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Reestablishment of the Mexican Gray Wolf: The Economics of Depredation

NM STATE UNIVERSITY

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Reestablishment of the Mexican Gray Wolf: The Economics of Depredation

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INTRODUCTION

The Mexican gray wolf (*Canis lupus baileyi*) was deliberately extirpated prior to the 1970s from the southwestern United Sates through concerted efforts and investment. This subspecies was listed as endangered in 1976 after the United States Fish and Wildlife Service (USFWS) determined they were in danger of extinction (F.R. vol. 41, no. 83). In 1982, the USFWS completed the Mexican Wolf Recovery Plan (MWRP) with goals of maintaining a captive breeding program and re-establishing the species in their historical habitat. However, lack of action by USFWS on the MWRP provoked litigation by environmental groups to force immediate implementation of the recovery plan. This suit resulted in a settlement with undisclosed conditions and parameters. By 1996, a proposed experimental rule and Final Environmental Impact Statement (FEIS) were published. In 1998, designation of a Nonessential Experimental Population was accompanied by the Endangered Species Act (ESA) section 10j special rule on managing the reintroduced population.

Reestablishment of this subspecies has generated extensive emotional, political, biological, and socioeconomic debate. This debate has failed to yield consensus regarding the success or failure of the recovery program. The resulting polarity has diminished constructive dialogue and

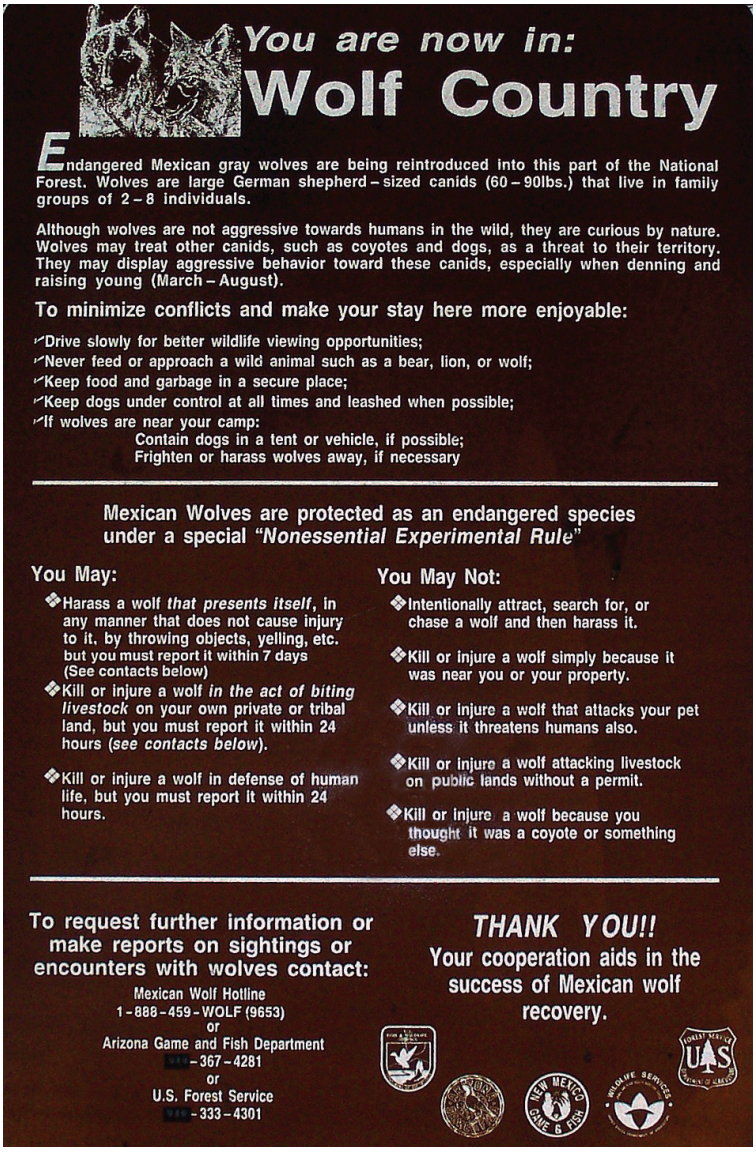

***Figure 1*. Posted sign in Gila National Forest informing visitors of wolf presence.**

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prevented mitigation of the issues. The current polarized state of the debate means that stakeholders fail to even seek potential middle ground. While there are many unique perspectives on the economic, ecological, social, and political impacts or benefits related to the reestablishment of Mexican wolves, they have not been clearly described or evaluated in a systematic or scientific fashion. The Mexican wolf recovery program would benefit greatly from such analyses.

Local communities and rural counties are particularly concerned about the wolf recovery program and the economic impacts it may be having on livestock operations in the recovery area. From an economic perspective, a fundamental question is whether a disproportionate burden or economic impact is being imposed on a few individuals for the good of American society.

BACKGROUND AND LITERATURE

Since the arrival of domestic livestock in the Southwest, there have been several efforts to control or eliminate predators—wolves (*Canis lupus*), grizzly bears (*Ursus arctos*), mountain lions (*Puma concolor*), bobcats (*Lynx rufus*), and coyotes (*Canis latrans*). In 1893, the Territorial Bounty Act was passed by the Arizona–New Mexico Territorial Legislature, allowing a bounty to be paid on stock-killing predators. In 1907, the U.S. Biological Survey and Department of Agriculture assessed damages and began a campaign to control predators. By 1914, Congress created the Biological Survey, including the Predatory Animal and Rodent Control Program, which was responsible for experiments and efforts to eliminate wolves, prairie dogs, and other animals injurious to agriculture and animal husbandry. These efforts, along with private bounty programs, were developed to address the economic impacts of predation on livestock and disease transmission (e.g., spread of rabies) and were the primary reasons for eliminating these predators. While there was a perceived threat to human life from attacks by predators, depredation of livestock and associated economic impacts were likely what led to the concerted effort to control predators at that time. Accompanying the extensive efforts toward eliminating harmful and predatory animals was the development of more efficient and effective methods of elimination.

The estimate of economic damage in New Mexico caused by 40 to 50 wolves in 1918 was $60,000—equivalent to about $960,000 in 2007 dollars (Brown, 1992). From 1915 to 1920,[2] wolf-induced economic losses were estimated at half a million dollars—comparable to $9.4 million in 2007 dollars (Brown, 1992). In a 1921 U.S. Department of Agriculture news release, the Bureau of Biological Survey estimated annual economic losses in livestock of $20 to $30 million ($205 to $308 million in 2007 dollars) to all predators throughout the West. According to Brown (1992), average destruction by predatory animals during this same period was estimated to be $1,000 worth of livestock annually ($10,000 in 2007 dollars) for each wolf and mountain lion, $500 ($5,000 in 2007 dollars) for each stock-killing bear, and $50 ($500 in 2007 dollars) for each coyote and bobcat. He also illustrated cases where substantial damage was caused by just a few predators. For example, one wolf in Colorado killed nearly $3,000 worth of cattle ($30,000 in 2007 dollars) in one year, two wolves in Texas killed 72 sheep in two weeks, one wolf in New Mexico killed 25 head of cattle in two months, and another wolf killed 150 cattle valued at $5,000 ($51,000 in 2007 dollars) during a six-month period. During this era, wild ungulate populations were low and livestock numbers had reached record high numbers, which possibly led to higher depredation rates and economic impacts. However, Mexican wolves were extirpated prior to scientific study of the predator–prey relationship. Although most

[2]Used base year 1917

of the information regarding wolf damages is anecdotal, there is little argument that wolves preyed upon domestic livestock.

The objective of the MWRP is "to conserve and ensure the survival of *Canis lupus baileyi* by maintaining a captive breeding program and re-establishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevation of a 5,000 square mile area within the Mexican wolf's historic range" (1982 Mexican Wolf Recovery Plan). Contrary to historic evidence of depredation, current recovery documents state most wolves will not depredate even when livestock are present, and that ranch failures are not expected to occur (USDI, 1982). The same document also states that only a small number of livestock owners are expected to be affected; however, some could sustain significant losses in a given year (USDI, 1982, pp. 4–7). The evolving view on predators is likely related to the distinct change in the U.S. economy that has occurred since the early 20th century. In the early 1900s, agriculture was the primary industry in the United States, seen as an important tool in settling the frontiers, and necessary for the sustenance of families. Today, most Americans do not have daily contact with agriculture or food production. The agrarian mindset under which wolves were extirpated is unfamiliar to them. However, in rural areas, and to individual family enterprises involved in agriculture, the challenges offered by the presence of wolves are real and present. It is also very likely that these family ranches disproportionately bear the economic impacts of wolf reintroduction, and this individual-level perspective is often overlooked in economic analyses of endangered species recovery. Meyer (1995) suggested that the economic effects of endangered species listings are so highly localized and of such small scale and short duration that they do not substantially affect state economic performance in the aggregate. Despite the limited contribution of endangered species listings to the aggregate, analyses of impacts at the local scale are needed. We conducted analyses and interviews of numerous livestock operations in the recovery area to examine the possibility that livestock depredation by reintroduced Mexican wolves was negatively impacting a small subset of ranches in the recovery area. The objective of this paper is to analyze the impacts of the MWRP on rural agricultural enterprises in the Mexican Wolf Recovery Area (MWRA). This effort was designed to (1) provide perspective and background information to people not familiar with wolf depredation issues and (2) provide a basis for improved discussion and decision-making regarding socio-economics of individual family enterprises in the recovery area.

METHODS

Beginning in 2005, we invited ranchers in Catron County, New Mexico to discuss economic impacts of the Mexican Wolf Recovery Program on their individual operations. Ranchers interviewed can be viewed as proactive and progressive managers because they readily participated and expressed interest in devising new approaches to managing livestock in the wolf recovery area. Many ranchers expressed concern about impacts to themselves and their neighbors. Seven ranchers met two criteria: (1) directly affected with numerous depredations over several years, and (2) were willing to discuss their experiences in some detail. Ranchers reported livestock killed or injured by wolves, and we termed these *direct* losses. Some of these losses were confirmed by USDA Wildlife Services as being caused by wolves, whereas other losses were not confirmed by the agency for reasons discussed below. Interviews also revealed several types of *indirect* and *related* losses associated with the recovery program. However, there is currently no mechanism for confirming these types of losses. Each of these seven ranchers was interviewed during

April of 2006 to discuss economic impacts of depredation. Using ranch records, livestock losses were classified as wolf-related or typical ranch losses. Wolf-related losses were further classified as direct (i.e., wolf killing livestock) or indirect (i.e., changed management activities due to wolf recovery program).

Direct Losses

Published ranch cost-and-return estimates from New Mexico State University (NMSU) were used to estimate effects on net income associated with loss of cattle (direct loss) due to wolf depredation (Torell, 1998; Hawkes, 2006). Information on direct losses derived from interviews was inputted into the livestock budget model to estimate net income differences. This approach enabled comparisons of net incomes between a typical ranch with and without wolf depredations. Losses attributed to wolves were not solely confirmed kills or even investigated depredations. All animals included in the *wolf responsible* category were classified as such by ranchers, given some credible evidence (e.g., wolf tracks and no other predator tracks, known calf completely missing and only wolf tracks in the area). If the rancher being interviewed did not know the cause of an animal's death, or had no evidence of wolf involvement, animal losses were considered normal losses that would have happened without the wolf being reintroduced into the area.

Compensation Program

The Bailey Wildlife Foundation Wolf Compensation Trust is the only compensation program available to ranches for livestock losses caused by wolves. This program typically pays the current market value of the depredated animal. This is not a guaranteed compensation program, as is revealed by the fact that no payments were made in New Mexico in the fall of 2007 and spring of 2008, even though livestock depredations by wolves were confirmed.[3] We evaluated the market value relative to the real value these animals represent to a ranch, including investment to date, loss of future productivity, and loss due to replacement and acclimation (to elevation, fitness for terrain, knowledge of pasture foraging and watering locations). We also analyzed differences in compensation relative to variations within and across years. Time of year is important because livestock prices cycle within the year, with the typically highest calf value in March and April and the lowest in October and November.

Indirect Losses

Data from 1996 and 2006 ranch cost-and-return estimates from NMSU (Torell, 1998; Hawkes, 2006) were used to estimate losses associated with changing management (indirect loss) at the individual ranch level. Estimates were not intended to calculate precise losses to these ranches; rather they were used to evaluate the incremental impacts due to wolf presences and management changes. Information collected during interviews was used to adjust budgets based on estimated management changes as a result of wolves on individual ranches. Indirect losses considered in the analyses used adjustments (based on interviews) of 5% more in feed cost, 50% more in fuel and maintenance of vehicles, hiring a permanent full-time person, and 1% in increased vet costs associated with changes in management in an attempt to address wolf presence.

Adobe Ranch Case Study

In addition to direct and indirect losses, ranchers reported additional expenditures or losses as a result of wolf presence on their ranch. Related losses (i.e., decreased livestock performance as a result of wolf presence) were calculated for one ranch in the Gila as a case study. The Adobe Ranch in the Gila National Forest experienced an increase in wolf presence during 2007, confirmed livestock depredations,

[3]http://www.defenders.org/resources/publications/programs_and_policy/wildlife_conservation/solutions/full_list_of_payments_in_the_northern_rockies_and_southwest.pdf

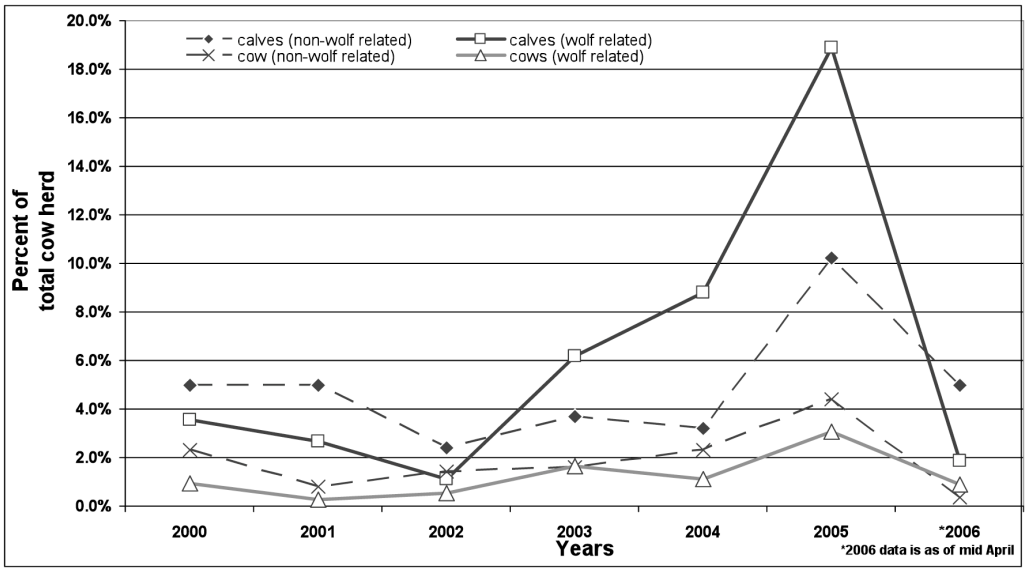

***Figure 2*. Annual livestock losses as a percent of total cow herd for several Catron County ranches.**

and resulting management challenges. Adobe Ranch personnel were interviewed regarding their experiences with depredations. Ranch management personnel provided ranch monitoring records that recorded precipitation, estimated wolf presence based on sightings, number of confirmed and likely livestock depredations, and performance of steer calves from fall weaning to shipping off the ranch (a period of 35–102 days depending upon the year, 2002–2007). This practice of weaning calves on the ranch and shipping at a later date has several advantages, especially if ample forage is available. It allows the calves to be vaccinated and adapt to weaning with less stress and stress-related sickness. It can also be financially advantageous, as calves that have been weaned at least 45 days with appropriate vaccinations receive a premium, and market prices are rebounding from seasonal lows.

Only steer calves were used in this analysis because the heaviest heifer calves were retained as replacements some years, which artificially deflated average heifer weights at shipping. Calves were shipped off the ranch at weaning during 2004; therefore, there are no data for that year. A 99% confidence interval for calf Average Daily Gains (ADG) was computed. In addition, regression analysis was conducted to quantify the relationship between growing season (April–October) precipitation and ADG. Using calf values from previous years, estimates are provided regarding dollar losses to the Adobe Ranch from direct losses (e.g., animal mortality), indirect losses (e.g., increased medicine costs), and related costs (e.g., animal performance—or lack of gain—losses). Results are supplemented with qualitative information provided by ranch personnel with respect to wolf activity and effects on livestock management.

RESULTS AND DISCUSSION

Direct Losses

Average annual normal calf loss on these ranches (losses due to lightning, disease, coyotes, etc.) since re-introduction of Mexican wolves in New Mexico ranged from 3.2% (2002) to 10.2% (2005) as a percent of total mother cows on the ranch. Average annual normal losses of mature cows ranged from 0.4% (2001) to 4.4% (2005) as a percent of total mother cows on the ranch. Wolves were likely responsible for annual mortality of 1.1% (2002) to 18.9% (2005) of calves and 0.3% (2001) to 3.1% (2005)

of cows per ranch (Figure 2), in addition to normal mortality.

Confirmed and probable livestock depredations by Mexican wolves fall into the lower range of actual depredations and do not address depredations that are never found or might be found too late for confirmation. Research in Idaho suggests that the ratio of detected kills to undetected kills is approximately 1:8 (Oakleaf et al., 2003). Many wolf depredations are likely contaminated by other predators (i.e., coyotes) and scavengers prior to confirmation of the predatory species responsible for the mortality, and in some cases species confirmation may be precluded due to contamination. Reported wolf-killed livestock numbers estimated in this analysis likely underestimate actual losses because of unfound or indeterminable losses that were listed as normal losses.

Depending on where the industry exists within the beef price cycle and the size of their operation, ranches may or may not be able to absorb additional losses. To demonstrate the effects of the price cycle, we used published NMSU cost-and-return estimates from 1996 (a low in the price cycle) and 2006 (a peak in the price cycle) to estimate the economic effect on an individual ranch with wolf-related livestock losses for 2005 (3.1% cows, 18.9% calves). In 1996, a ranch with about 180 cows would have a decrease in net income of $63.17 per cow, whereas in 2006, a comparable ranch would have experienced a decrease in net income of $125.18 per cow via direct losses of livestock to wolves. The 2006 ranch went from a positive net income to a negative ranch income when livestock depredations were included in the analysis. Therefore, with similar losses through the entire price cycle of this representative ranch, it would not experience any positive net returns.

Compensation Program

The FEIS (USFWS, 1996) assumes that depredated livestock are replaced on grazing allotments, and that effects on the overall number of livestock present during a grazing season are marginal. It became clear during the interviews that this was an unsubstantiated statement because the current compensation program falls short in several areas. First, compensation only occurs for confirmed kills, and confirmation is often difficult. Second, for confirmed wolf depredations, compensation often takes 3 to 6 months. Even if compensation is received sooner, ranchers may hesitate to place a naïve animal in unfamiliar, rough terrain. Naïve animals may experience increased vulnerability to depredation by wolves, reduced performance relative to experienced local animals, and a reluctance to range far from water, which can result in excessive forage use in certain areas. Given these factors, as well as rancher hesitation to leave the ranch (to remain vigilant of further depredations), replacements would likely not be purchased until the following year. Further, animals are often selected and bred for specific traits, including birth weight, confirmation, disposition, and acclimation to terrain and climate, that are not easily replicated in purchased animals. Livestock are not easily replaceable—ranchers must search for and purchase appropriate replacement stock. Another shortcoming of the current compensation program as revealed through interviews is that compensation is paid at the current market value for a confirmed wolf kill. This practice underestimates the real value of the animal to the economic enterprise. For example, if a bred four-year-old cow is killed by a wolf, we assume that it would cost $1,000[4] to purchase a bred four-year-old cow. However, it is likely that this replacement cow will be purchased later in the year, given that the

[4]Market value as of April 2006, when this study was completed—value changes as the market fluctuates.

compensation takes several months. When this occurs, there will likely be one less calf at market time ($605 value[5]) for that year, and only in the following year will the replacement cow produce a saleable product. But many ranchers stated that due to the time required to acclimate, and the associated stress of raising that calf, the replacement cow will often not breed back the following year. We assumed that 30% of replacement animals would not breed back the following year (estimate provided by C. Mathis, Extension Livestock Specialist, personal communication, 2008), which contributes an additional $182 loss of income to the ranch. If we include the cost of travel to acquire the new animal (estimated at $250) the total cost of replacing the lost animal is $2,037 if compensation is delayed and $1,432 if compensation is immediate (Table 1).

Another option, and the preferred alternative of ranchers we interviewed, is to raise a replacement animal (Table 1). The opportunity costs include retaining a replacement heifer that could have been sold ($605), and waiting two years before the replacement heifer will produce a sellable product ($605 × 2). However, the cow that was killed would have had a shorter productive life than the younger heifer that replaced her. Therefore, the younger animal is credited $350 (35% of $1,000) for a potentially longer productive life. The total sum loss of $1,465 does not include feed and vaccination costs of raising the animal or the risk associated with losing the animal. This scenario assumes a constant value of animals and available forage.

Using either scenario, the likely real value of an animal lost ranges between $1,432 and $2,037 as compared to the fluctuating market value ($605–$1,000) typically paid to ranchers through the existing compensation program. Applying estimated dollar values to the total number of discovered livestock killed by wolves potentially underestimates total financial impact by a factor of eight (Oakleaf et al., 2003). We did not calculate these estimates here, as we are uncertain of the applicability of Oakleaf's research to the Southwest and because of the informality of our data collection. Research investigating the probability of ranchers detecting wolf-related depredations of their livestock on southwestern rangelands is lacking. In addition to the direct costs of wolf depredation, indirect costs also affect the economic realities of rural citizens.

Table 1. Opportunity Costs and/or Replacement Costs for Depredated Cow as Determined Through Interviews of Catron and Sierra County Ranchers and Analysis of Market Values

Purchase of Bred Cow	
Cost of purchased cow	$1,000*
Cow not breeding back following year (30%)	$182*
Travel cost to purchase replacement cow	$250**
Immediate Replacement Total	**$1,432**
Loss of calf for current year	$605*
Delayed Replacement Total	**$2,037***
Raising Replacement Heifer	
Retained heifer calf that would have been sold	$605*
Loss of two years of production (2 calves)	$1,210*
Productive life credit of replacement heifer	-$350
Total	**$1,465**

*Market prices, April 2006

**Estimate of average costs provided by ranchers

Indirect Costs

Interviews with producers revealed additional impacts to ranch income beyond direct losses of livestock. Published net ranch income estimates from 1996 (Torell et al.) suggested a loss of $189.87 per cow for medium-sized ranches (186 mother cows) in the northwest region of New Mexico, the region Catron County was grouped into in 1996. Net ranch income in 2006 for a large ranch (183 mother cows) in the southwest region of New Mexico was estimated as $52.79 per cow. Catron County was grouped in the southwest region in 2006 because it was determined

[5]Market value as of April 2006, when this study was completed—value changes as the market fluctuates.

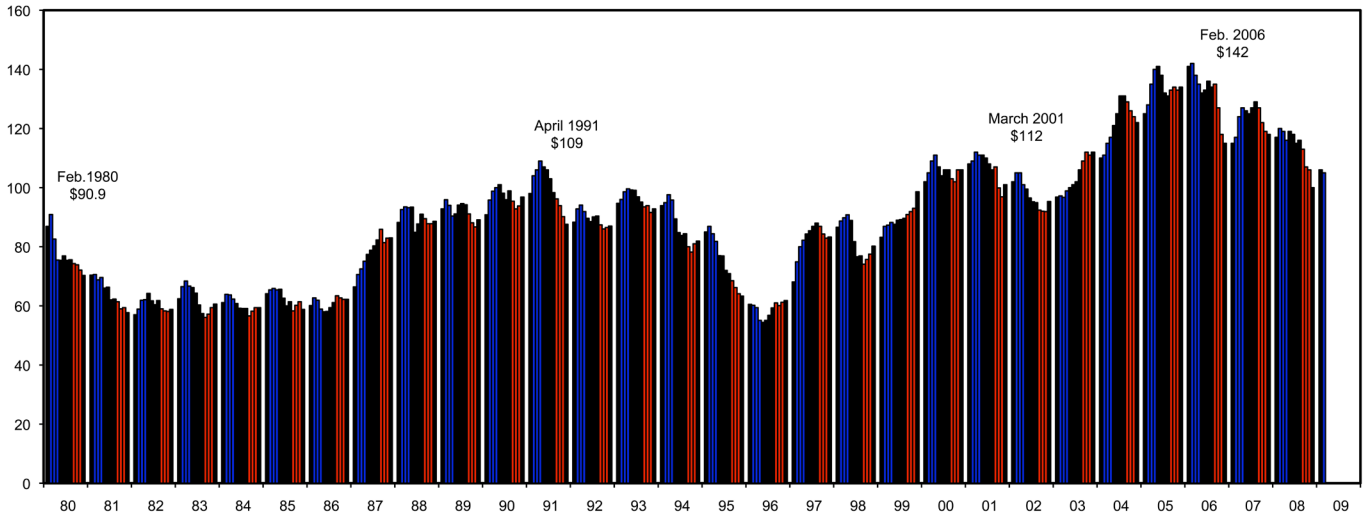

***Figure 3*. United States calf prices ($/CWT) from 1980 through 2008. (Source: USDA, NASS, Agricultural Prices.)**

its ranches were more characteristic of that region (J. Hawkes, personal communication, 2008). Indirect costs resulted from changes in management by ranchers in an attempt to minimize livestock depredations and stress-related losses associated with the presence of wolves. Adjustments in gross income and variable costs (resulting from management changes) revealed that loss in net ranch income was an estimated $338.88 and $157.04 per cow for 1996 and 2006, respectively. Reductions in calf crop percentages and weight losses associated with livestock being stressed and harassed were not estimated, but merit further consideration.

Economics of Ranching in the Mexican Wolf Recovery Area

The livestock industry in southwestern xeric (hot and dry) forests exhibits unique organizational attributes and infrastructure that should be considered when estimating economic impacts of wolf recovery on individual ranches. Most family ranches (48% to 99.6%) in the recovery area are highly dependent upon Forest Service lands for sustainability of their family's economic enterprise (USFWS, 1996). Changes in federal regulation, pressure from special interest groups, and endangered species issues add to traditional challenges that ranchers face. Traditional challenges include market fluctuations (Figure 3), the cost-price squeeze (Figure 4), weather variation, and livestock illness. As a result, these families and the communities they make up may face substantial difficulty in absorbing additional costs without recourse to adequate compensation. Economically, agriculture meets the criteria of a perfectly competitive market where all firms (i.e., ranchers) sell an identical or homogenous product, are price takers not price setters, have a relatively small share of a market, and have complete freedom to enter and exit the market. The key point here is that ranchers are price takers and unable to effect a price change or determine the price of their product. Therefore, they are at the mercy of the markets. The market has an average price cycle of 12 to 13 years from peak to peak, but can vary with external forces such as opening international borders, dairy buy-outs, and weather extremes. Ranch survival may depend on when these incremental and additive impacts occur relative to the price cycle. For example, calculations of 2006 (a peak year) net income losses based on direct costs and indirect costs were $72 and $157, respectively. In 1996 (a low year),

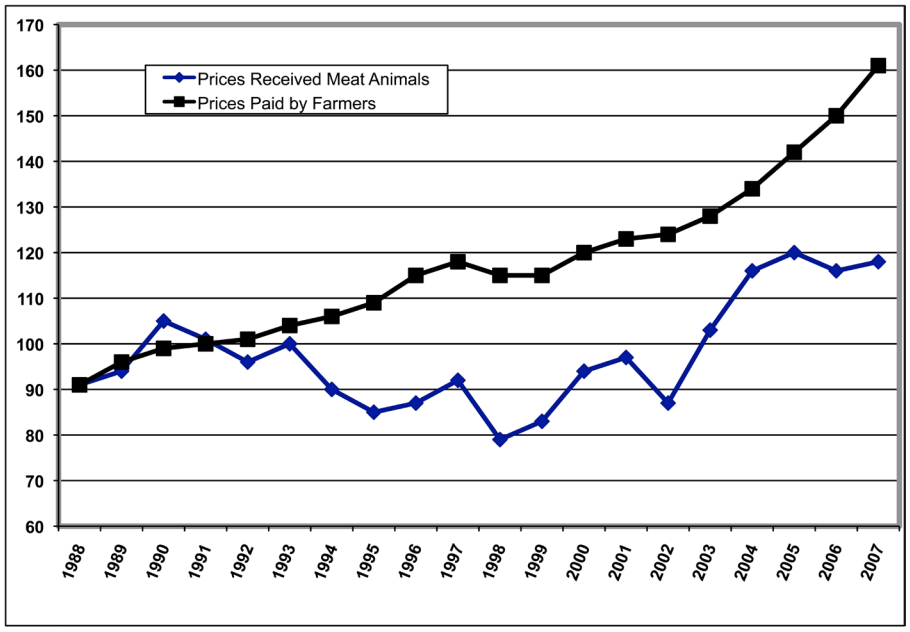

***Figure 4*. National Prices Received Index (PRI) and Prices Paid Index (PPI) from 1987 through 2007 for agricultural producers. (Source: USDA, NASS, Agricultural Prices Summary.)**

net income losses for direct and indirect costs were estimated at $253 and $339, respectively. This suggests that continuous depredations by wolves on a single ranch could result in negative net incomes and dramatic effects upon the financial stability of the ranch.

Livestock prices are just one factor that affects profitability and cannot be controlled by individual ranchers. The cost–price squeeze refers to the difference between the prices paid for inputs and the amount received for a product. The Prices Paid Index (PPI) and the Prices Received Index (PRI) demonstrate an increase in operating costs accompanied by a relative decrease in prices received for the product (livestock) from 1990 through 2002 (Figure 4). Ranches are paying more for ranch supplies, in real terms, than they are receiving for their product. Although these two indices neared each other in 2004–2005, the gap has widened since then, with a decrease in the prices received and an increase in prices paid for inputs.

Given the combination and cumulative effects of low cattle prices and high input costs, we would anticipate increased hardship for ranches experiencing additional losses caused by wolves. Research is needed to investigate impacts to rural agricultural communities in association with wolf presence. Understanding the economic challenges ranchers face and identifying opportunities to offset the costs brought about by wolf recovery could benefit ranchers in maintaining their family businesses. In our study, interviewees' ability to absorb high livestock losses in 2005 was largely due to favorable livestock prices that year. However, it is anticipated that when the market takes a downturn such as that which occurred in 1996, losses will be more difficult to absorb and ranchers will be less likely to maintain a viable business. Ranchers were reluctant to identify thresholds at which they would be forced to sell their ranches. Several did suggest that with the current price cycle and increased input costs, if calf crops fell 15% lower than average, they would seriously consider discontinuing their family beef production enterprises.

Importance of Scale

When predicting economic impacts associated with Mexican wolves, depredation rates were analyzed at a scale comprising all cattle within the recovery area (USFWS, 1982). According to the five-year review (USFWS, 2003), total direct economic impact represented between 0.05% and 0.47% of total cash receipts, and uncompensated losses represented between less than 0.02% and 0.44% of total cash receipts in the Blue Range Wolf Reintroduction Area (BRWRA). Although technically correct, these statements do not provide accurate analysis of impacts to individuals or local communities directly affected by livestock losses and costs associated with depredations by Mexican wolves. When analyzed at a state or regional scale, impacts may appear insignificant. This approach masks localized wolf activity and depredations that are often clustered on a small number of the total ranches in the recovery area. Individual ranchers may suffer a disproportionately large proportion of wolf depredation within a given time period, suggesting that research and associated analyses need to occur at a scale congruent with the effect. To a rural community, each ranch is a key social and economic contributor, helps define customs and culture, and is an important component of the local economy. What affects one ranch affects its neighbors and the community at large. At a region or state level, individual ranch enterprises have a less significant impact, yet still contribute and define the larger area socioeconomically. The greater the spatial scale used, the less any one individual contributes proportionally; this masks the localized effects individuals and communities experience with regards to wolf presence. It is important, for full disclosure, to analyze the effects of the recovery program at a smaller scale relevant to affected parties, not simply at the greater scale of interested parties.

Adobe Ranch Case Study—Performance-Related Losses

From 2000 to 2003, the Adobe Ranch knew of only two wolves on the ranch. In 2004, the number of wolves increased to nine, until 2006 when the total dropped to six. By the fall of 2007, a total of 14 wolves (three packs) were known to be on the ranch (Adobe Ranch Management, personal communication, 2008). Wolves were also in close proximity to the ranch headquarters and branding pasture beginning in February. This level of wolf activity coincidently led to eight confirmed and one probable depredation. Total depredations for 2007 included confirmed (13 animals), probable (1 animal), and possible (4 animals) on the Adobe Ranch. The Adobe Ranch alone accounted for 46% of the total confirmed depredations reported to the Bailey Wildlife Foundation Wolf Compensation Trust in New Mexico for 2007.[6] Also, 50% of the possible depredations and 100% of the probable depredations for 2007 occurred on this ranch.

Weaning weights, shipping weights, and site-specific precipitation were available for the Adobe Ranch from 2002 to 2007. Growing season precipitation was correlated to steer performance, as forage production is closely related to growing season precipitation. Cumulative precipitation from April through October was considered growing season precipitation.

There was little variation in steer ADG from 2002 through 2006 (Figure 5), with an average of 0.08 lbs/day, which is considered normal performance in the region when fall-weaned calves are retained (C. Mathis, personal communication, 2008). However, ADG in 2007 was much lower than in previous years when calves were managed similarly between weaning and shipping, falling well below the lower limit of a 99% confidence interval of -0.75 lb/day. Using actual market values from the Clovis Livestock Auction in Clovis, New

[6]http://www.defenders.org/resources/publications/programs_and_policy/wildlife_conservation/solutions/full_list_of_payments_in_the_northern_rockies_and_southwest.pdf

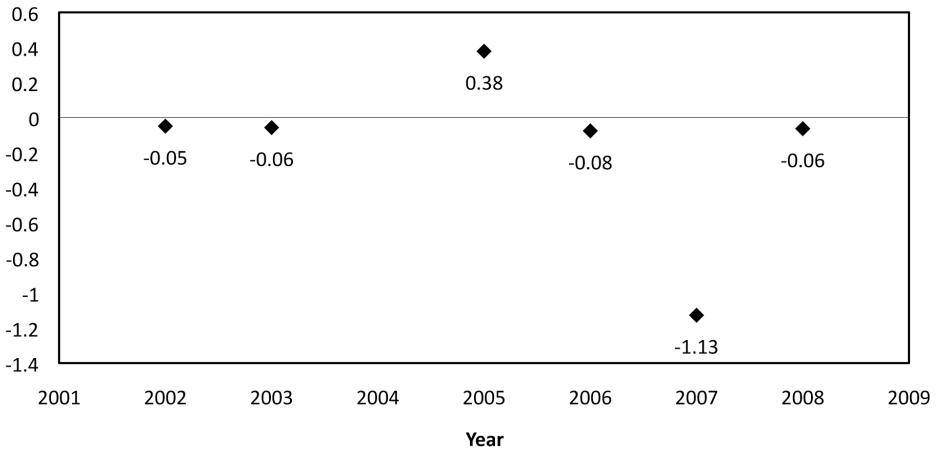

***Figure 5*. Average Daily Gain (ADG) for steers from 2002 through 2008 on the Adobe Ranch, Catron County, NM.**

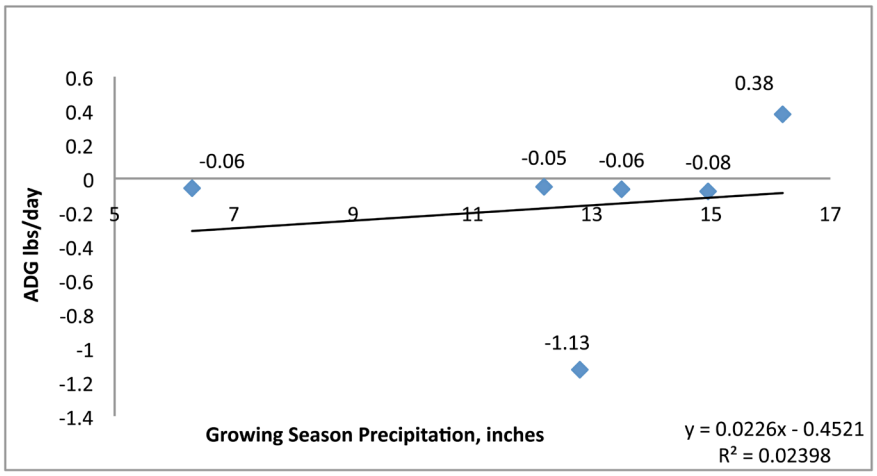

***Figure 6*. Impact of growing season precipitation on steer Average Daily Gain (ADG) from 2002 through 2008 on the Adobe Ranch, Catron County, NM.**

Mexico,[7] cost of the estimated impact of weight loss in 2007 was -$108.83 per steer weaned:

NG = (ASW – (AWW + (ADG*D))) * (S + P) / 100

NG = Net gain or loss
ASW = Average shipping weight
AWW = Average weaning weight
ADG = Average daily gain
D = number of days between weaning and shipping
S = Sale price ($/cwt)
P = Premium ($/cwt)

The previous calculation assumes a $7.00 premium for weaning and preconditioning steer calves a minimum of 45 days before shipping (King, 2007). Additionally, growing season precipitation explained only 2% ($r^2 = 0.02$) of the variation in steer ADG from weaning to shipping on the Adobe Ranch (Figure 6). Therefore, 98% of the variation in ADG was due to something other than the growing season precipitation received on the ranch.

These results do not prove that wolves

[7]http://www.retail-lmic.info/tac/spreadsheets/spreadsheets.html—No. 1-2 steers, 450- to 500-lb calves with average dates of weaning October 6 and shipping on December 10.

impacted steer performance because the data were not generated from a controlled study. However, with negligible impact of growing season precipitation on calf ADG, and calf management in 2007 similar to previous years, it is possible that increased wolf activity and depredation among weaned calves had a detrimental effect on steer ADG. At the least, this case study supports the need for research on non-lethal impacts of wolves on livestock. Total values for direct losses on the Adobe Ranch ranged from $8,585 for confirmed losses to a combined $11,993 for confirmed, possible, and probable losses. These calculations assumed an opportunity loss for calves equal to the shipping values of steers in the fall of 2007. Cow values were the average value of replacement cows (medium to large, young to middle aged, and 3- to 6-months bred) at the Roswell livestock auction during the month the depredation occurred (http://www.ams.usda.gov). Management of the Adobe Ranch estimated that there were probably four calves lost for every calf loss investigated. Using this estimate, the direct impact increases to $36,407 for 2007, not including the additional cost in medicine ($720.00) and labor/opportunity costs of approximately $1,484.33.

SUMMARY

The entire U.S. economy has changed drastically since the extirpation of wolves in the Southwest. Big game animals have become more valuable, outdoor recreation continues to increase, and ranches have changed from a few large operations to many smaller operations. Mexican wolf depredations represent potentially greater economic losses to smaller individual ranches than to larger ranches in the past. Economies of scale allowed larger ranches to more easily absorb these types of losses before the Mexican wolf eradication than smaller ranches can today. Similarly, impacts today would have incremental effects on local communities and counties, as the historic tax bases have decreased with reduced livestock numbers and the loss of receipt-generating activities such as logging.

"Adaptive management" has been a common phrase used for the Mexican wolf recovery program, presumably because scientific data would be used to guide management decisions. As more scientific information becomes available from research, management practices should be adjusted to improve potential for biological and social success. However, there has been very little scientific research on the Mexican wolf since its release into the wild, and virtually none has been made available to local producers to help them manage their livestock in the presences of wolves.

MANAGEMENT IMPLICATIONS AND FUTURE WORK

Our analysis did not include the daily disruptions and costs accrued by the rancher living with wolves. A great deal of this information was relayed during interviews, but these types of data are qualitative and difficult to summarize and analyze. These include, but are not limited to, time and money spent cooperating with the USFWS, not being able to use their cow dogs, and precautionary measures for horses and cattle. It should be recognized that there are undoubtedly other costs that were not quantified and which, cumulatively, represent significant burdens to residents in the MWRA. There have been some attempts to identify how many depredated livestock are never found or identified as wolf-related, but the results of the research conducted in the Southwest have not been finalized or published. An additional project by the University of Arizona is trying to determine what the wolves are eating through tracking movements of wolves. This could be beneficial information to local livestock producers in planning grazing strategies to avoid depredations by wolves. There has also been research conducted

by Texas Tech University that determined elk to be the primary prey of the Mexican wolf (Reed et al., 2004). However, ranchers in the area were concerned that the data were collected on an area or at a time when no livestock were present. Any flaws in experimental design of this nature must be addressed before research outcomes will garner widespread acceptance. Economic analysis relies on results of these types of research to determine a comprehensive set of financial-based variables to ranch net income. Information from well-designed, well-executed studies must be made available to the local producers and should focus on including producers in the development of research questions and objectives, data collection, and interpretation. It is our estimation that dissemination of research results by existing federal and state government wildlife agencies will not result in significant acceptance by local producers; too much trust has been lost. Third-party entities trusted by local citizens and with the scientific expertise to interpret results should be part of the scientific inquiry, design, and education/outreach effort. This approach would undoubtedly improve the reception given such scientific information and the social acceptance of the recovery program.

Only after goals and objectives of wolf recovery have been clearly identified and specifically defined will objective third-party scientists be able to develop research that addresses management of wolf recovery and its effect on residents. There are multiple issues and conflicts (such as effects on hunting, pets, livestock industry, and residence), with complex interactions, that have been identified since release of Mexican wolves in the BRWRA. This analysis has demonstrated that our understanding of the disproportionate economic impacts on a few affected individuals has been limited and that further investigation is warranted. Potential research questions include, but are not limited to, (1) Why are wolf depredations more numerous in certain geographic areas (and what are the characteristics of these areas)? (2) Are depredation rates and numbers a function of animal husbandry practices, topography, prey availability, the breed of livestock, or individual wolf-specific factors? (3) Is adapting livestock and wolf management practices from other areas to minimize wolf depredation practical and effective in the Southwest? and (4) How can we identify and implement innovative practices that incorporate unique habitats, wild ungulate populations, management practices, and local customs and cultures? Once data on these types of questions are collected, a comprehensive economic analysis will be possible in determining the effects of wolf presences on rural economies dependant on livestock agriculture for their livelihoods.

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NOTES

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