

Finally, some are worried that wolves will negatively impact big game hunting for deer, elk, pronghorn, and moose. At a statewide level, data from the northern Rocky Mountain states of Montana, Idaho, and Wyoming indicate that population sizes of elk (the primary prey of wolves) and hunter harvest have not declined since wolves were reintroduced starting in the mid-1990s. However, at a local level, the effects of wolves on big game can vary. For example, in the Greater Yellowstone Ecosystem, elk numbers are stable or increasing in some areas where wolves and elk interact, but they have declined in some regions. Wolves are more likely to effect big game populations when acting in conjunction with other factors that limit prey populations, such as harsh weather, other predators, and human hunters (Mech 2012). Wolves also can make big game more wary, move more, and use habitat differently by seeking greater cover, which would make hunting more challenging in some areas. An economic analysis in Montana concluded that, overall, wolves have not had a significant economic effect on elk harvest in the state (Hazen, 2012). Rather, demand for hunting shifted from the southwest region near Yellowstone to areas farther away from where wolves were first introduced. Based on the few studies that are available, hunting-related benefits in Colorado may not decline substantially overall statewide when wolves are restored. However, at a local level, if wolves contribute to declines in big game herds and hence hunting opportunities, this will result in costs to those reliant on hunting to support their livelihoods.

Conclusions

Once loathed and eradicated throughout much of their former range, wolves are making a comeback in the Rocky Mountain West. Although wolves have recovered in some areas, controversy remains due to deeply held feelings on both sides. Our goal is to provide an overview of the economic costs compared to benefits of wolves in the Rocky Mountain West. By assembling information from the few published studies available, we create a mosaic of what total economic benefits of wolves might be worth. We could not provide a definitive value because these disparate sources cannot be directly compared. Willingness to pay (WTP) for existence and bequest value alone exceeds $17 million per year just for the Greater Yellowstone Ecosystem. WTP for coexistence in Washington state adds up to nearly $270 million/year. And visitors spend over $45 million per year just to visit the GYE where they might catch a glimpse of a wolf. The cost of co-exiting with wolves includes personal impacts, commercial production, and public management. Sound estimates of the total costs are not known because conflicts are difficult to document. However, spending on state management programs, which includes compensation and cost sharing programs to offset commercial production costs, center between $1-1.5 million per year.

We posed the question at in the beginning of this manuscript: *is coexistence worth the conflict*? Of course, there are many things to consider besides dollars and cents, but from an economic standpoint, a review of available studies suggests that benefits cover costs multiple times over. Therefore, the answer depends on if and how benefits and costs are distributed. Will the majority of people who receive benefits, but incur no costs, be willing to transfer some of those benefits to a minority of ranchers and hunters that bear most of the costs? What is already known is that states with wolves offer cost sharing to help livestock producers adopt non-lethal ways to manage wolves and/or compensation for livestock losses, but budgets can be tight and stakeholders have diverse opinions about how much should be paid (Harris, 2020). For example, the Washington state study reported that the state spent $1.64 million on the costs of their wolf management programs in contrast to the 270 million projected benefit (adjusted by 2022 CPI). The information presented in this study can help all sides develop and implement more effective and equitable policies through a better understanding about the benefits and costs of a sustainable wolf population.

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