Trends in Summer Coyote and Wolf Predation on Sheep in Idaho During a Period of Wolf Recovery

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ABSTRACT Before the reintroduction of gray wolves (*Canis lupus*) to Idaho in 1995–1996, the primary depredation problem for livestock producers in summer was coyote (*Canis latrans*) predation on sheep and lambs. Since the reintroduction and biological recovery of wolves in Idaho, wolf predation on livestock has become a bigger problem in some areas than coyote predation. We evaluated trends in predation on sheep by coyotes and wolves in Idaho during the summer months, when most sheep are grazed on United States Forest Service (USFS) grazing allotments and are most vulnerable to wolf predation. An analysis of the available data suggests a significant negative relationship between the increase in Idaho's wolf population and summer coyote depredations on sheep ($r = -0.64$; $p = 0.0193$), and a positive relationship between the increase in Idaho's wolf population and summer wolf depredations on sheep ($r = 0.90$; $p < 0.0001$). As expected, the value of predation losses exhibited similar relationships; the value of sheep lost to wolves was positively correlated ($r = 0.94$; $p < 0.0001$) with wolf population size and the value of sheep lost to coyotes was negatively correlated ($r = -0.57$; $p = 0.0408$) with wolf population size. Future management strategies for wolves in Idaho will ultimately determine whether these trends continue.

KEY WORDS *Canis latrans*, *Canis lupus*, economic losses, predation, wolf recovery

Sheep production in Idaho is a substantial agricultural industry with the adult sheep inventory fluctuating between 245,000 to 210,000 annually from 1994–2007, and averaging about 231,000 adult sheep (NASS 2009b). Most sheep producers in Idaho practice shed lambing, and most lambs are born in February and March. In June, when lambs are 3–4 months old, ewes and their lambs are moved to summer ranges, typically located on higher elevation United States Forest Service (USFS) grazing allotments. In September and October, sheep are rounded up and lambs are shipped to market (Wagner 1988).

Coyotes have historically been the primary species responsible for most predation losses for sheep and lambs while on summer range in Idaho (NASS 2004, 2007, 2009a). However, since the reintroduction of wolves into central Idaho in 1995–1996, there has been a perceived decrease in predation on sheep by coyotes and an increase in predation by wolves. This perception coincides with a rapidly increasing wolf population, which was estimated at 732 animals in 2007 (Nadeau et al. 2008), exceeding the original recovery goal of around 100 wolves. Wolf predation on sheep in Idaho occurs year-round but, historically, the greatest number of wolf damage complaints has occurred when sheep are on summer range (Fig. 1) and are more likely to be within the home range of wolves. Our objective was to evaluate trends in summer predation on sheep by coyotes and wolves during this period of wolf population growth in Idaho.

METHODS

We analyzed sheep loss data available through the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS), Management

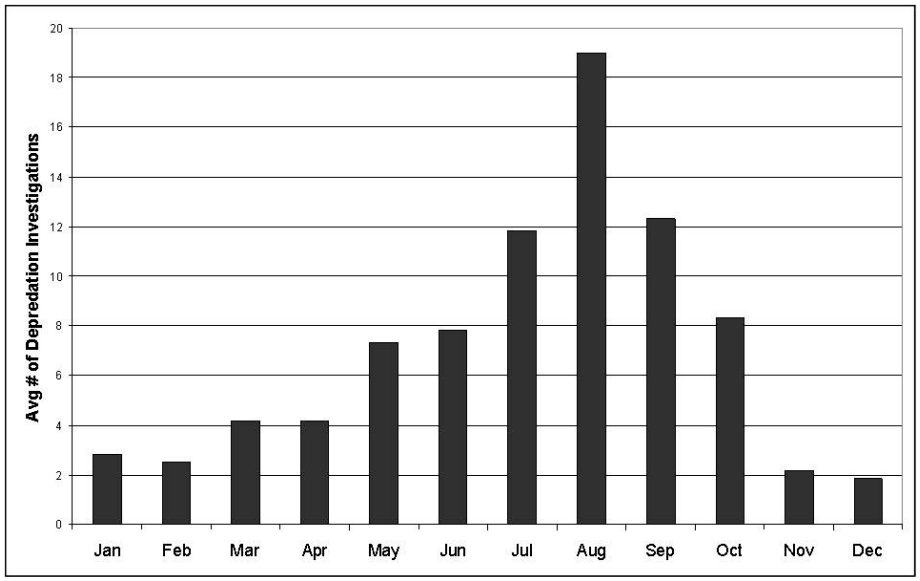

Figure 1. Average number of wolf depredation investigations per month in Idaho, 2002–2007.

Information System (MIS) database in Idaho. The MIS data compiled for this analysis included both verified and unverified sheep losses due to predation by coyotes and wolves from June through September for the years 1995–2007. Verified losses included only those confirmed as coyote or wolf predation through an onsite investigation of evidence by trained and experienced WS employees. Unverified losses included those losses that were reported to WS by sheep producers, but may not have been examined by WS employees. Schaefer et al. (1981) evaluated the reliability of unverified producer reports of livestock losses and concluded that these data were reliable estimates of predation.

The U.S. Fish and Wildlife Service, the Nez Perce Tribe, and the Idaho Department of Fish and Game (IDFG) have been involved to varying degrees in intensive wolf population monitoring efforts. This monitoring has included regularly occurring ground and aerial surveys facilitated by the fact that many of the wolf packs in Idaho contain at least one radio-collared animal. The IDFG also maintains an online reporting system that allows hunters and other members of the public to routinely report any wolf sightings, and these reports can be followed up to facilitate monitoring efforts. Monitoring data is used to prepare a minimum population estimate at the end of each calendar year (Nadeau et al. 2008).

Coyote populations are not monitored in Idaho and, consequently, we did not have a direct means of assessing the relationship between wolf and coyote population levels. However, we did use the MIS data to examine possible relationships between wolf population growth and coyote depredations within the Idaho livestock industry. The variables derived for analysis from the MIS database included the annual number of sheep killed by coyotes and wolves from June–September. The economic value of sheep losses due to predation by coyotes and wolves was also obtained from the database. While the economic value of predation losses is closely related to the number of animals killed, fluctuations in livestock

markets can result in varying impacts to producers.

Correlation analyses were performed between the annual data on wolf population levels, and sheep losses and economic values during June–September from 1995–2007. To examine for possible indicators of predatory behavioral characteristics, we also conducted separate correlation analyses between wolf population growth and depredations on lambs and adults by both wolves and coyotes. Correlation analyses were conducted using SAS PROC CORR (SAS Institute 2004). Idaho MIS data indicated a trend of annually increasing wolf predation on cattle, but this increase was not evident when looking at only the summer months. Therefore, we did not include a trend analysis of summer depredations on cattle as we did for sheep.

RESULTS

We found a positive relationship ($r = 0.90$; $p < 0.0001$) between wolf population growth and wolf depredations on sheep (Fig. 2), and a similar relationship ($r = 0.94$; $p < 0.0001$) between wolf population size and the value of the sheep losses (Fig. 3). Alternatively, we found a negative relationship ($r = -0.64$; $p = 0.0193$) between wolf population size and predation losses due to coyotes (Fig. 4). Wolf population size also was negatively correlated ($r = -0.57$; $p = 0.0408$) with economic value of sheep lost to predation by coyotes (Fig. 5).

Separating sheep losses from wolf and coyote predation into losses of lambs and losses of adults was not effective at producing insights into predatory tendencies by either wolves or coyotes. Correlations followed the same pattern as above, but with less strength. Wolf population size was correlated with wolf predation on adult sheep ($r = 0.86$; $p = 0.0002$) and lambs ($r = 0.69$; $p = 0.0088$). Similarly, wolf population size was negatively correlated with coyote predation on adult sheep ($r = -0.62$; $p = 0.0226$) and lambs ($r = -0.61$; $p = 0.0279$).

DISCUSSION

Many factors influence the susceptibility of livestock to predation and the ability and incentive for predators to depredate livestock. Nevertheless, we were specifically attempting to detect whether wolf population growth was related to the amount and value of summer sheep losses to coyotes, and to wolves. Although there have not been specific studies of the relationships between coyotes and wolves in central Idaho, these associations have been intensively studied in the greater Yellowstone ecosystem (GYE) (Crabtree and Sheldon 1999, Switalski 2003, Berger and Gese 2007). Soon after wolf reintroduction, a 50% decline in the number of coyotes on the northern range of Yellowstone National Park due to aggression and predation by wolves was documented (Crabtree and Sheldon 1999, Smith et al. 2003). Berger and Gese (2007) similarly documented a 39% decrease in coyote numbers in the Lamar River Valley of Yellowstone following the reintroduction of wolves. These findings are consistent with previous observations that coyote densities appear lower in areas where wolf densities are higher (Fuller and Keith 1981, Carbyn 1982, Dekker 1989, Thurber et al. 1992).

Coyote abundance also appears to be limited through spatial avoidance or displacement by wolves (Berger and Gese 2007, Arjo and Pletscher 1999, Peterson 1995, Thurber et al. 1992). On Isle Royale, interspecific resource competition could not be prevented through special avoidance resulting in the elimination of coyotes by wolves in about 8 years (Mech 1966).

Berger and Gese (2007) suggested coyote abundance in the GYE was limited

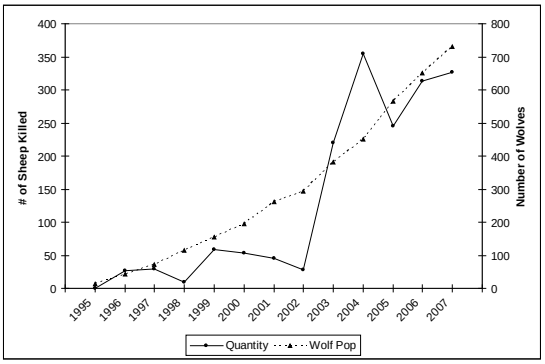

Figure 2. Summer sheep losses due to wolf predation with reference to increasing wolf population in Idaho, 1995–2007.

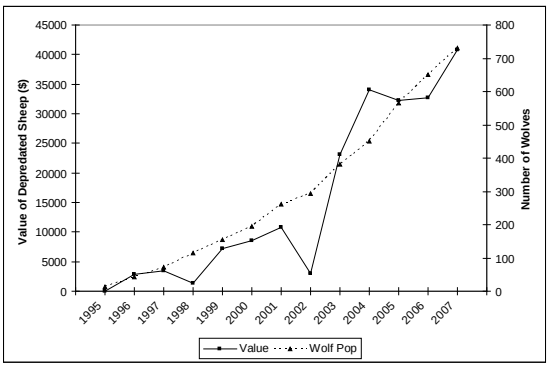

Figure 3. Value of summer sheep losses due to wolf predation with reference to increasing wolf population in Idaho, 1995–2007.

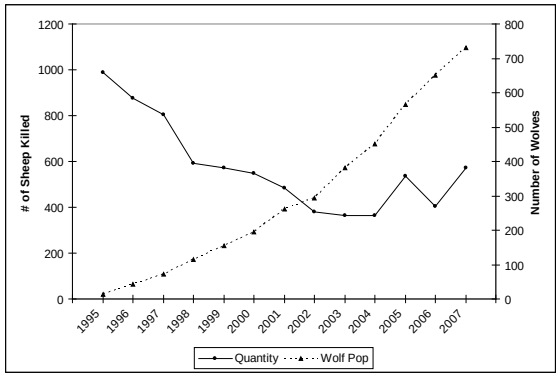

Figure 4. Summer sheep losses due to coyote predation with reference to increasing wolf population in Idaho, 1995–2007.

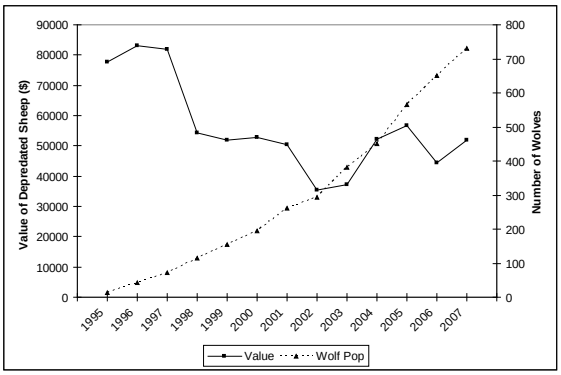

Figure 5. Value of summer sheep losses due to coyote predation with reference to increasing wolf population in Idaho, 1995–2007.

through interference competition with wolves, with impacts on survival and dispersal of transient coyotes resulting in reductions of coyote populations. Reductions in coyote densities and coyote depredations on livestock in response to Idaho's increasing wolf population would be consistent with this hypothesis. It would also be consistent with the findings of Berger et al. (2008), who documented a negative correlation between coyote and wolf densities, and found that coyote predation on pronghorn fawns was reduced 4-fold in areas with wolves, as compared to pronghorn areas without wolves.

Although coyotes are more wary and vigilant in the presence of wolves (Switalski 2003), Berger and Gese (2007) reported the presence of wolves did not appear to limit coyote distribution. Where coyotes and wolves coexist, it is not uncommon to capture coyotes in traps set for wolves during depredation control actions (Fuller and Keith 1981). From 2005–2008, 26 nontarget coyotes were trapped during wolf depredation control efforts conducted by WS in Idaho, even though pan-tension devices were used to reduce the likelihood of nontarget captures (T. Grimm, USDA, APHIS, Wildlife Services, personal communication). Thurber et al. (1992) also documented regularly capturing coyotes during wolf trapping efforts in Alaska. The decrease in summer coyote predation on sheep in Idaho, coinciding with an increase in the wolf population, is probably related to reduced coyote densities on summer grazing

range, but we have no coyote population monitoring data to support this hypothesis.

Factors other than coyote density may also have been contributing to decreased predation on sheep. The majority of producers in Idaho that graze sheep on open rangelands employ the use of livestock guarding dogs to decrease predation by coyotes. With the increase in Idaho's wolf population, instances of wolves injuring or killing one or more guard dogs at a time typically occur every year in Idaho. Some sheep producers have responded by increasing the number of livestock guarding dogs used with individual bands of sheep, particularly if those bands are being grazed in areas with a history of wolf depredation problems. Sheep herders in areas with chronic wolf problems often sleep very near their flocks at night, and maintain a heightened vigilance to reduce the likelihood of wolf predation. These measures to reduce wolf predation are probably effective in reducing the likelihood of coyote predation as well.

In some cases, sheep producers might not be requesting assistance from WS for coyote depredations if they know they are having wolf depredation problems at the same time. Collinge (2008) noted that individual wolves are much more likely to kill livestock than are coyotes or other predators, and wolves often kill more sheep per depredation incident than other predators. Many sheep producers also recognize that WS personnel must prioritize their work, and responding to wolf depredation complaints is often a higher priority than responding to coyote problems.

An analysis of statewide sheep inventory and mortality data collected annually in Idaho (NASS 1998, 2001, 2003, 2004, 2007, 2009b) suggested there has been a slight decrease in the annual percent predation loss for the sheep industry between 1995–2007. However, there are too many variables contributing to this decrease to make inferences on the cause for this decline. For example, increased protection methods employed by sheep producers are not accounted for in the predation loss data. Also, in 2001 the Idaho WS program augmented aerial hunting efforts to address coyote and wolf damage complaints with the use of an additional fixed-wing aircraft. Harper et al. (2005) also concluded that numerous variables were likely the cause for an inability to correlate patterns in predation losses in Minnesota to areas with and without a history of depredation.

If wolf populations continue to increase in Idaho, depredation on livestock also would be expected to increase. Over the last 20 years, wolf populations have been expanding in the Great Lakes region resulting in range expansion and colonization of previously unoccupied areas (Mech 1998, 2001; Berg and Benson 1999; Fuller et al. 1992). During this same period, livestock depredations by wolves increased (Fritz 1982, Fritz et al. 1992). A similar scenario to the Great Lakes region is apparently occurring in Idaho. When wolves were reintroduced into central Idaho they occupied a relatively small area in the Salmon River drainage. As the population has grown, wolf range has expanded into the lower elevation, privately-owned lands and depredations on livestock have increased. Whether or not this trend continues will likely depend largely on whether Idaho is successful in reducing the state's wolf population through regulated public hunting of delisted wolves.

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