



Short communication

Dynamics of early wolf and cougar eradication efforts in Montana: implications for conservation

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Abstract

Bounty records from Montana (1902–1930) were used to better understand spatial and temporal response of wolves (*Canis lupus*) and cougars (*Puma concolor*) to an eradication program. Number of payments for wolves declined from a high of 4116 in 1903 to 0 by 1928. Numbers of cougar pelts fluctuated, but generally declined from 177 in 1908 to 2 in 1930. An inverse spatial relationship existed between density of payments for wolves and cougars. Payments for wolves were greatest in the Prairie ecoregion, while payments for cougars were greatest in the Montane. The ratio of pup to adult wolves also was greatest in the Prairie ecoregion and least in the montane. If distribution and frequency of bounty payments were a reflection of the distribution and abundance of wolves, populations were highest and most productive in areas where they currently do not occur.

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1. Introduction

Once two of the most widely distributed large carnivores in the world, wolves (*Canis lupus*) and cougars (*Puma concolor*), were nearly eradicated in the western US as a result of habitat loss and predator control programs during the 20th century (Mech, 1970; Young and Goldman, 1944). Central to the success of predator control programs were economic incentives in the form of payments (bounties) to hunters or trappers in exchange for animal parts or pelts. Records of bounty payments provide a novel source of data regarding distribution and relative abundance of wolves and cougars, and response of large carnivores to human-caused exploitation. Improved understanding of where ancestral populations existed and their response to exploitation provide a historical perspective to management of large carnivores such as wolves and cougars, and may aid current conservation efforts for these species (Berger and Wehausen, 1991; Fuller and Kittredge, 1996).

The first territorial bounty legislation aimed at wolves and cougars in Montana was enacted in 1883 (Curnow, 1969). Bounty payments occurred until 1887, when the bounty law was repealed. A new bounty program was reinstated in 1891. By 1930, wolves were eradicated from Montana, and few cougars remained (Bangs et al., 1998; Young and Goldman, 1944, 1946). County treasurers, because of state accounting requirements, kept careful records of the eradication program through meticulous ledgers of bounty payments. These ledgers provide a source of harvest data, which may provide insight into historical exploitation and eradication of two species of large carnivores.

The goal of this study was to increase understanding of spatial and temporal dynamics of exploitation of large carnivores, and identify implications of this understanding for current management of these species. Our objectives were to: (1) document and analyze harvest records from bounty payments for wolves and cougars in Montana; (2) identify trends and spatial patterns in the eradication of wolves and cougars; (3) identify possible implications of these results to restoration and management of those species on the western landscape.

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2. Methods

2.1. Study area

Montana has a land area of 381,086 km², and averages approximately 870 km from east to west and 450 km from north to south (Fig. 1). Elevations range from 546 m where the Kootenai River exits the state in the northwest corner to 3898 m in the Beartooth Mountains of south central Montana. The western third of Montana is mountainous and the eastern two-thirds are a mix of undulating cleft prairie interspersed with rivers and isolated mountain ranges of the Missouri and Yellowstone watersheds.

All counties of Montana were assigned to one of three main ecoregions, the Montane, Intermountain, and Prairie ecoregions (Riley, 1998). The Montane ecoregion was comprised of Northern Rocky Mountain Steppe–Coniferous Forest–Alpine Meadow Provinces (McNab and Avers, 1994) within the Columbia Basin of northwestern Montana. Southwestern Montana and the Rocky Mountain East Front were classified into an Intermountain ecoregion, which contained a mix of Middle Rocky Mountain Steppe–Coniferous Forest–Alpine Meadow and Southern Rocky Mountain Steppe–Open Woodland–Coniferous Forest–Alpine Meadow Provinces. The remainder of the state is predominately in the Prairie ecoregion, comprised of Great Plains–Palouse Dry Steppe Province.

2.2. Data

Bounty harvest records from 1902 to 1930, originally recorded by county clerks, were transcribed from ledgers archived in the Montana State Library in Helena. Record books from 1924 were missing. Records represented number of bounty payments for cougar, adult wolf, and wolf pup pelts submitted by individuals in the county for which the animals were killed. Cougar bounty prices changed from \$7 in 1902 to \$10 in 1905. Adult wolf bounty prices changed from \$5 in 1902 to \$10 in 1906 and \$15 dollars in 1912. Bounty price for wolf pups was \$3 until 1904 and \$4 thereafter.

With the 1910, 1920, and 1930 censuses, some individual county boundaries shifted. Three county outline maps representing boundaries during time periods 1902–1910, 1911–1920, and 1921–1930 were digitized. To assess spatial and temporal dynamics, a geographic information system was created that joined historic harvest with appropriate counties for each time period.

2.3. Analyses

Temporal changes in bounty payments over time were summarized at the statewide and ecosystem level. Spatial changes in bounty payments over time were summarized at the county level. The number of pups per adult wolf bounty payments was calculated on an annual basis and summarized by ecoregion. We also

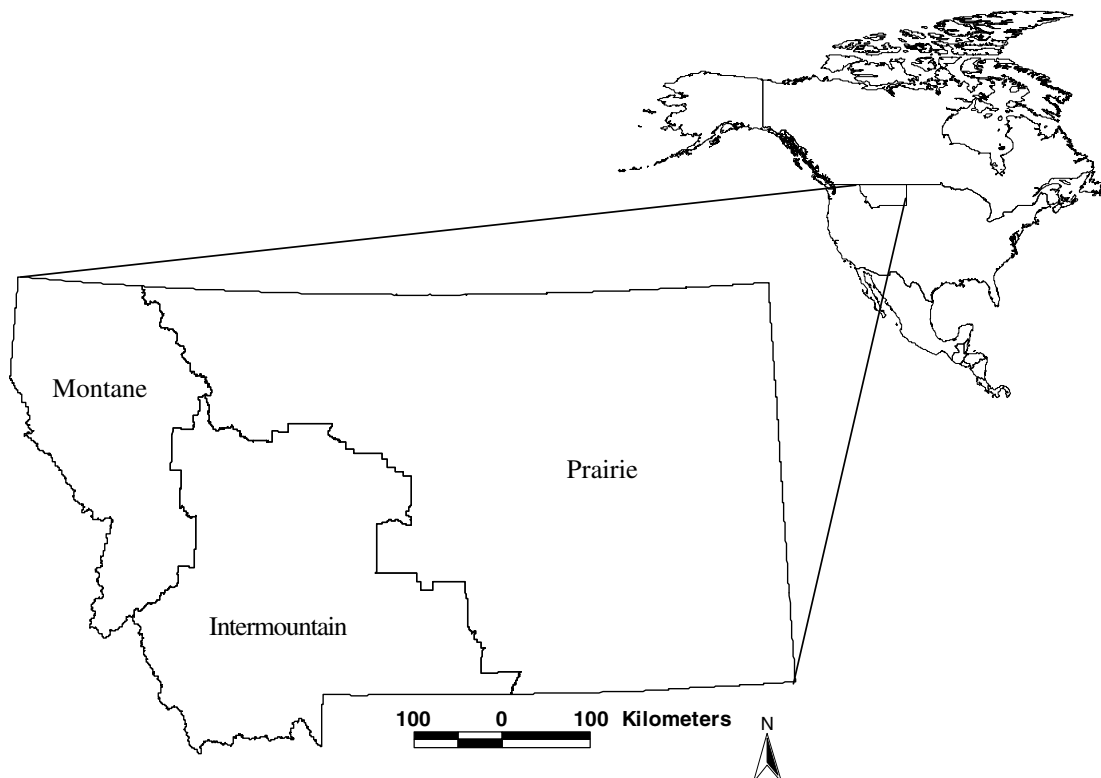


Fig. 1. Location of Montana within North America. Montana was stratified into Montane, Intermountain, and Prairie ecoregions.

summarized the proportion of total wolf and cougar bounty payments made in each ecoregion.

Bounty records may provide a glimpse of historic wolf and cougar ecology as well as population response to human exploitation. However, caution need be exercised when making inferences from the data. Some patterns we observed may be an artifact of wolf and cougar vulnerability to human harvest, or errors in reporting bounty kills. Data are lacking on bounty hunter effort, which might enable stronger inference between bounty kills and actual populations. Another source of potential bias is our inability to document the entire history of wolf and cougar exploitation in Montana. Bounty kills in Montana began in 1883, but only records from 1902 to 1930 were retrievable. Despite these potential sources of bias, we believe patterns from these data may be valuable for conservation planning.

3. Results

3.1. Wolf bounty payments

Number of payments declined rapidly from a peak in 1903 until 1909 (Fig. 2). A temporary increase in payments occurred from 1911 until 1914, after which a decline occurred until wolves were extirpated. No payments for wolf pelts were made in Montana after 1927.

Bounty payments for wolves were widespread across Montana from 1902 to 1910, but were greatest in the eastern half of the state (Fig. 2). Through time, the pattern of payments became more scattered across Montana as payments were no longer reported in some counties. Wolf kills from 1911 to 1920 were concentrated in the middle of the state with brief, but relatively high densities of kills localized in the northwest and southeast. Small numbers of wolf pelts were presented in a scattering of counties across most of the state during the last 9 years wolves were present in Montana. One exception was the Montane ecoregion, where no payments were made after 1921. The last bounty payment for wolves was recorded in Powder River County in southeastern Montana.

The ratio of wolf pups to adults was greatest in the Prairie ecoregion (Fig. 3). The ratio of pups to adult wolves presented for payment never exceeded one in the Montane (max = 0.07) or Intermountain (max = 0.57) ecoregions.

3.2. Cougar bounty payments

Cougar payments fluctuated from 1902 to 1922 with peaks occurring at an interval of 3–4 years (Fig. 2). Payments were greatest in 1908, when 177 pelts were

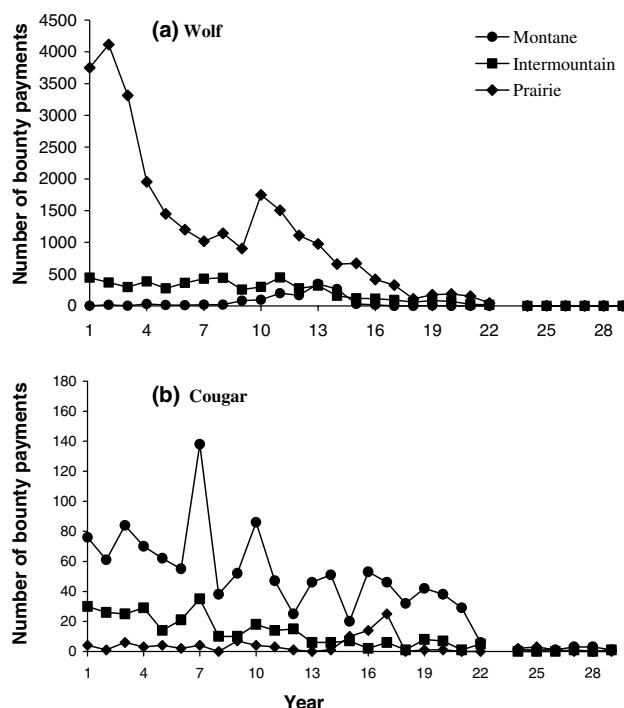


Fig. 2. Total and ecoregion-specific annual bounty payments made for wolves (a) and cougars (b) in Montana, 1902–1930. Data for 1924 were missing. Note difference in magnitude between cougar and wolf harvests.

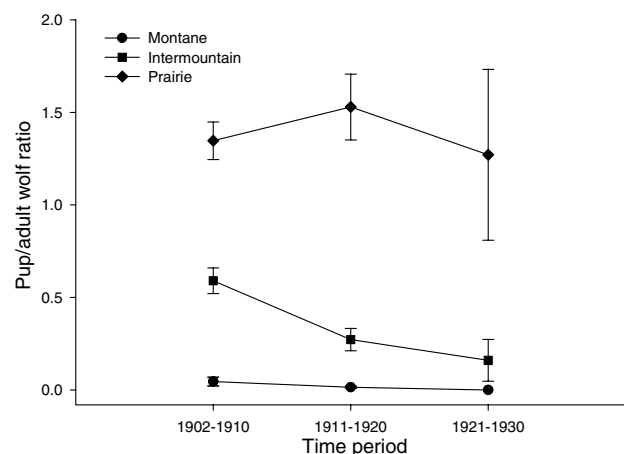


Fig. 3. Average ratio of pup pelts per adult pelts in bounty payments for wolves in Montana, 1902–1930. Annual ratios were averaged over each census period (1902–1910, 1911–1920, and 1921–1930) in each ecoregion. Bars indicate 1 standard error.

submitted for payment. By 1930, only two payments were made for cougar pelts in Montana.

From 1902 to 1910, nearly all counties in Montana had cougar pelts presented for bounty payment (Fig. 2). The highest numbers consistently occurred in the Montane and Intermountain ecoregions. By 1911, few pelts were presented for payment in the eastern half of the state. From 1925 to 1930, less than five pelts per year

were presented across the state. Numbers of cougar pelts were more concentrated in the Montane ecoregion except in the last 5 years when they were scattered across the western half of the state.

4. Discussion

The spatial differences in abundance and productivity we observed between wolves and cougars have several implications for conservation. Wolves in the western US currently are limited to mostly mountainous habitats of Idaho, Montana, and Wyoming, on or adjacent to national forests and national parks (Bangs and Fritts, 1996; Bangs et al., 1998). If historical distribution and abundance of bounty payments were a reflection of earlier distribution and abundance of wolves in Montana, ancestral wolf populations likely were highest and most productive in areas where they currently do not occur. Localized pockets of high bounty yields were observed in the Montane and Intermountain ecoregions. However, these ecoregions did not sustain high yields for as long as the eastern Prairie ecoregion. High apparent productivity of wolves in the prairie was expressed in the ratio of pups per adults presented for payment, and this occurred despite high human-caused mortality. Other ecoregions of Montana experienced lower harvests, yet these ecoregions did not appear to support sustained wolf productivity.

The relatively gentle terrain of the Prairie ecoregion is advantageous to a predator that pursues its prey (Mech, 1970). Immense herds of plains bison (*Bison bison*), which occupied the Prairie ecoregion in Montana, likely were linked to relatively high densities of ancestral wolves in those areas (Young and Goldman, 1944). It is likely not coincidental that eradication of bison and initiation of the state's first bounty program both occurred in 1883. Wolf populations probably switched prey from bison to cattle as livestock grazing spread rapidly throughout the Prairie ecoregion. Potential conflict with agricultural interests now reduce opportunities for species restoration in that ecoregion, and may limit future range expansion of wolves in Montana (Bangs et al., 1998).

A second implication of our analysis is that optimizing both cougar and wolf populations in the same area may be an unrealistic management goal due to interspecific interactions. The number of wolf bounty payments was highest where payments for cougars were least. The spatial pattern of bounty payments indicates a west to east gradient in abundance (least to greatest) existed during the early 20th century for wolves, and an opposite east to west gradient in abundance (least to greatest) was observed for cougars. This observation is supported by early explorer accounts of wolves in

Montana. For example, Lewis and Clark reported wolves present throughout eastern Montana, but made no mention of wolves once they reached the continental divide (Coues, 1893).

Competition between wolves and cougars may exist and have profound effects on their behavior and population dynamics. Patterns of winter prey selection in Glacier National Park indicated wolves and cougars exhibit exploitation and interference competition (Kunkel et al., 1999). Wolves can effectively compete through direct competition for prey or occasionally killing cougars (Bangs and Fritts, 1996; Boyd and Neale, 1992; Kunkel et al., 1999; White and Boyd, 1989). Potential for competitive interactions is an important conservation consideration because cougars exist in every area where wolves are presently being restored in the western US (Hornocker and Mobley, 1992). Cougars are capable of exploiting valley and foothill habitats because of relatively new, abundant white-tailed deer (*Odocoileus virginianus*) populations (Riley and Malecki, 2001). Historically, many of these valleys were inhabited by wolf populations that may have discouraged cougars from descending to lower elevations (Mussehl and Howell, 1971). If wolf populations continue to expand into areas currently occupied by cougars, wolves may once again restrict cougars to more mountainous and rugged terrain. Research is needed to better understand dynamics of potential competitive interactions between wolves and cougars, and their implications for conservation.

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