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COLORADO GRAY WOLF RECOVERY: A BIOLOGICAL FEASIBILITY STUDY

FINAL REPORT - 31 MARCH 1994

Larry E. Bennett

Copy Number 1

Presented to Mr. Lee Carlson
Colorado State Supervisor
United States Fish and Wildlife Service

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EXECUTIVE SUMMARY

The gray wolf was abundant in Colorado prior to Euroamerican settlement. Extensive human persecution led to its extirpation in the state by the 1920s. During Fiscal Year 1993, Congress directed that funding be provided to the United States Fish and Wildlife Service, Region 6, to conduct a study on the feasibility of reintroducing gray wolves in Colorado. The study was divided into a biological component and a human dimensions component.

On 1 April 1993, the biological component of the study was initiated by the University of Wyoming Cooperative Fish and Wildlife Research Unit. This document is the Final Report of this portion of the study.

A total of 11 national forests and adjacent areas were evaluated after the initial selection of potential areas was reduced to a Primary Analysis Area encompassing the western half of the state. These potential wolf recovery areas were then evaluated by comparing several selected habitat characteristics to those recommended by other Wolf Recovery Teams currently involved with wolf recovery programs in the United States. An unweighted ranking system identified and classified several potential areas that met the minimum recommended requirements for wolves. Specific issues pertaining to each area requiring a more in-depth investigation are identified.

The contiguous nature of the National Forest System and Bureau of Land Management lands in Colorado and potential transboundary movement by wolves suggest that any future wolf recovery efforts consider all the areas evaluated as one unit. The resulting complex consists of about 38 000 square miles of public land, of which, about 9 578 square miles are roadless.

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FORWARD

The following document is the result of a one-year study to determine the biological feasibility of reintroducing the gray wolf to Colorado.

Because of fiscal and time constraints, this study was designed as a course-screen approach to identify and describe potential areas in Colorado with suitable wolf habitat. It must be emphasized that the areas evaluated should be considered as preliminary potential wolf reintroduction areas because of the limited scope of this project. Additional in-depth studies will be necessary before wolves are reintroduced to any of these locations. The level of detail in this study is course compared to an in-depth approach such as provided by the recent Yellowstone National Park and Central Idaho Environmental Statement wolf recovery process.

International wolf experts acknowledge that:

> Socio-economic, ecological and political factors must be considered and resolved prior to reintroduction of the wolf into biologically suitable areas from which it has been extirpated (see Appx. A, p157).

The degree to which this guideline has been followed has been demonstrated in the Yellowstone wolf reintroduction process:

> The scoping procedure for the Yellowstone reintroduction procedure involved thirty-four open houses throughout Wyoming. Montana, and Idaho and at 7 other locations in the U.S. to identify issues that the public wanted considered in the Draft Environmental Impact Statement. More than 1 730 people attended these meetings, and nearly 4 000 comments were received. All issues were considered, organized into 39 separate headings, and were addressed in the following way:
>
> **Eighteen issues were addressed as part of one or more wolf management alternatives:**
>
> Amending the ESA
> Missing component of the ecosystem
> Humane treatment of wolves
> Enjoying wolves
> Regulated public take
> Cost of program
> State, tribal, federal authority
> viable population
> Travel corridors
> Range requirements

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Control strategies
Illegal killing
Compensation
Delisting
Need for education
Spiritual/cultural
Social/cultural environment
Recovery areas

Six issues were analyzed in detail in the EIS because they are potentially impacted by wolves or wolf recovery strategies

big game
hunting harvest
domestic animal depredation
land use restrictions
visitor use
local economies

Fifteen issues/impacts were not evaluated further in the DEIS because they were not significant to the decision being made

Wolves not native to Yellowstone National Park
Wolf rights
Federal "subsidies"
Human safety/health
Other predators and scavengers
Endangered species
Plants, invertebrates, fish, reptiles, amphibians, birds, and mammals
Diseases and parasites
Private property rights
Wolf recovery in other areas
Existing wolves in Central Idaho and Yellowstone
Existing wolves in northwestern Montana
Wolf subspecies
Wolf/dog/coyote/ hybridization
Need for research

Needless to say, this study pales in comparison to the scope of the Yellowstone recovery process. However, an attempt was made to gather as much information as possible and present it in a manner that would not only meet the study's objectives, but also provide an examination of wolf biology and ecology and a historical perspective.

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Several points should be made at the outset regarding this study:

(1). Boyce (1992) states, "we cannot know the consequences of wolf recovery until it actually takes place." I would hope the reader keeps this fact in mind throughout the document. Unfortunately, the wolf in the West was extirpated without much scientific thought and we are now faced with extrapolating observations from other regions. The inherent risk of this process is summed up well by the preceding statement.

(2). There are no absolute values contained in this report and the words "estimate", "estimated" or "approximate" should be kept in mind wherever I missed adding them. Livestock numbers, road mileage, acreage, human density, etc. are all dynamic values that vary in both space and time.

(3). The text of this report is presented in non-technical language to address a large cross-section of readers who may become involved in any future reintroduction program. Animal and plant common names are used throughout the text and most of the measurements are in the English System.

(4). Throughout the majority of the historical literature, the two adjectives "gray" and "grey" were used as a common name for ***Canis lupus*** Linneaus. This report will use the adjective "gray" in agreement with current usage.

(5). This report is based on my interpretation of the literature and does not necessarily reflect the opinion of the University of Wyoming Cooperative Fish and Wildlife Research Unit or the U.S. Fish and Wildlife Service. The author accepts full responsibility for any omissions and typographical errors and constructive criticism is welcome.

Larry E. Bennett

University of Wyoming Cooperative Fish
and Wildlife Research Unit, Laramie, WY.

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ACKNOWLEDGEMENTS

I have had the pleasure of meeting and interacting with a large number of professional people during the course of this project. A special thank you goes to Stanley Anderson and Fred Lindzey of the University of Wyoming Cooperative Fish and Wildlife Research Unit and Lee Carlson and Larry Shanks of the United States Fish and Wildlife Service for their support and constructive criticism.

I would also like to express my gratitude to Congressman David Skaggs and Michael Robinson for their effort in making this study possible.

I would like to thank all the agency people of the BLM, NFS, NPS, and CDOW who took the time out of their busy schedules to answer my information requests either by mail or by phone. I also appreciate the constructive comments their representatives provided after reviewing the draft copy of this report. At the risk of forgetting someone I will simply say thank you; you know who you are.

A special thank you to Ms. Pam Uihlein for her effort in compiling much of the historical Colorado wolf information. I know how much time is involved in ferreting out these older publications and I appreciate her effort.

I am indebted to Dr. Vladimir Bobrov with the Man and Biosphere (MAB) Program in Moscow for obtaining two Russian publications and to Ms. Dasha Solovyeza for translating selected portions.

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INTRODUCTION

During fiscal year 1993, Congress directed that funds be made available to the United States Fish and Wildlife Service (FWS), Region 6 to conduct a study on the feasibility of gray wolf (*Canis lupus*) reintroduction in Colorado. The proposed study was divided into two categories, the biological issue and the human dimensions issue. On 1 April 1993 the Service initiated the biological component of the study in cooperation with the University of Wyoming Cooperative Fish and Wildlife Research Unit.

Objectives of the biological component of the feasibility study are:

(1). Identify and describe habitat within Colorado with adequate biological components to support a viable gray wolf population.

(2). Determine the potential/likelihood of wolf movement from identified areas to other management areas not deemed suitable for wolf management.

The gray wolf was first listed as endangered on March 11, 1967, under the original Federal endangered species legislation of 1966 (32 Federal Register 4001). Its current endangered status was conferred by listing under the Endangered Species Act (ESA) of 1973[1].

As a result of a 1978 lawsuit, the gray wolf was delisted from endangered status to threatened

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[1] The Endangered Species Act of 1973, Pub. L. No. 93-205, 81 Stat. 884 (1973)(codified as amended at 16 U.S.C.A. sections 1531-1544 (1995 & Supp. 1991), The ESA repealed sections 1-3 of the Endangered Species Conservation Act of 1966 (Pub. L. No. 89-669, sections 1-3, 80 Stat. 926 (1966 Act) and sections 1-6 of the Endangered Species Conservation Act of 1969 (Pub. L. No. 91-135, 83 Stat. 275 (1969 Act). Sections 4 and 5 of the 1966 Act were redesignated as the National Wildlife Refuge System Administration Act of 1966, Pub. L. No. 91-135, section 12(f), 83 Stat. 275 (codified at 16 U.S.C.A., sections 668dd-668ee (1985 & Supp. 1991). The remainder of the 1969 Act has been amended throughout sections of 16 U.S.C. and 18 U.S.C. The ESA was amended by the Endangered Species Act Amendments of 1978, Pub. L. No. 95-632, 92 Stat. 3571, and the Endangered Species Act Amendments of 1982, Pub. L. No. 97-304, 96 Stat, 1411. In 1988, the ESA was reauthorized by Congress, H.R. Conf. Rep. No. 1467, 100th Cong., 2nd Sess., Cong. Rec. H82449 (1988); S.R. Conf. Rep. No. 1467, 10th Cong., 2nd Sess., Cong. Rec. S12557-61 (1988).

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status in Minnesota.[2]

The FWS is under an affirmative duty to conserve both threatened and endangered species.[3]

Conservation includes:

> [t]he use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the ESA] are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.[4]

Prior to Euroamerican colonization, the gray wolf occupied almost all of North America with the possible exception of true desert and alpine areas (Young 1944). The early association of the gray wolf with man in Colorado is documented in the fossil record at the Lindenmeir archeological site in northern Larimer County, Colorado. An accepted radiocarbon date for this site has been placed at 11,000 years before present (yr BP). The wolf was respected and revered by the early peoples and lived as an coequal apex predator along with man until Euroamerican settlement of the Continent beginning in the early 1600s (Lopez 1978, Young

---

[2] 43 Fed. Reg. 9,612 (1978). See: 50 C.F.R. section 17.11 (1990) for final listings of the gray wolf on endangered and threatened lists under the ESA. In September, 1974, the Minnesota Department of Natural Resources petitioned FWS to "delist" the Minnesota wolf population from endangered status under the ESA. FWS deferred its decision pending recommendation of the Eastern Timber Wolf Recovery Team. Later, as a result of a 1978 case in the United States District Court for the District of Minnesota brought by a farmer for compensation for livestock depredation, Brzoznowski v. Andrus, Civ. No. 5-77-19 (D. Minn. June 9, 1978), and on the recommendation of the Eastern Timber Wolf Recovery Team, the Secretary of the Interior reclassified Minnesota's wolf population from endangered to threatened status. 43 Fed. Reg. 9,607 (1978) (codified at 50 C.F.R. section 17 (1980).

[3] 16 U.S.C. sections 1532(3), 1536(a)(1) (1988).

[4] 16 U.S.C. sections 1532(3)(1988).

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1944 and others).

It is very doubtful whether, in all of recorded history, that any other mammal (or other organism) in the entire animal kingdom has been subjected to such continuous persecution and series of legal acts stipulating rewards for its extirpation. Whenever the wolf is mentioned in history, biblical reference, fiction, materia medica, poetry, legend, myth, story or nursery rhyme, it will be found prominent in the life of man.

Perhaps the most recognizable factor that has strained wolf-human relationships throughout recorded history has been the development of pastoralism. Caughley (1984) states:

> During the past 50,000 years people have modified their environment many times and in so doing have changed the ecology of many other species. The first quantal change was big game hunting, a technique invented by the Acheulean culture of Africa at a time beyond the range of radiocarbon dating and which spread rapidly outward. Throughout the world over 100 genera of mammals weighing more than 50kg (the megafauna) became extinct, together with many of their dependant predators and scavengers. The extinctions were not contemporaneous but followed the chronology of man's spread and his development as a big game hunter. Thus, Africa lost 40% of its megafauna genera during the last glaciation and North America 70% around BP 12,000. Madagascar lost all its ground quadrupeds and its brachiators sometime around AD 1000 soon after the Melansians found the island. New Zealand lost all six of its genera of large ratites about AD 1700 . For the previous 800 years they had formed the basis of a Polynesian hunting culture. With very few exceptions these extinctions took place without ecological replacement. The ecology of the world was altered profoundly. My reason for discussing this part of human prehistory is to place into perspective the next ecological jolt: the invention of pastoralism. Hardly anywhere in the world did it act upon a pristine system....

Boitani (in: Fritts et al. in press) states that the most negative of human attitudes developed in portions of Europe where the human ecological type was nomadic shepherds, while sedentary

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crop and livestock growers were more ambivalent, and hunters and warriors had positive views of the wolf. Unfortunately for the wolf, most European settlers in North America were from places and backgrounds where attitudes were most negative (Oakley 1986, in: Fritts in press). These negative attitudes took on a religious fervor in the American West as illustrated in the following quote by Benjamin Corbin (1900), who was known as the "boss wolf hunter" of North Dakota at the turn of the century.

> In the New Testament, the parable of the Good Shepherd shines like a star. If Jesus did not disdain to call himself the Good Shepherd, why should any man in North Dakota not be proud to be called by that name, or be associated as I am, with the men who are feeding their flocks on the rich and abundant pastures of this great commonwealth? Largely, my life has been spent in protecting these flocks against the incursions of ravenous beasts of prey. I know it is but a step and the first step, which counts in the march of civilization. God made the country but man made the town--and some of these towns are pretty tough, like most of the men's work. I can not believe that providence intended these rich lands, broad and well-watered, fertile and waving with abundant pasturage, close by mountains and valleys, filled with gold, and every metal and mineral, should be forever monopolized by wild beasts and savage men...the herds and flocks must be raised and protected here for my lord and my lady, if it takes the last man and last dollar. The wolf don't like them, and I trust the wolf will never come near their doors, or that any of them will turn out to be "wolves in sheep clothing," but if he comes near mine I will take him in, and it will be the saddest day of his life. That's why I am here. The wolf is the enemy of civilization, and I want to exterminate him.

The antithesis of the last sentence is, "civilization is the enemy of the wolf." This observation has been well documented in North America beginning in Colorado in the early 1800s. "Habitat fragmentation" is a relatively contemporary term for events that pale in comparison with those that occurred in Colorado and the West over 150 years ago. Associated with "civilization" was the initial, gross fragmentation of the wolf's ancestral range which would signal the "beginning of the end" for wolves in the western United States.

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The "ecological jolt" of pastoralism referred to by Caughley began to impact Colorado's wolf population beginning in 1861 when the first cattle herd was established in the Arkansas Valley (Peake 1927).

The establishment of the range livestock industry in the West was just one of many cumulative impacts that eventually led to the extirpation of the wolf. A complex series of events were taking place during this period of time which placed the wolf in direct conflict with livestock interests later in the century. Although the livestock industry carries the brunt of the responsibility for wolf extirpation, it must be pointed out that all of society should share the responsibility during this period of time. The mere presence of an increasing human population and human-related activities played an equally but important role. The dryland winter wheat farmer was indirectly just as responsible as the "wolfer" as he extended his territory from Kansas to eastern Colorado with the introduction of Russian hard red winter wheat. The coming of the railroads, building of roadways, gold and silver mining, logging operations were just a few of the human activities that were concurrent with the growing cattle industry during this time.

The driving force behind this attack on the land and its inhabitants was the concept of "Manifest Destiny" which relegated the new territory (wilderness) to the status of a physical object which had to be conquered and tamed to allow for the establishment of civilization. Unfortunately, this included everything that symbolized wilderness, including Native Americans, native ungulates, and the wolf. In less than 60 years, probably the greatest man-

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caused perturbation ever imposed on any ecosystem, at any time or place, had occurred. The wanton, wholesale slaughter of large native ungulates almost completely eliminated an entire trophic level of a food chain that had co-evolved with the wolf for thousands of years and the replacement of this trophic level by domestic livestock which rapidly filled the void.

Many current negative perceptions of wolf behavior were developed from this period of time. I feel the issue is important and have included Appendix B to clarify and quantify the magnitude of these events to help the reader place into context how they affected the gray wolf population at that time.

Description of Study Area.--A brief description of a state as large and diverse as Colorado would fill a large volume. However, an attempt is made to summarize those general characteristics that apply to this study. A color map of Colorado (Pierson Graphics, Denver, CO) is located in Appendix F (p. 269) as a reference.

Colorado is called the Centennial State, admitted to the Union in 1876 and is ranked the eight largest state in land area and has the highest average elevation. The highest point is at Mt. Elbert, 14 433 feet above sea level, one of the 53 "fourteeners" rising above 14 000 feet. The lowest elevation is 3 350 feet in extreme eastern Prowers County. Other statistics include (Colorado Agricultural Statistics 1993; U.S.D.A., SCS 1987):

Approximate land area:	103 730 mi^2
Approximate water area:	371 mi^2
Approximate total area:	104 100 mi^2
Approximate area of Federal Land:	37 239.1 mi^2
Approximate area and use of nonfederal land:	66 125.0 mi^2
Approximate crop land area:	17 187.5 mi^2

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Approximate pasture land area:	1 978.1 mi^2
Approximate rangeland area:	36 604.7 mi^2
Approximate forest land area:	6 373.4 mi^2
Minor cover/use:	1 885.9 mi^2
Approximate irrigated area:	4 687.5 mi^2
Number of farms and ranches (1992):	25 500
Land area in farms and ranches (1992):	51 250 mi^2
Average size of farm and ranches (1992):	1 286 acres

Erickson & Smith (1985) describe Colorado as a state of contrasts. This is due, in part, to three great physiographic provinces included within its boundaries which they describe as the Great Plains, The Southern Rocky Mountains, and the Colorado Plateau. Figure 1 shows the physiography of Colorado and adjoining states.

Extending from the Rocky Mountains, eastward across eastward Colorado, Montana, Wyoming, Kansas, Nebraska, the Dakotas and south to Texas are the mid- and short-grass prairies of North America. The early Great Plains have been referred by several authors as, "The Serengetti of the West" because of the large and varied number of native ungulates that inhabited the region. Grasses of this short- and mid-grass region store much of their biomass at ground level or underground in the form of stolons and rhizomes. They are able to withstand frequent defoliation by grazing without loss of stores (Platou and Tueller 1985). The widespread use of fire in this region was documented by Moore (1972).

Before the Euroamerican immigrants came as hunters, trappers, farmers, and ranchers, the Great Plains supported populations of pronghorn and bison estimated at 30-40 million for each species (Nelson 1925) with bison numbers possibly as high as 100 million (Roe 1970).

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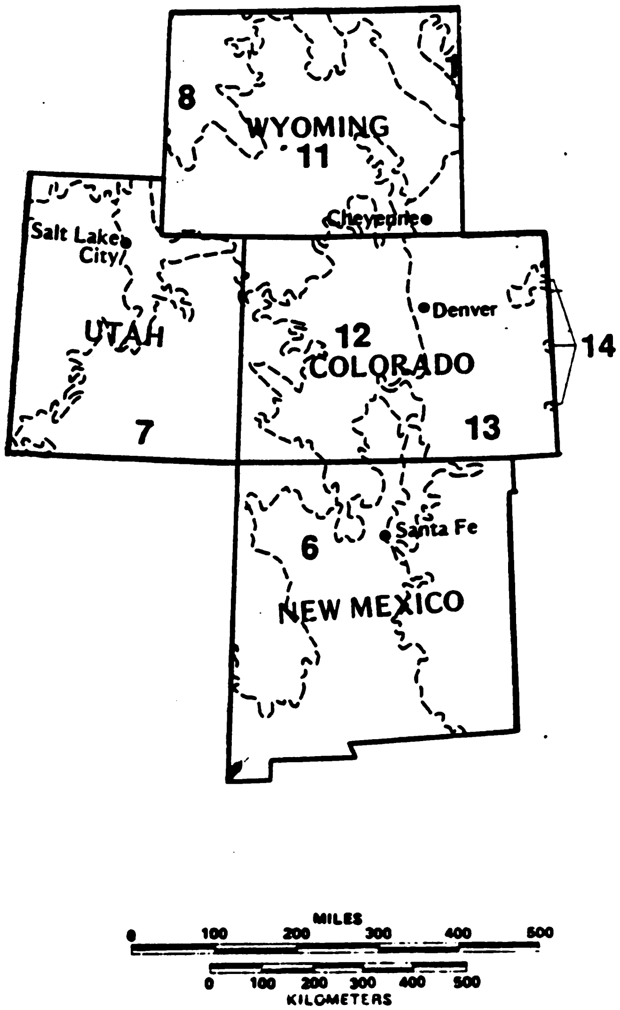

6 Lower Basin and Range
7 Colorado Plateau
8 Middle Rocky Mountains
11 Wyoming Basin
12 Southern Rocky Mountains
13 Rocky Mountain Piedmont
14 Great Plains

Source: A.W. Kuchler, Potential Vegetation of the Conterminous United States, Second Edition (American Geographical Society, 1975) with BLM Physiographic Regions By Kenneth Brown and Richard Kerr, 1979.

Figure 1. Physiography of Colorado and Adjoining States (Source: USDI, BLM. 1991. Final Environmental Impact Statement - Vegetation Treatment on BLM Lands in Thirteen Western States).

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Following the bison herds were often large groups of pronghorn antelope, traveling in bands of does, yearlings, and fawns in summer, then grouping into wintering herds in excess of 500 animals (Yoakum 1978). Pronghorn were often observed in the company of bison, presumably for protection from the ever-present "buffalo wolf" packs that followed the bison herds (Bryant 1846, in: Dorn 1985).

The large bison populations were not only a primary food source for the wolf and Indian, but indirectly may have been responsible for modifying the habitat to the advantage of other ungulate species. England and DeVos (1967) believe, based on historical records, that bison overgrazing was probably significant locally which increased the growth of forbs. Increased forb density may have been amenable to high pronghorn populations. Overgrazing and wallowing by bison may have produced conditions favorable to the "invasion" of the grasslands by woody vegetation which would provide cover and browse for elk, deer, and moose.

Elk, although preferring semi-timbered country bordering the vast treeless prairie, were numerous on the plains. J.R. Mead (a hunter and naturalist who lived in Wichita, Kansas) referred to droves of "1000 more or less" and said they were especially numerous in the 1850s and 1860s north of the Smoky Hill River, where they preferred broken country with timbered draws and streams (Hoffmeister 1947). Elk, like the bison, are also gregarious generalist grazers. Summer herds of elk up to 400 animals were common, and in winter, concentrations of over 1,000 were possible (Boyd 1978).

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Mule deer and bighorn sheep populations on the Plains were relatively small and their distribution restricted to areas of with uneven topography and sufficient cover. These species are less well adapted to open country with predominantly grass forage. The white-tailed deer were numerous and served as a staple food item in the Indian diet.

The Colorado Plateau is described as a region identified with the American Southwest and with sharply contrasting landscapes, juniper-covered plateaus, arid valleys, small towns, and vast empty spaces (Erikson & Smith 1985).

The Southern Rocky Mountains are described as part of a stringy, rough-textured fabric of intensely folded and glaciated highland that stretches from New Mexico to British Columbia. The major vegetation regions in Colorado and adjacent states are shown in Figure 2. In Colorado, there are 17 recognized plant series and 57 plant associations identified as forested ecosystems (Hoover and Wills 1984). The 17 plant series and 9 ecosystems are shown in Table 1.

These contrasting physiographic regions also affect the distribution of Colorado's human population. It has been stated that Colorado is in effect, "two" states: a large one of 53 counties, typical of the mountain states; and the smaller 10-county state, densely populated, intensively cultivated, and strongly urban and industrial. The latter is the Front Range urban corridor of Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, Pueblo, and Weld Counties (Erickson & Smith 1985).

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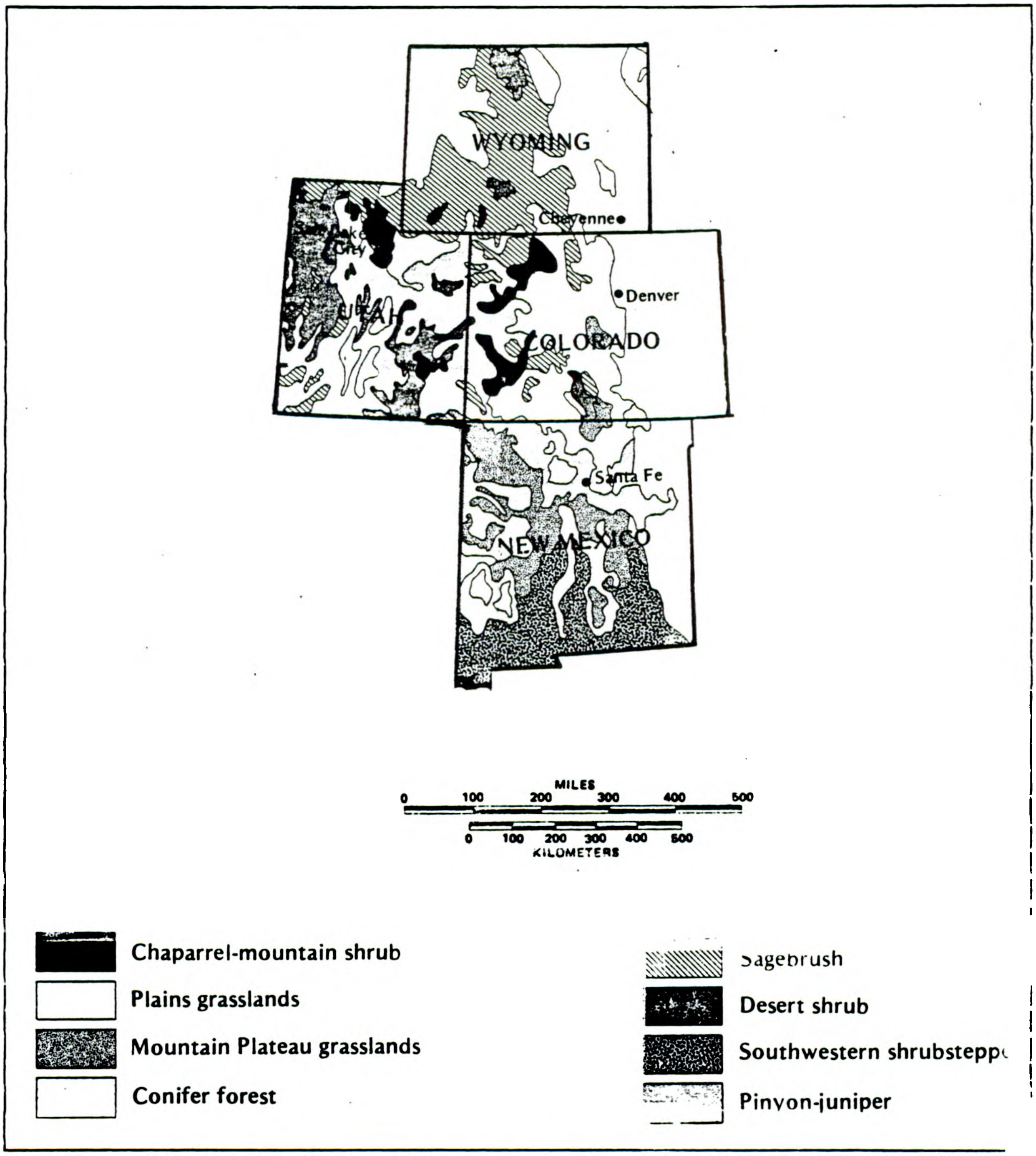

Figure 2. Vegetation Regions of Colorado and Adjoining States (Source: USDI, BLM. 1991. Final Environmental Impact Statement - Vegetation Treatment on BLM Lands in Thirteen Western States).

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Table 1. Relationship Between the 17 Recognized Forested Plant Series in Colorado and the 9 Ecosystems into Which They are Divided.[A]

Plant Series	Ecosystem
Engelmann Spruce Subalpine Fir Bristlecone Pine Limber Pine	Subalpine Forest
Douglas Fir	Douglas Fir
Ponderosa Pine	Ponderosa Pine
Lodgepole Pine	Lodgepole Pine
Aspen	Aspen
Pinyon Pine Rocky Mountain Juniper Utah Juniper One-seed Juniper	Pinyon-Juniper
Gambel Oak	Gambel Oak
Thinleaf Alder Blue Spruce	High Elevation Riparian
Plains Cottonwood Narrowleaf Cottonwood	Cottonwood Riparian

[A] Source: Hoover & Wills (ed). 1984.

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It has been estimated that about 10 000 humans occupied the area now known as Colorado in 1500 (Erickson & Smith 1985). This figure equates to a human density of about 0.1 human per square mile. According to the 1990 Census (U.S. Dept. of Commerce), this same area is now occupied by about 3 294 394 humans, or a human density of about 32 humans/mi^2.

Climate is the driving force for vegetative growth and is dominated by mountainous topography in Colorado. This complex topography causes considerable variation in site-specific temperature, precipitation, and surface winds. Precipitation is greater on the windward side, with amounts increasing dramatically with elevation. Temperatures are much colder than lowlands at similar latitudes, and may become frigid when cold air drains into mountain valleys. Diurnal up- and down-valley winds predominate. Mountain inversions may form and last for several days. Figure 3. shows average annual precipitation in Colorado and adjoining states.

The existing air quality in the undeveloped areas of Colorado is near or below measurable limits for most air pollutants (BLM 1991). Through the Clean Air Act of 1977, Congress established a system for the Prevention of Significant Deterioration (PSD) of "attainment and "unclassified " areas. PSD Class I areas are predominantly National Parks and certain Wilderness areas where virtually any degradation would be significant.

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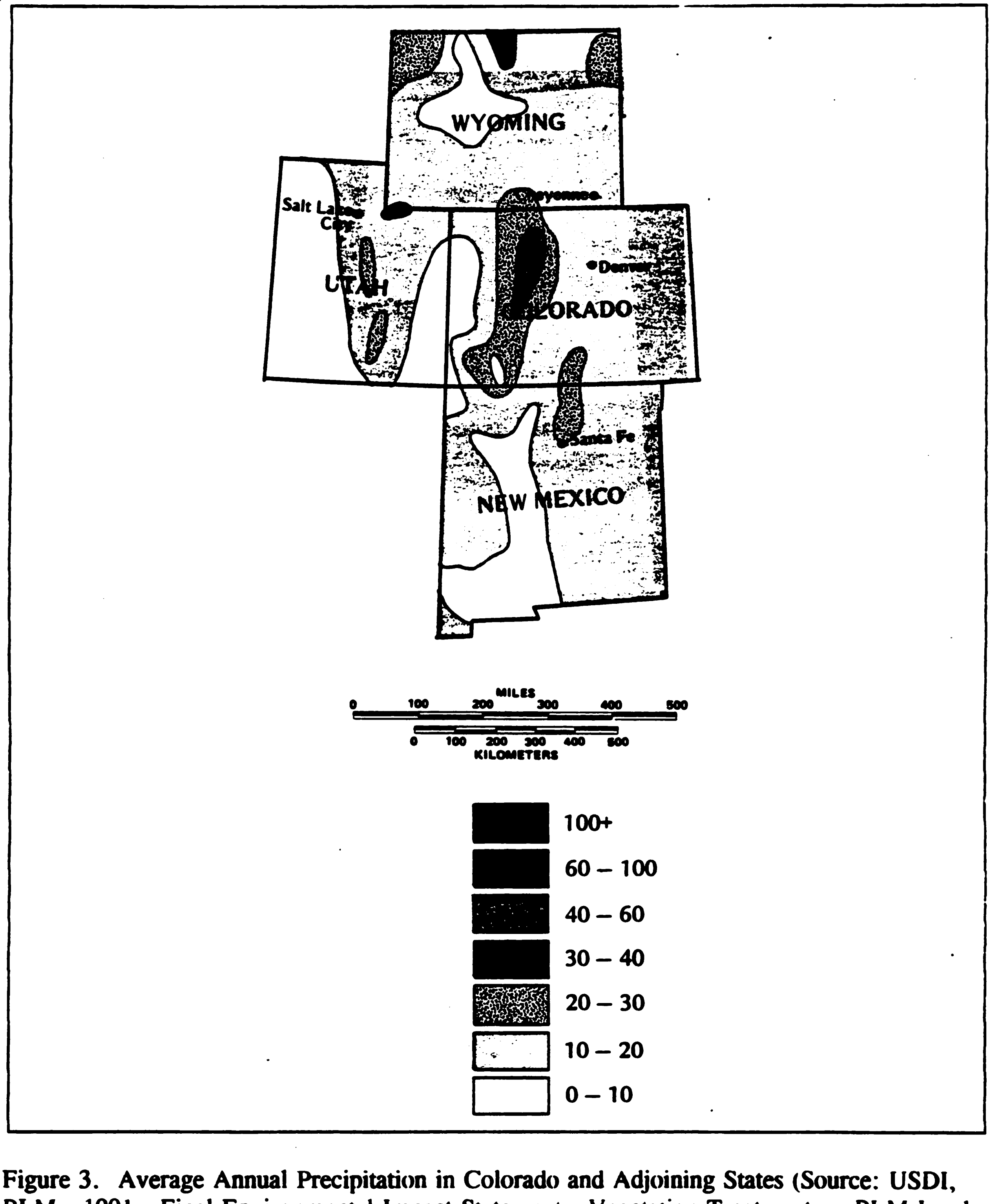

Figure 3. Average Annual Precipitation in Colorado and Adjoining States (Source: USDI, BLM. 1991. Final Environmental Impact Statement - Vegetation Treatment on BLM Lands in Thirteen Western States).

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PSD Class I regulations also address the potential for impacts to Air Quality Related Values (AQRVs). These AQRVs include visibility, odors, and impacts to flora, fauna, soils, water, and geologic and cultural structures. A possible impact to AQRVs is acid precipitation (BLM 1991). Figure 4 shows the Class I Air Quality areas in Colorado and adjoining states.

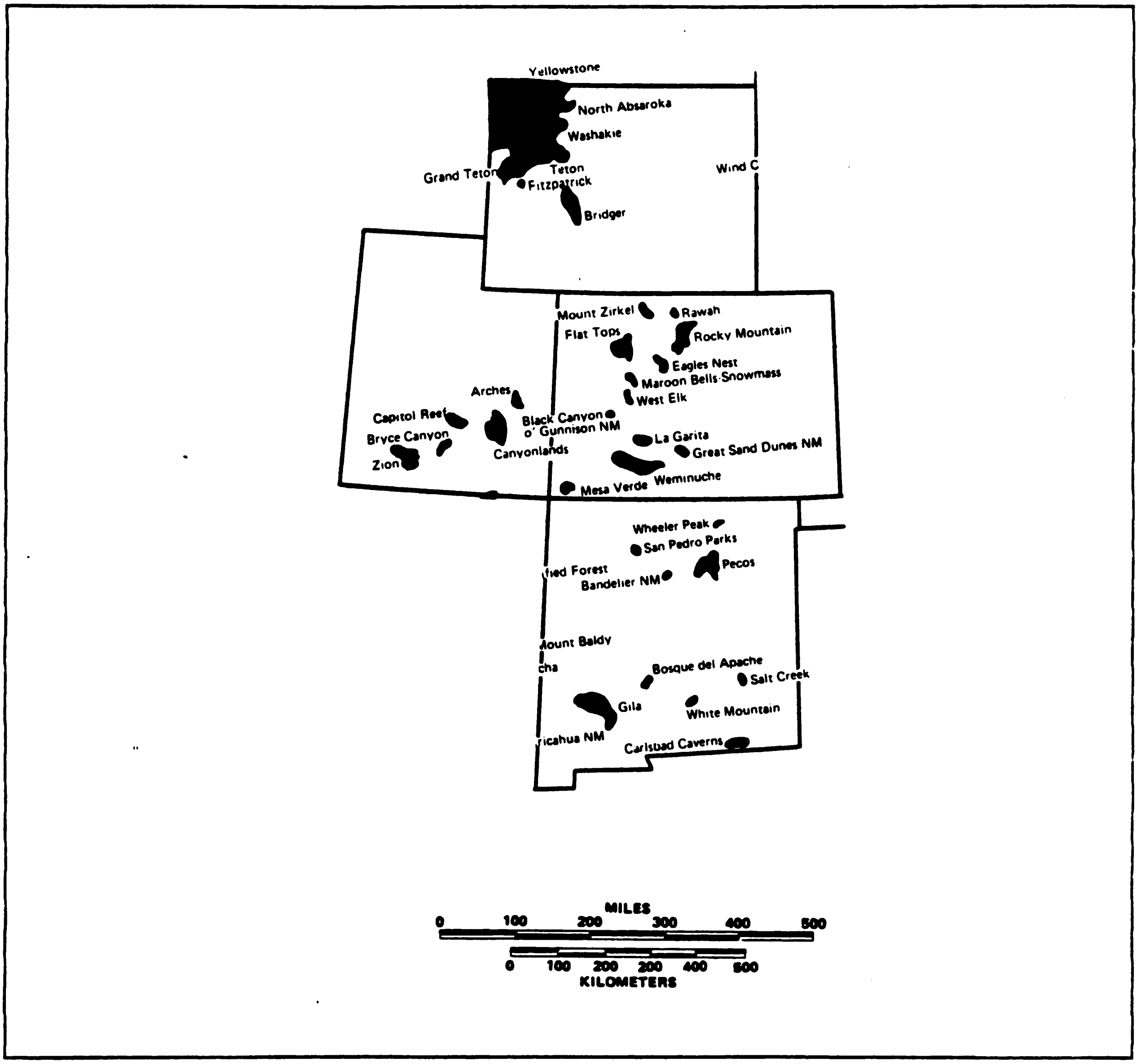

Figure 4. Class I Air Quality Areas in Colorado and Adjoining States (Source: USDI, BLM. 1991. Final Environmental Statement - Vegetation Treatment on BLM Lands in Thirteen Western States).

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GRAY WOLF BIOLOGY AND ECOLOGY[5]

A brief overview of the biology and ecology of the wolf is presented to acquaint the reader with the central focus of this report. For those interested in a more detailed account, the following publications are recommended (see Bibliography):

Mech, D. 1970.

Mech, D. 1974.

Zimen, E. 1978.

Bibikov, V (ed). 1985.

Bibikov, V. 1990.

Taxonomy.--Wolves have existed throughout North America and have occupied nearly all habitats in the Northern Hemisphere except for true deserts and alpine areas. Early taxonomists divided the gray wolf into 24 subspecies based on skull characteristics, body size, and color; often utilizing few specimens. Goldman (1944) described two sub-species of wolves for Colorado in historic times. The following is abstracted from Goldman (1944):

> *Canis lupus nubilus* Say, Long's Expedition Rocky Mountains 1: 169, 1823.
> Type: No type specimen designated.
>
> TYPE LOCALITY Engineer Cantonment, near present town of Blair, Washington County Nebr.
>
> DISTRIBUTION: Formerly Great Plains region from southern Saskatchewan and Manitoba south to southeastern New Mexico and southern Oklahoma, and

[5]Unless otherwise noted, the following chapter is paraphrased from: U.S. Department of Interior, Fish and Wildlife Service. 1993. The reintroduction of gray wolves to Yellowstone National Park and central Idaho - (Draft EIS), Helena MT.

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from the eastern base of the Rocky Mountains east to western Minnesota, western Iowa, and Missouri; now probably extinct. Intergraded on the north with *occidentalis*, on the west with *irremotus* and *youngi*, on the east with *lycucon*, and on the south with *monstrabilis*.

GENERAL CHARACTERISTICS: Size medium; color rather light; skull short, broad, and massive, with supraoccipital region narrow, the inion strongly projecting backward and tending to develop a descending hook. Averaging smaller than *youngi* of the southern Rocky Mountain region, with upper parts less suffused with buff; skull with supraoccipital region projecting farther posteriorly. Resembling *irremotus* of the northern Rocky Mountain region, but usually grayer, less inclining towards white; frontals narrower. Differs from *occidentalis* of Mackenzie in smaller size and shorter, less extensively white pelage. Similar in size to *monstabilis* of Texas, but usually paler, pelage longer and denser; skull flatter. Differs from *lycaon* of southern Quebec in paler color and much more robust skull.

COLOR: Upper parts in general a mixture of white and varying shades of light buff...Many color variations are presented...Black individuals may occur in the same litter with those normally colored.

Skull: Relatively short and massive in general form, with heavy rostrum and narrow supraoccipital shield and inion prominently projected posteriorly...

MEASUREMENTS: An adult male from Douglas, Wyo.: Total length, 1,982 (7.8 ft.); height at shoulder, 940 (3.7 ft.)...

REMARKS: The Great Plains wolf was a well-marked race, mid-continental in geographic position. Its range included that of the greatest game herds of North America, which afforded an ample food supply...

Specimens examined: Total number, 191, as follows: Colorado: Bent County, 15 (7 skull only); Fort Massachusetts (now Fort Garland), San Luis Valley, near head of Rio Grande, 1 (skull only); Higbee, Otero County (20 miles south), 3; Republican Fork of Kansas River, 1 (skull only); Thatcher (11 miles north), 1 (skull only)...

Canis lupus youngi Goldman, Mamm. Jour. 18 (1): 40, February 14, 1937.

TYPE LOCALITY: Harts Draw, north slope of Blue Mountains, 20 miles northwest of Monticello, San Juan County, Utah...

DISTRIBUTION: Formerly numerous in Rocky mountain region from northern Utah and southern Wyoming south through Utah and western

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Colorado to northern Arizona and northern New Mexico; west irregularly to central Nevada (Gold Creek, Elko County), and sporadically at least to southeastern California (Providence Mountains). Now extremely rare and restricted mainly to the rugged territory bordering the upper Colorado River in southeastern Utah and southwestern Colorado. Intergraded on the north with *irremotus*, on the east with *nubilus*, and on the south with *mongollensis*.

GENERAL CHARACTERS: A light-colored subspecies of medium to rather large size. Averaging larger than *nubilus* of the prairie region of Nebraska, with upper parts usually more suffused with buff; skull with supraoccipital region much less prominently projecting posteriorly. Similar in size to *irremotus* of the more northern Rocky mountain region, but upper parts more suffused with buff; skull differs in detail, especially the greater breadth of the frontal region. Larger than *mogollonensis* of the Mogollon Mountain and plateau region of New Mexico and Arizona, with upper parts usually paler, less extensively overlaid with black and more suffused with buff.

MEASUREMENTS: Type (approximated from tanned skin): Total length, 1800 mm.; tail vertebra, 470; hind foot, 255. An adult male from Castle Peak (Burns Hole, 15 miles northeast of Eagle), Colorado: Total length, 1777; height at shoulder, 806; weight, 125 pounds. An adult female from Salt Creek (22 miles north of Fruita), Colorado: Total length, 1701; height at shoulder, 724; weight, 110 pounds. An adult male from Laramie, Wyoming: Total length, 1600; tail vertebra, 420; hind foot, 270.

REMARKS: *C. l. youngi* was evidently the wolf of the southern part of the Rocky Mountains and high adjacent plains, displacing *nubilus* west of the prairie region of Nebraska and Kansas. It appears to have been most typical in the Colorado River drainage along the western side of the continental divide. One only, perhaps a wanderer from southern Nevada was trapped in the Providence Mountains, southeastern California, in 1922...

SPECIMENS EXAMINED: Castle Peak (Burns Hole, 15 miles northeast of Eagle), 1 (skin only); Chico Creek (near Dove Creek), Dolores County, 1; Glade Park (Black Ridge), Mesa County, 3; Piceance, Rio Blanco County, 3 (1 skull without skin); Pueblo (20 miles northeast), 2 (skulls only); Redvale (25 miles northwest), 1 (skull only); Salt Creek (about 22 miles north of Fruita), 2; Sulphur, Rio Blanco County, 1; West Creek, Garfield County, 2.

Contemporary researchers using multivariate analysis and molecular genetics, along with larger samples sizes suggest that 24 subspecies are unwarranted and that 5 North American subspecies are more reasonable. These subspecies overlap extensively with each other since

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they represent averages and trends in morphology that occur within a given geographical area. Genetically, there is very little distinction among gray wolf populations, at least due in part to the mobility of the species. Currently, all populations of wolves in the lower 48 states, irregardless of subspecies classification, are listed as endangered except for the gray wolf in Minnesota which is listed as threatened.

Present Number of Wolves in North America.--In 1992, the number of gray wolves in North America was estimated by Fritts (1992) to be:

Canada	55,000
Alaska	5,900-7,200
Minnesota	1,500-1,750
Wisconsin	About 40
Michigan	12-20 on Upper Peninsula about 12 on Isle Royal
Montana	About 50, including a pack on the U.S.-Canadian border
Washington	Number unknown, but small
Idaho	Less than 15
North Dakota	Occasional

Physical Characteristics.--In physical appearance the gray wolf resembles a large domestic dog, such as the Alaskan malamute. The wolf is the largest wild member of the dog family Canidae. Coat color ranges from white to shades of gray and black. In Minnesota, most wolves are gray. However, in Montana, black wolves are as common as gray wolves. Adult males average 90-110 pounds and range from 43-175 pounds, while adult females average 80-90 pounds and range from 39-125 pounds. Males are usually 5-6.5 feet long from nose to tail tip, and females range form 4.5-6 feet in length. Most wolves stand 26-32 inches tall at the shoulder. The largest wolves are in Alberta, British Columbia, and Montana.

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With long legs and a deep, narrow chest, the wolf is well suited for far-ranging travels. Wolves have large feet which aid in wintertime travel over crusted snow and allow them an advantage for preying on various ungulates, which can sink much deeper in the snow. Front feet are slightly larger than rear feet. Wolf tracks average 4 inches wide and 5 inches long with claw marks. Wolf and large domestic dog (Great Dane, St. Bernard, and Irish wolfhound) tracks are similar in size, and often impossible to differentiate from each other (Figure 5).

Ognev (1931) described the locomotion method of the wolf as:

> The wolf's usual method of locomotion is a slow trot or canter. It often covers dozens of miles in pursuit of prey. At first sight this light gait seems to be a very clumsy one as the animal seems to "stumble" with its hind paws at every step, but this is only a superficial impression, in reality, a very true and beautiful straight trail remains. Such an unusual trail is made by the extremely precise placing of the hind feet, not only print on print, but even digit on digit, in the prints of the fore paws...

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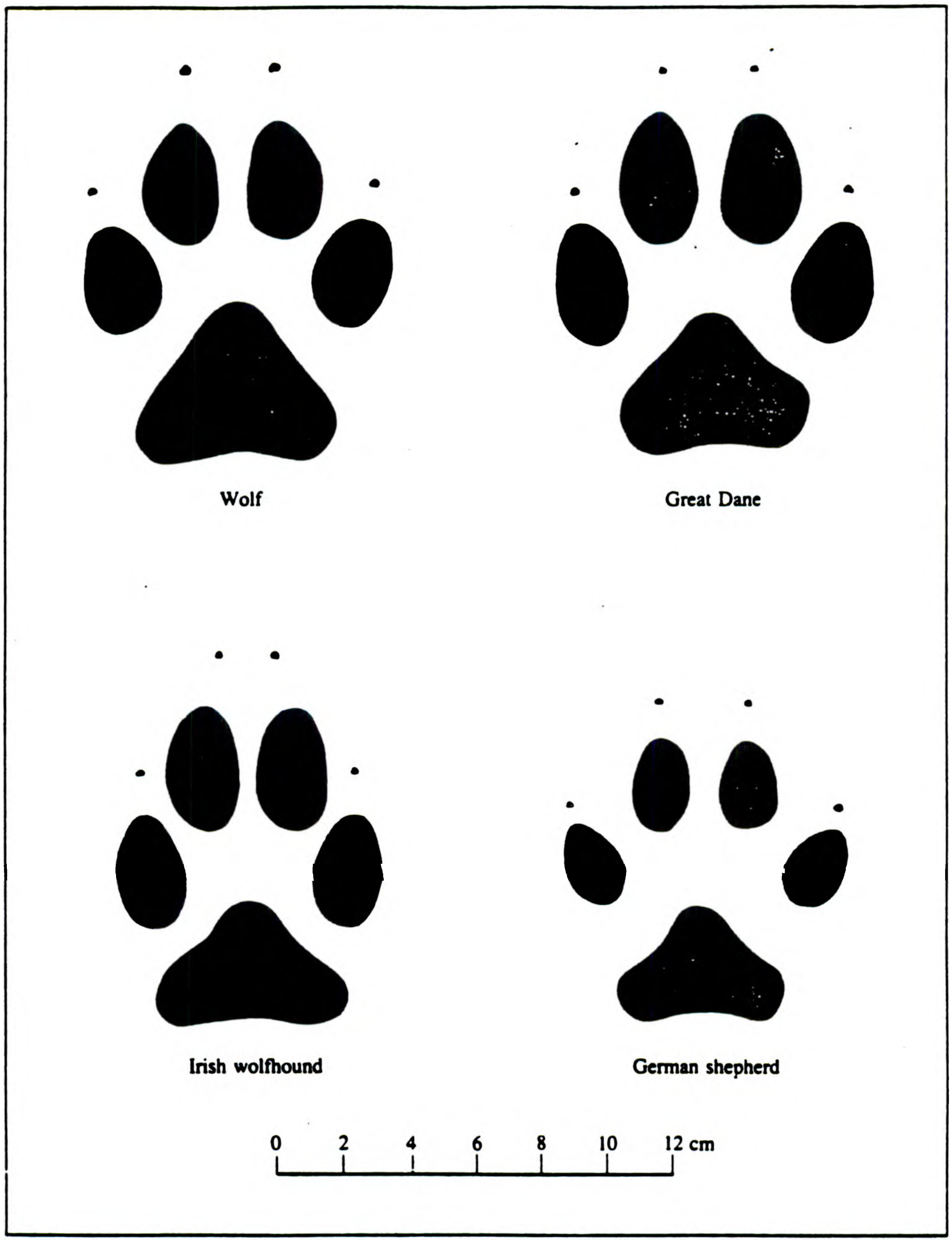

Figure 5. Wolf and dog tracks based on mean measurements of each (not full size). Source: Harris & Ream 1981.

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Communication.--Two important means of communication for wolves are howling and scent-marking. Within a wolf pack, howling serves in the identification, location, and assembly of separated pack members. It may also be particularly useful in facilitating the movement of pups and adults from one rendezvous site to the next. Howling may serve a social function when pack members rally around the alpha individuals and greet each other. It is also a means of advertising the presence of the pack within its territory, and the pack's willingness to defend resources such as pups, a kill, and the territory. This avoids direct conflict between packs.

Harrington and Mech (1978) state:

> To function effectively in territorial maintenance, howling must be audible over the great distances often separating packs...According to Joslin (1967), humans can sometimes hear wolf howls in Algonquin Park at a distance of 4 miles, and Stephenson (in Henshaw & Stephenson, 1974) reported that humans can hear wolf howls at 10 miles on the North Slope of Alaska, where lack of vegetation optimize sound transmission. In wooded areas of Minnesota, wolves apparently responded to human howling at distances as great as 6.8 miles in our study....

Brock (In: Condit 1956) states, " the baying of a pack of wolves can be heard quite plainly at a distance of 9 miles under favorable atmospheric conditions." This observation was made in the late 1800s in the Powder River country of Wyoming.

Scent marking is the application of an animal's odor to its environment. It is used by wolves to communicate information regarding territory, location of food, and even the behavioral or physiological condition of the animal. Scent-marking usually involves urinating and defecating. Scent marks are commonly made at route junctions and especially along the edges of pack territories. These scent marks inform lone wolves or packs when they are

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entering another pack's territory.

Pack organization.--The basic social unit in wolf populations is the pack. A pack consists of 2 to 30 wolves (usually 5-15) which have strong social bonds to each other. Historical reported pack sizes in the western United States have been estimated to range from 10 to 75 (see Appendix B). One instance was recorded in the late 1800s where possibly "more than 100" wolves from different packs congregated at one time (Condit 1956). The largest pack size I could find in the more modern literature is from Ognev (1931):

> According to L. P. Sabaneev, a wolf pack of more than 15 head is rarely to be encountered in the central part of former European Russia. This is not the case in Siberia, particularly in the southern and central parts, where packs of 100 or more of the gray predators can be seen to this day (1931).

A recent non-fatal encounter in Glacier National Park (Montana) between a grizzly sow and cub and 17-18 wolves was documented by Servheen (1993). Table 2 shows contemporary average wolf pack sizes. Packs are formed when 2 lone wolves of the opposite sex find each other, develop a pair bond, breed, and produce a litter of pups. Central to the pack are the dominant (alpha) male and (alpha) female. The remaining pack members are usually related to the alpha pair and constantly express their subordinate status through postures and expressions when interacting with the dominant pair. Young members approaching sexual maturity may challenge the dominant animals, which can result in dynamic changes in each wolf's social position in the pack.

Breeding within the pack usually occurs only between the top-ranking alpha male and female. Wolves become sexually mature at 2 years of age. Although courtship behavior occurs in

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Table 2. Average Size of Wolf Social Units and Their Primary prey. Sample Sizes are in Parenthesis.[1]

Mean group size	Primary Prey	Source
4.2 (270)[2]	white-tailed deer	Stenlund 1955
5.9 (54)	white-tailed deer	Pimlott et al. 1969
8.0 (5)	white-tailed deer	Van Ballenberghe et al. 1975
6.5 (24)	white-tailed deer	Mech 1973
5.8 (94)	white-tailed deer	Mech 1977b
4.3 (33)	white-tailed deer	Fritts & Mech 1981
12.5 (4)	elk	Carbyn 1981
11.6 (18)	moose	Haber 1977
7.2 (20)	moose	Fuller & Keith 1980
9.3 (23)	moose	Gasaway et al. 1983
9.8 (32)	moose	Peterson et al. 1984
4.4 (32)	moose	Messier 1985a
9.0 (24)	moose	Ballard et al. 1987

[1] Source: Bednarz 1988.

[2] Number of observations of groups made from aircraft. These may not have included the entire social unit.

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varying degrees throughout the year, the actual breeding season occurs from late January through April, depending on the latitude. Wolves in higher latitudes generally breed later. Wolves in Yellowstone National Park (45 degrees latitude) bred any time from late January to late February and possibly early March. During the breeding season in late winter, the pack may move extensively within its territory.

Pregnant alpha wolves complete digging of dens as early as 3 weeks before the birth of the pups. Most wolf dens are burrows in the ground, usually in sandy soil. Wolves may also den in hollow logs, rock caves, or abandoned beaver lodges. Some dens are used traditionally by a wolf pack from year to year. Also, certain specific areas (on the order of 5 square miles) may contain several den sites which are used in different years by the pack. Some wolf packs can be sensitive to human disturbance during this season and may abandon the den if disturbed. This poses a particular risk to younger pups that cannot regulate their own body temperature.

Wolf pups in general, are born in late March to May after a 63-day gestation period. In Yellowstone, wolf pups were born any time from late March through April. Litter sizes of wolves usually range from 4 to 7. In Yellowstone National Park, the average litter size taken from dens in the early 1900s was 7.8 pups and varied from 5 to 13.

With the denning established in the spring, pack movements center around the den. However, adult pack members may travel long distances from the den for food. The

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maternal female is usually at the rendezvous site more than the other adults, but she may also range several miles away. All pack members may help feed the female and young. Pack members also provide play and protection for the growing pups. The pups are weaned at 5 to 6 weeks of age.

A wolf pack will usually move from the den site (or occasionally from a second den site) to the first rendezvous site when the pups are 6-10 weeks of age which is in late-May through early July. The first rendezvous site is usually within 1-6 miles of the natal den site and often consists of meadows and adjacent timber with surface water nearby. A succession of rendezvous sites are used by the pack until the pups are mature enough to travel with the adults, usually by September or early October. Each successive rendezvous site is usually 1-4 miles from the previous site. Occupancy times vary from 10-67 days. As with dens, rendezvous sites may receive traditional use by wolf packs year after year. Wolves appear less sensitive to human disturbance at later rendezvous sites than they do at the first one.

By about October, pups are mature enough to travel with the adults, and pack movements become nomadic throughout the territory. As the pack travels throughout its established territory preying primarily on ungulates, the alpha wolves usually lead the pack and choose the direction and specific routes of travel. Wolves often travel on established routes including game and logging trails, roads, and frozen waterways, occasionally cutting across one such route to another. Daily travel distances for wolf packs are typically in the range of 1-9 miles, while distances between successive kills vary from 8-34 miles. Wolf packs in

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in Yellowstone National Park apparently followed the ungulates and included both summer and winter ranges of ungulates in their territories.

In most wolf populations, packs occupy exclusive territories. Territory size can vary significantly, depending on several factors. Table 3 shows the published territory sizes for wolves in North America. Territories in northwestern Montana average about 300-400 mi^2. Lone wolves may range over areas in excess of 1,000 mi^2. As pack members are traveling, they deposit urine and scat markers which identify their territories. Foreign wolves entering established territories may be killed.

Mortality.--Wolves die from a variety of causes: malnutrition, disease, debilitating injuries, interpack strife, and human exploitation and/or control. In areas with little or no human exploitation, the primary causes of mortality are disease and poor nutrition in pups or yearlings and death of adults from other wolves. Mortality rates for yearlings in unexploited populations can average about 45% and 10% for adults. In Minnesota during 1969-1972, September appeared to be a critical month for malnourished wolf pups to survive. Minnesota wolf pups with body weights less than 65% of standard weight had a poor chance of survival, whereas pups of at least 80% of standard weight had a high survival rate. Body weights appeared related to available food supply. Mortality rates of wolf pups in exploited populations (with snaring, poisoning, or hunting) can reach 80%.

Fall and winter may be critical periods for wolf survival. Beginning in autumn, wolf

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Table 3. Territory Size of Wolves in North America^.

Locality	Mean in mi^2	Range	Source
		CANADA	
Alberta	202	36-679	Fuller & Keith 1980
Alberta	146	not reported	Bjorge & Gunson 1983
Alberta	540	not reported	Rowan 1950
British Columbia	311	not reported	Ream et al. 1985
British Columbia	27	24-29	Scott & Shackelton 1982
Ontario	19	not reported	Kolenosky & Johnston 1967
Ontario	67	40-239	Pimlott et al. 1969
Ontario	85	not reported	Kolenosky 1972
Quebec	122	42-239	Messier 1985
NW Territories	90	not reported	Banfield 1954
Western Canada	50	not reported	Cowan 1954
		ALASKA	
Alaska	791	593-989	Haber 1977
	254	not reported	Gasaway et al. 1983
	616	457-776	James 1983
	243	68-594	Peterson et al. 1984
	628	360-970	Ballard et al. 1987
	1,800	not reported	Murie 1944
	5,000	not reported	Burkholder 1959

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Table 3. (Cont.).

Locality	Mean in mi²	Range	Source
		MINNESOTA[B]	
Northeast	42	20-55	Van Ballenberghe et al. 1975
	71	not reported	Mech 1972
	70	23-123	Mech 1986
	54	25-105	Mech, unpub. data -in Fuller 1989
Northcentral	82	61-104	Berg & Kuehn 1980, 1982
	44	19-85	Fuller 1989
	33	15-52	Fuller 1989
Northwest	99	29-253	Fritts & Mech 1981
East	75	26-118	R. Theil, pers. commun to Fuller 1989
		WISCONSIN	
	150	not reported	Thompson 1952
		MICHIGAN	
	260	not reported	Stebler 1944

[A] Source: Bednarz 1988.
[B] Fuller et al. 1992

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mortality rates are most influenced by the degree of exploitation and/or control by humans. Overwinter (October-March) mortality rates within packs ranged from 0-33% for a minimally exploited population to 14-88% for a heavily exploited population. Established wolf populations apparently can withstand human-caused mortality rates of 28-35%. Protected wolf populations can increase at rates of 28-35%.

Dispersal.--The nature and extent of dispersal in wolves appears related to wolf density and prey availability. In low-density populations, these animals may disperse just out of their natal pack's territory into an unoccupied area, find another lone wolf of the opposite sex, and form a new pack. In high-density populations, such animals may stay in the pack, if possible, and wait for changes in the rank order and opportunities to mate. If forced out, these loners may trail a pack or live in the buffer zones between territories to avoid packs. In some situations, young adult wolves may disperse hundreds of miles. However, mortality is often high among dispersing animals and therefore, the chances of finding a mate and successfully establishing a new pack are low. Wolves may disperse at ages ranging from 9-28 months or more. Dispersal in late winter by yearlings is common.

Niche.--Prior to arrival of European man, wolves and Native Americans were the primary apex predators of large ungulates in most of North America. All biological and social aspects of the wolf make it adapted to this role. No other carnivore in the western United States replaces the ecological role of the wolf. Although the coyote occasionally preys upon young, old, and vulnerable ungulates, its main diet primarily consists of rodents and lagomorphs.

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the coyote does not prey year-around on large ungulates. Other animals (besides man) that regularly prey on large mammals in North America include mountain lions, and black and grizzly bears. Although the mountain lion preys on large ungulates, its method of hunting (primarily "ambush") and social organization (solitary) contrast sharply with the socially cooperative methods of the wolf. Black and grizzly bears, usually solitary by nature, stalk and kill moose, elk, and deer and take mostly calves but occasionally take vulnerable adult ungulates as well.

Food Habits.--In general, wolves depend upon wild ungulates for food year round. In northern Montana, elk, moose, and deer (mule and white-tailed deer) are the principal prey species. In Colorado, elk and mule deer are expected to be the primary prey species. Smaller mammals can be an important alternative to ungulates in the snow-free months. These small mammals include beaver, marmots, ground squirrels, snowshoe hare, pocket gophers, and voles. In various areas of North America, during years of abundant beaver populations, beaver have comprised 25-75% of the spring-fall diet of wolves, so in those areas or situations, they may prey less on young ungulates. Nonetheless, when these figures for beaver are converted to a biomass basis, ungulates still constitute the bulk of the summer diet and certainly of the annual diet. In areas where beaver are not so abundant, ungulates usually account for more than 90% of the biomass consumed by wolves.

On an average, wolves eat 9 pounds of meat per wolf per day during winter. Although the wolf is capable of eating large quantities of food in a short time, such quantities are not

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always available. Thus, wild wolves may have to go for several days at a time without eating. Wolves probably could fast for periods of 2 weeks or more while searching for vulnerable prey. When food is available, wolves can replenish themselves to prepare for another period of fasting. The wolf, with its large stomach capacity, seems well adapted for this feasting and extended fasting.

The frequency of kills by a wolf pack varies tremendously, depending on many factors including: (1) pack size, (2) diversity, density, and vulnerability of prey, (3) snow conditions, and (4) degree of utilization of the carcasses. Because the wolf's prey varies in size from small mammals to beaver to bison, the kill rate of each species varies according to the amount of food each provides.

In Minnesota, where wolves eat white-tailed deer almost exclusively, estimated kill rates range from 15-19 deer per year. In areas where elk are the dominant prey, these kill rates are generally lower. In Riding Mountain National Park, 1 wolf averaged 14 ungulates killed per year which included deer, elk, and moose. Based on prey abundance in Yellowstone, the primary prey is expected to be elk and mule deer. It has been estimated that wolves will kill an average of 12 ungulates/wolf/year.

Bednarz (1988) reviewed published literature of primary prey in areas that were supporting reproducing populations of wolves (Canada, Mich, Alaska, Minn. Wis.)(Table 4). Results of this study are based on the assumption that large ungulates were the primary source of

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Table 4. Primary Prey Taken by Wolves in North America.[A]

Locality	Primary prey Species	%[B]	Secondary prey Species	%[B]	Source
			CANADA		
Alberta	elk	59	mule deer	18	Cowan 1947
Alberta	Buffalo	65[C]	fox	6[C]	Fuller & Novakowski 1955
Alberta	elk	40	mule deer	29	Carbyn 1974
Alberta	Moose	49	snowshoe hare	36	Fuller & Keith 1980
Alberta	cervid	51	hare	28	Bjorge & Gunson 1983
Manitoba	elk	87	moose	10	Carbyn 1983
NW Territories	caribou	47	unident. bird	13	Kuyt 1972
Ontario	beaver	48	white-tailed deer	35	Pimlott 1967
Ontario	W-T deer[D]	80	moose	8	Pimlott et al. 1969
Ontario	W-T deer	52	beaver	36	Messier 1984
			UNITED STATES		
Alaska	caribou	43	dall sheep	26	Murie 1944
Alaska	moose	56	snowshoe hare	30	Stephenson & Van Ballenberghe 1976
Alaska	caribou	67	moose	26	Haber 1977
Alaska	moose	55	caribou	12	Gasaway et al. 1983
Alaska	caribou	94	arctic ground squirrel	15	James 1983
Alaska	moose	67	snowshoe hare	38	Peterson et al. 1984

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Table 4. (Cont.)

Locality	Primary prey Species	%B	Secondary prey Species	%B	Source
Michigan	W-T deer	38	snowshoe hare	38	Stebler 1944
Isle Royal	moose	76	beaver	11	Mech 1966
Isle Royal	moose	86	beaver	11	Shelton 1966
Isle Royal	beaver	51	moose	49	Peterson 1977
Minnesota	W-T deer	80C	snowshoe hare	8C	Stenlund 1955
Minnesota	W-T deer	44	beaver	16	Byman 1972
Minnesota	W-T deer	46	moose	30	Frenzel 1974
Minnesota	W-T deer	57	moose	14	Van Ballenberghe et al. 1975
Minnesota	W-T deer	67E	moose	27E	Fritts & Mech 1981
Minnesota	W-T deer	78	snowshoe hare	23	Reimann 1983
Wisconsin	W-T deer	97	snowshoe hare	5	Thompson 1952

A Source: Bednarz 1988.

B Percentage occurence in scats unless otherwise noted.

C Percentage occurence in stomachs.

D W-T = White-tailed deer.

E Estimated biomass consumed.

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prey and that smaller mammals represented only a very small portion of the wolves' diet. Based on the literature, he calculated an estimated mean biomass of 1950 pounds per square mile as a minimum requirement for wolves.

Bednarz (1988) further clarified that a mean biomass of 1950 pounds per square mile is "overly conservative" and systematically reduced it to 1225 pounds per square mile. He also noted that wolves can and do survive in areas with an equivalent of as little as 260 lbs of biomass per square mile (Nelson & Mech 1981).

Influence of Wolf Predation on Ungulate Populations.--Wolf predation on larger ungulate populations usually results in smaller fluctuations in ungulate numbers over the years. Smaller die-offs from winterkill may occur because wolves are preying on weakened animals before they die.

Wolf predation is one component of total annual mortality in many ungulate populations. Wolves usually do not deplete their prey populations, but may keep some prey species at low levels if ungulate populations are already low and other limiting factors exist. Computer models have predicted that wolves in the Yellowstone area may reduce ungulate populations by 5-30% and decrease fluctuations in the populations, but would not have devastating effects on the prey populations. Table 5 summarizes the conclusions of various studies addressing the possible effects of wolf predation.

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Table 5. Conclusions of various studies addressing the possible effects of wolf predation.^

Prey	Concluding statement on the effects of wolf predation	Source
Beaver	probably of minor importance	Shelton 1966
B-T deer	probably preventing population recovery	Rausch & Hirman 1977
Caribou	probably prevents destructive growth in population	Murie 1944
Caribou	probably no effect	Kuyt 1972
Caribou	probably limits growth of herds	Bergerud et al. 1983
Caribou	probably plays minor role	Van Ballenberghe 1985
Caribou	probably chief limiting factor	Bergerud & Elliot 1986
Dall sheep	probably prevents population from increasing	Murie 1944
Dall sheep	showed no effect	Gasaway et al. 1983
Dall sheep	probably little effect	Heimer & Watson 1986
Elk	inconsequental	Cowan 1947
Elk	reduces rate of increase; probably prevents destructive irruptions in population	Carbyn 1983
Moose	probably of minor importance	Shelton 1966
Moose	appears to have little effect on prey populations	Haber 1977
Moose	probably prevents increase in population	Fuller & Keith 1980
Moose	may prevent overexploitation of habitat	Carbyn 1983
Moose	may prolong population declines and limit growth	Gasaway et al. 1983
Moose	probably controls population numbers	Keith 1983
Moose	may accelerate decline and slow recovery in population numbers	Peterson & Page 1983
Moose	may have important effect at low densities	Messier 1984

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Table 5. (Cont.)

Prey	Concluding statement on the effects of wolf predation	Source
W-T deer	probably no effect	Thompson 1952
W-T deer	probably prevents overuse of range	Stenlund 1955
W-T deer	may have prevented destructive irruptions	Pimlott 1967
W-T deer	may influence deer population	Pimlott et al. 1969
W-T deer	probably maintains population in equilibrium with browse supply	Byman 1972
W-T deer	may have accelerated decline and probably prolonged period of low numbers	Mech & Karns 1977

[A] Source: Bednarz 1988.

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Influence of other Predators.--Wolf impacts on other predators can vary. Coyotes may be less abundant in Yellowstone with wolves present, and red fox may benefit from wolf presence. Black bears and wolves usurp carcasses from each other, and wolves occasionally prey upon black bears (and vice versa), but no published information suggests either species would be significantly affected. Recent observations in Montana indicate that wolves may be a more direct competitor with mountain lions than previously believed (Bangs & Fritts 1993). They report that wolves killed three mountain lions, and it was not uncommon for them to track lions and usurp their ungulate kills, suggesting that the potential impact of wolves on ungulate populations may be lower than previously predicted. Brown bears and gray wolves coexist throughout much of North America and Eurasia. Sympatric populations of wolves and grizzly bears do not appear to significantly impact survival or reproduction of each other. Some indirect competition for spring carrion, winter-weakened ungulates, and newborn calves may occur between wolves and grizzlies in Yellowstone. However, based on data from other geographic areas, grizzlies appear able to compete with wolves for prey; because grizzlies are omnivorous and not totally dependant upon ungulates, it is likely grizzlies will easily adapt to the presence of wolves.

Wolf-Dog Hybrids.--Concern has been expressed over the potential effects of wild wolves crossbreeding with domestic dogs. Young (1944) cites several instances where crossbreeding was observed. Most of these cases involved Husky-Wolf crosses in the northern regions of North America, but the best documented was the Collie-wolf cross observed in Colorado (Young 1944). Extirpation of the wolf in the western United States occurred

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when the human population (and associated pets) was sparse, thus crossbreeding is not commonly recorded. Perhaps a more complete record of wolf-dog hybrids is to found in the Russian literature where wolves and man have had a lengthy association. The following comments are from: Man and Biosphere Monograph. The Wolf. 1985. (in Russian).

> Crossbreeding of dogs with its wild ancestor, the wolf, is well known, but until the end of the 1950s it has not been observed too much in our country. This is basically happening because of the human influence and their desire to be able to regulate the number of wolves. That is why the lack of wolves, when the wolf packs are being formed, is being replaced by the dogs. During the period after the war, there were several single cases of off breeds found in 1953 and 1957. In Krasnodarsky and the Baltic Region, the brood of off breed puppies appeared only where there very few wolves. By the beginning of the 1970s there were a lot more wolf-dogs in these 2 regions and several others. Black, white, pie-bald off breeds, and ones with intensive coloring more like a fox, were seldom seen among the wolves of the Voronejskaya region. Late there were 8 more similar places. By 1971, wolves were seen in 14 out of 41 regions occupying about 30% of the territory. Their spread has been mostly in the southeast part of the region...Wolf-dogs lived along with normal wolves (9 cases), on their own (over 20 cases), and taking the wolf's place in nature (1 case). Many off breeds can be easily recognized at a distance by their non-typical coloration. The ones that had been living separately, look similar to both wolves and dogs. At times, they acted like wolves and hunted dogs and ate them, but apparently close to the dogs, they behaved more like dogs and hide in half destroyed places and spend all day hiding there.
>
> Later, as the result of the decrease in wolf numbers, the cases of crossbreeding with dogs increased. During 1976, wolves were mostly concentrated in the western, southern, and southeastern parts of the Voronejskaya region. The density of their population was about 6 animals per 1000 km^2. By 1978, the were about 5 centers of wolf-dog offbreed concentrations. In 4 cases the crossbreeds have been observed in the wild along with wolves, in one case with dogs, and 4 times on their own. The crossbreeds more often mate with wolves than dogs and the characteristics of the wolf usually dominate. Wolf-dogs tend to move closer to inhabited places with dwellings where it is impossible to avoid the closer contact with dogs. Finally, off breeds can kind of merge with the wild dogs. Seldom do wolves make contact with dogs. The ones that do can be defective animals, single males, and possibly the off breeds with the appearance of the wolf. By all means, the spread of wolf-dogs in the former USSR is really wide. This can be supported by the new information (Pavlov 1982). Very often there are hides found with non-typical coloring

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more common of dogs and the animal's behavior is absolutely not typical of wolves (in the places close to human inhabitation).

In the Voronejskaya region, wolf-dog crossbreeds appeared in the wild after contact of the dogs and wolves, and later on, they would begin acting similar and leading the same way of life. Some of the crossbreeds, usually in autumn, begin active hunting, which is not always connected with the lack of food in the garbage places. These crossbreeds started attacking domestic animals, usually sheep under the cover of night. In the Voronejskaya region, like the true wolves, they killed and ate the dogs. The crossbreeds, living separately in the wild, have been observed close to those places inhabited by humans. Purebred wolves have almost never been part of the packs who were trying to get close to the human houses. Crossbreeds used to eat the carcasses from the graves of the domestic animals. They can also chase an ungulate, catch it, kill it, eat it and lay down to rest at the kill site.

Their attitude towards humans is interesting also. The crossbreeds are braver toward humans than even to true wolves. They can attack domestic animals in the presence of humans. Sometimes they have been really aggressive. No doubt this is due to the dog's heritage. Sometimes crossbreeds organize into packs of 18 animals and are capable of chasing their prey for very long distances (several kilometers). This is not typical for wolves, but for dogs.

Most often single female wolves have mated with dogs. Very seldom do crossbreeds of both sexes get together. Pure-blood and crossbred wolf females can raise the pups by themselves. A wolf male and dog female will raise the pups together, if she does not leave him. Usually these are the dogs of a pretty good size such as the German Shepherd. There are cases of different sized animals mating. The mating season remains the same only in the case of a female wolf and male dog or male wolf and female dog. A crossbred female, taken as a cub and raised in captivity, mated a dog at the age of 8.5 months and brought up the pups. This distinguishes the crossbred wolf female from true wolves that only reach sexual maturity at the age of 2 years, and places her closer to the dogs who are capable of having offspring in the wild during their first year and even two litters a year.

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The Fossil Record of the Gray Wolf in Colorado.--The early presence of the gray wolf is recorded in the fossil record at two distinct Colorado sites. The first is located north of Fort Collins, Colorado, just south of the Wyoming State line, to the west side of Interstate 25. The archeological name for this location is the "Lindenmeir Site" (5 LR 13), one of the best documented Folsom Complex archeological sites in the United States (Gunnerson 1987). The Lindenmeir site represents an early people (Folsom) who hunted large (now-extinct) bison, using distinctive-fluted points. Excavation of this site was carried out by the Smithsonian Institution between 1934 and 1938 and the Colorado Museum of Natural History in 1935 and Haynes in 1959-60. Two acceptable radiocarbon dates for the Folsom occupation level at the site are 11,200 $\pm$ 400 yr BP (years before present)(sample GX-1282) and 10,780 $\pm$ 135 yr BP (sample I-141)(Wilmsen and Roberts 1978). Gunnerson (1987) states that a date of ca. 11,000 yr BP for the Folsom occupation at the site is generally accepted. Mammalian bones identified at the site represent the following animals and their number represented (Wilmsen and Roberts 1978):

13 *Bison antiquis* (Long-horned bison-Extinct)
1 *Camelops sp.* (Camel-Extinct)
1 *Canis lupus cf. nubilus* (Gray wolf)
2 *Antilocapra americana* (Pronghorn antelope)
1 *Odocoileus virginianus* (White-tailed deer)
1 *Vulpes velox* (Swift fox)
1 *Vulpes fulva* (Red fox)
1 *Canis latrans* (Coyote)
1 *Cynomys ludovicianus* (Black-tailed prairie dog)
2 *Lepus townsendii* (White-tailed jack rabbit)
1 *Lepus americanus* (Snowshoe hare)
2 *Terapena cf. ornata* (Ornate box turtle).

Because the Lindenmeir Site is a cultural site it is impossible to know if the presence of wolf remains represent a possible early domestication event or a human food item. Wolf remains

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from the "Fort Rock Cave" site in southcentral Oregon were listed as human food items by Cressman (1942). A radiocarbon date for the Fort Rock site has been placed at 9153 $\pm$ 350 yr BP. Regardless of its context, the fossil record at the Lindenmeir site documents the association of the gray wolf with Colorado's earliest human inhabitants.

An early non-cultural record of the gray wolf in Colorado is documented at the Chimney Rock Animal Trap about 50 air miles west of the Lindenmeir site. This natural animal trap is located in Larimer County, Colorado, at an altitude of 7900 feet near the edge of a 200 foot escarpment in Casper sandstone. It is about 1 mile southwest of a prominent butte known locally as "Camel Rock" or "Chimney Rock" 30 miles southwest of Laramie, Wyoming at the extreme southern end of the Laramie Basin (Hager 1972). The Chimney Rock animal trap is a circular depression about 65 feet in diameter and 10 feet deep with an overhang of 4 to 25 feet. Radiocarbon dating of bone specimens obtained at the 4 foot level in the sandy sediment of the trap's depression yield a date of 11,980 $\pm$ 180 yr BP. Gray wolf remains were identified during excavation, as well as three extinct genera (*Panthera atrox*-Pleistocene jaguar; *Martes nobilis*-extinct martin; and *Neogyps errans*-eagle-like vulture). Other animals identified include the black-footed ferret (*Mustela nigripes)*, grizzly bear (*Ursus arctos)*, bighorn sheep *(Ovis canadensis)*, and wolverine (*Gulo gulo)*. A complete faunal list is published in Hager (1972).

Anderson (1974) compared the late Pleistocene-early postglacial faunas from three cave locations in southeastern Wyoming (Little Box Elder Cave, Horned Owl Cave, and Bell

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Cave) to faunas of the same age in the Chimney Rock Animal Trap and the Jaguar and Moonshiner caves in Idaho. Gray wolf remains were identified in all faunas with the exception of Horned Owl Cave in Albany County, Wyoming.

Other late Pleistocene/Holocene archeological sites containing gray wolf remains in the Great Plains physiographic province are described by Graham, 1987; Davis, 1987; Purdue & Styles,1987; Semken & Falk, 1987; Martin, 1987; Walker, 1987; Chomko & Gilbert, 1987, and Graham et al., 1987.

Historic Colorado Gray Wolf Numbers.--How many wolves were in Colorado before Euroamerican settlement? Perhaps this is a moot point, but it is interesting to speculate what the population level may have been in an unexploited situation before steel traps, firearms, and poison became common.

A crude approximation can perhaps be made using several historical observations. Perhaps the closest estimate for Colorado is probably one made for Wyoming (Seton 1929). His rationale is as follows:

> R. M. Allen, the manager of the Ames Cattle Company (Nebraska), writing to *Recreation*, Sept., 1897, p. 207, says his range is in the northeast part of Crook County, Wyo. (5,435 square miles). Since the spring of 1895, they have killed on it about 500 Gray-wolves, and they seem as numerous as ever. This argues at least 1,250 Wolves in that county, or 1 to every 4 square miles. Only half the State is equally good Cattle (and Wolf) country; therefore, at this rate, it might have 10,000 Gray-wolves.
>
> Emerson Carney states that Wyoming paid bounties on 4,281 Gray-wolves during the years 1897 and 1898; that is, 2,140 each year. Since they

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continued numerous, this presupposes a minimum population of 8,000 in the State at that time.

Wyoming paid bounties for the killing of 20,819 Wolves in the 11 years prior to 1908 (Bailey 1907). As at least a half of those killed are not found, we may claim that 40,000 Wolves were killed, or 3,600 each year. Since their numbers bore this drain very well, it would prove the existence of at least 12,000 or 15,000 Gray-wolves in that State alone, with its 97,000 square miles of territory.

Vernon Bailey's investigations cited above showed that in the cattle ranges of the Wind river country, Wyoming, where Wolves were fairly numerous, he found 20 breeding dens in use within a space of 100 miles square; that is, 20 families of 10 Wolves each. But this was in poor Wolf country; half of it was mountains. Also it was evident that he found only about half of the Wolf dens, which, with the troops of bachelor Wolves, easily trebled the estimated population of that region, making 600 a safe estimate, at any rate, Wyoming might have had 6,000 Wolves in 1907, and over treble as many in the buffalo days, or 20,000.

There is no way of knowing how accurate Seton's estimate of 6,000 wolves in Wyoming for 1907 was, but a more precise figure was provided by Day (1929) a few years later:

...In the year 1896, the State (Wyoming) paid bounties of $3 each on 3,458 wolves. From 1895 to 1927, 36,161 wolves have been taken in Wyoming by regular Federal, State, and bounty hunters...In 1915, when the Biological Survey first started work in Wyoming, there were over 1,000 adult wolves in the State...At the present time (1927?), excepting those in Yellowstone National Park, there are probably no more than five adult wolves left ranging in Wyoming. Two of these are known to be in the Jackson Hole region, where they are doing little damage to domestic stock, but live largely on the elk abounding in that section.

Warren (1910) describing the situation in Colorado stated:

Wolves seem to be found all over Colorado, though from what Bailey says about their habits in Wyoming, they may move down from the higher elevations at the approach of winter. But wherever I have been in the State I have heard of the presence of wolves, in greater or less abundance, and I doubt if there is any county in the State, with the possible exception of Denver, which has not a few wolves within its limits, and Denver has some in confinement in the City Park.

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If Seton's rationale is applied to Colorado and we assume that the wolf population was fairly well distributed as stated by Warren, then the total wolf population may have been as high as 13,000 at the turn of the century with as many as 39,000 in the "buffalo days." If Day's 1915 estimate for Wyoming is calculated to a wolf/square mile figure based upon state size, the result would be about 1 wolf/97 square miles. Extrapolating this figure for Colorado would result in a figure of about 1,072 wolves in Colorado in 1915.

Corbin (1900) states that bounties were paid on 15,211 wolves in North Dakota from January 1897 to November 30, 1898 which would indicate a fairly large wolf population in that state, however, it is not unreasonable to assume that such numbers existed; the unknown variable is how many coyotes were included in this total (see Historical Assessment). The densest wolf population recorded in modern times is 1 wolf/7 mi^2 by Kuyt (1972)(Table 6). Extrapolating this figure would result in a total of 14,857 wolves for an area the size of Colorado. Regardless of the accuracy of these speculations, it is probably safe to say wolves in Colorado were numerous prior to Euroamerican settlement.

Historic Colorado Gray Wolf Distribution.--The historical record of wolf observations in Colorado was investigated and results mapped to determine if any distribution patterns were evident. Primary sources (see Appendix B) were: Armstrong (1972); Bailey (1907a, 1907b); Cary (1911); Warren(1906); and Animal Damage Control (1993). Other sources (i.e., newspaper articles, Bureau of Biological Survey publications, etc.) were used if it was evident the writer was speaking specifically of the gray wolf and not lumping

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Table 6. Reported Densities of Wolf Populations. [A]

Locality	Density (square Miles per Wolf)	Source
	CANADA	
Alberta	42	Cowan 1947
Alberta	45	Fuller & Keith 1980
Alberta	23	Bjorge & Gunson 1983
British Columbia	43	Bergerud & Elliot 1986
Manitoba	16	Carbyn 1982a
NW Territories	16	Clark 1940
NW Territories	60-120	Kelsall 1957
NW Territories	7	Kuyt 1972
NW Territories	10	Parker 1973
Ontario (Algonquin Park)	10	Pimlott et al. 1969
Ontario	100-200	Pimlott et al. 1969
Saskatchewan	60	Banfield 1951
Quebec	35	Messier 1985a
	UNITED STATES	
Alaska	27	Gasaway et al. 1983
Alaska	24	Peterson et al. 1984
Alaska (Coronation Island)	3[B]	Merriam 1964
Alaska (Unit 13)	50[C]	Rausch 1967a
Alaska (Mt. McKinley Park)	50	Murie 1944
Isle Royal (MI)	8	Peterson 1977
Isle Royal	7-10	Mech 1966a; Jordan et al. 1967

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Table 6. (Cont.)

Locality	Density (Square Miles per Wolf)	Source
Minnesota	17	Stenlund 1955
Minnesota	10	Mech 1973
Minnesota	22	Fritts & Mech 1981
Minnesota	14	Mech 1986

[A] Sources: Berdnarz 1988; Mech 1970.

[B] Artificial situation; four wolves were stocked here.

[C] Increasing population perhaps not yet stabilized.

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coyotes with the wolf observations. Each reported observation site was located on a map of Colorado and, in some cases, a vintage map had to be consulted to locate the common name of an area that is no longer known by that name. Figure 6 represents a summary of reported wolf observations between the years 1871 and 1945. The major drainage systems have been enlarged to reflect riparian area.

The observed distribution may be biased in the sense that most recorded encounters are in association with livestock and man. The most important need of the early settler (as well as his contemporary counterpart) was water for personal, livestock, and crop needs. For this reason, early settlement patterns tend to cluster along the major river basins such as the Arkansas and White River basins. It must also be kept in mind that these major river basins were prime all-season wildlife habitats before Euroamerican settlement.

Counties in the Plains region of Colorado reporting the greatest number of wolf observations were: Washington, Yuma, Kiowa, Bent, Prowers, Kit Carson, Crowley, Pueblo, Logan, Weld, Lincoln, Las Animas, and Baca.

Counties in the mountain and plateau regions with the greatest number of wolf observations were: Moffat, Jackson, Routt, Grand, Rio Blanco, Mesa, Montrose, San Juan, Archuleta, Garfield, Delta, Montezuma, La Plata, San Miguel, Dolores, and Gunnison.

As can be seen in Figure 6, wolf populations in the river basins such as the White,

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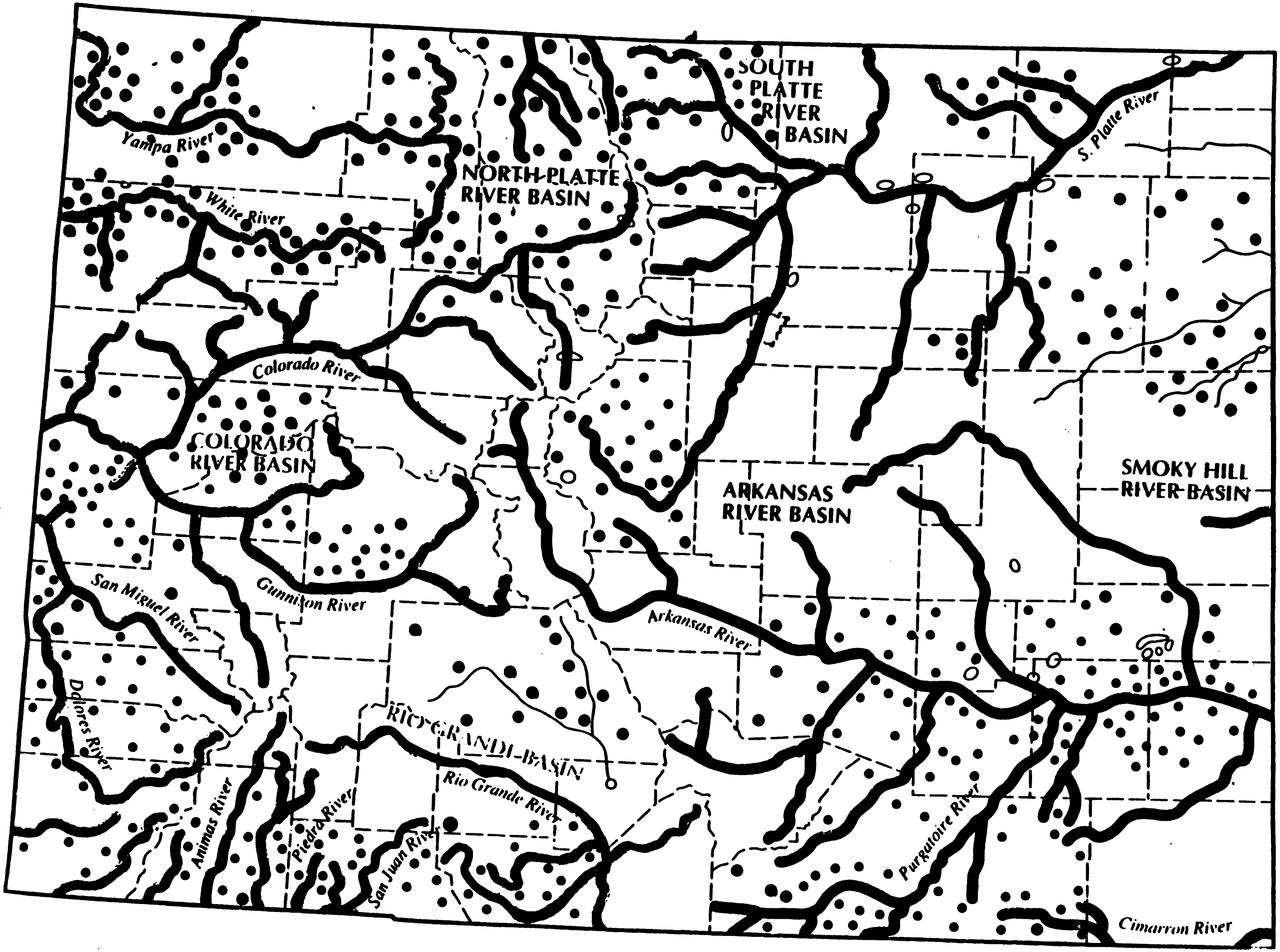

Figure 6. Location Map of Historic Reported Wolf Observations in Colorado.

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Republican, Yampa, Little Snake, Laramie, Arkansas, and South Platte were abundant. Other drainage systems (i.e., creeks and smaller rivers) such as Piceance Creek, Vallecito River, Los Pinos River, and Willow Creek also supported notable wolf populations.

Mountain Parks that had a historical abundance of wolves include: North Park, Middle Park, South Park, Brown's Park, Egeria Park, Lily Park, and the Estes Park Valley. Other specific areas reporting wolves were: Pagosa Springs, Meeker, Trinidad, Rangely, the Black Mesa, Cathedral Bluffs, Bear Springs Mesa, Unaweep Canyon, Iron Springs Divide, West Elk Mountains, Gore Range, Lamar, Chivington, Hugo, Olney. Arlington, Godiva Rim, and Las Animas. Wolves were reported in the national forests with specific mention of the White River, San Juan NF, Uncompahgre, Sopris, Arapahoe, Medicine Bow, and Montezuma National Forests.

Assessing the Historical Record.--Several major problems associated with assessing the historical record of wolves should be mentioned. Wolf/coyote misidentification introduces an unknown variable that is difficult to account for. Many of the early writers referred to both the coyote and gray wolf as wolves. Even George Bird Grinnell, a trained zoologist, often used "coyotes" and "wolves" interchangeably. Seton (1929) reported the following account by Grinnell (note the interchange of terms):

> An old doe Antelope suddenly came into view, closely followed by a Coyote. Both of them seemed to be running as hard as they could, and both had their tongues hanging out as if they had come a long way. Suddenly, almost at the heels of the Antelope--much closer to her than the other Wolf--appeared a second coyote, which now took up the running, while the one that had been chasing her, stopped and sat down and watched. The Antelope ran quite a

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long distance, always bearing a little to the left, and now seeming to run more slowly than when I first saw her. As she kept running, it was evident that she would either run around the little hill on which I stood or come back near it....After a little, it was evident that the Antelope would come back pretty near to the hill, but on the other side of it from where she had passed before, and the Wolf which I had first seen chasing her trotted out 200 or 300 yards onto the prairie and sat down. The Antelope was now coming back almost directly toward him, and I could see that there were two Wolves behind her, one close to her heels and the other a good way back. The first Wolf now seemed quite excited. He no longer sat up but crouched close to the ground, every few moments raising his head very slowly to look at the doe, and then lowering it again so that he would be out of sight. Sometimes he crawled on his belly a few feet farther from me, evidently trying to put himself directly in the path of the Antelope, and this he seemed to have succeeded in doing. As she drew near him I could see that she was staggering, she was so tired, and the Wolf behind her could at any moment have knocked her down if he had wanted to, but he seemed to be waiting for something. The Wolf that had following him was now running faster and catching up.

When the Antelope reached the place where the first Wolf was lying hidden, he sprang up, and in a jump or two, caught her neck and threw her down. At the same moment the two wolves from behind came up, and for a moment there was a scuffle in which yellow and white and gray and waving tails were all mixed up, tearing away at their breakfast.

The preceding account is in Seton's section on coyotes and it is assumed he was speaking of coyotes, but it is evident that the terminology is evasive in identifying the species. Greenquist (1983) cites another common example of wolf/coyote misidentification:

Manville Kendrick (personal communication), a Powder River, Wyoming rancher, told me that the old time ranchers, himself included, called wolves coyotes. This startled me, and I asked him if he did not mean that they called coyotes wolves; but he indeed meant what he had said...Kendrick said that wolves had been mainly animals of the plains, but had been driven into mountainous, wooded places by the harassment of man.

The wolf/coyote misidentification problem is evident in the fur harvest records that date back to 1690 (Novak 1988). In *Furbearer harvests in North America, 1600-1984*, a supplement to *Wild furbearer management and conservation in North America* (1987), the authors preface

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the wolf section with this comment:

> As mentioned in the discussion of the coyote table, at least some of the pre-20th century harvest listed as "Wolf" must have been coyotes. However, there is no way of knowing what proportion of this reported harvest was coyotes so we have listed the harvest entirely as wolf as originally reported.
>
> In the 20th century, jurisdictions such as Arkansas and Texas reported wolf harvests. these may in part have been red wolves (*Canis rufus*), but it seems likely that at least part of this harvest was coyotes. Nevertheless, we reported the harvest in the wolf tables because there is no way of knowing what proportion may have been coyotes. On the other hand, jurisdictions such as Iowa and Wisconsin recorded wolf harvests in the 1930s, 1940s, and 1950s. Given the range of the wolf in the United states, these must have been mainly or entirely coyotes and we have reported them as such. In Manitoba from 1925-26 to 1943-44, the harvest of wolves and coyotes was lumped and reported as "Wolf". We also have listed this combined harvest as a wolf harvest, but it should be remembered that the data include an unknown number of coyotes.
>
> The problem of misidentification of coyote pelts as wolves persist, especially for sizes where the two species overlap (i.e., for young wolves and adult coyotes). This is a problem because wolves are listed on CITES Appendix II, and export permits must be provided.

To complicate the furharvest record, the wolf harvest totals vary significantly among the published literature. An example is for the years 1900 to 1905 where Novak (1987) states that wolf skin production for these years was:

1900 - 2,500 pelts (Hudson Bay Company)
1901 - 1,000
1902 - 1,500
1903 - 1,500
1904 - 1,000
1905 - 1,000

However, data presented in Andersch Bros. (1906) states that total wolf skin production in the United States and Canada for these years was:

Season of 1899-1900 - 75,000 (Hudson Bay Co. and C. M. Lampson & Co.)
Season of 1900-1901 - 72,500

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Season of 1901-1902 - 90,000
Season of 1902-1903 - 110,500
Season of 1903-1904 - 100,000
Season of 1904-1905 - 125,000

Another problem found in the early literature is quantifying animal numbers with the writing style of the time. Terms such as "myriads", "bands", "troops", and "droves" (see Appx. B) were the most common terms used to describe wolf numbers. All these terms, as used in the modern sense, signify a large number, but are meaningless except in the gross sense.

The wide use of strychnine by "wolfers" in the 1850s and 1860s, and joined by stockmen in the 1870s, and later by Government personnel after the turn of the century preclude even an approximate guess of how many canids were actually present. Almost all historical accounts (see Appx. B, esp. Biological Survey accounts) state that roughly 50% of the total canid predators killed with strychnine were never accounted for. If this is true, it is evident that a reliable estimate for any one area would be impossible because all records (i.e., ADC, furharvest, etc.) are based on actual pelts delivered and not on the actual number killed.

APPROACH TO RESEARCH

Probably the most difficult aspect of this type of study is the delineation of specific areas and the scope of characteristics to evaluate. It would be a simple matter if the subject was a cottontail rabbit with a home range of a few acres, but with a wide-ranging predator such as

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the wolf, the problem quickly becomes complicated.

A holistic approach was chosen to identify and describe potential areas in the state that could support a wolf population(s). This was a very conservative approach that took into consideration many characteristics (i.e., human density, livestock density, etc.) of a larger geographical area than would probably be utilized by wolves. The primary reason for this approach is the recognition that wolves are capable of transboundary movement and possess great dispersal capabilities. These characteristics may not be evident for the first few wolf generations, but must be considered in the long-term, in the interests of a sucessful recovery program.

Other unknown variables associated with wolf recovery in Colorado that suggest a holistic approach include the following:

1. For all practical purposes, the wolf has been absent from the state for about 70-80 years. It is unknown at this time how wolves will react to regaining an ecological niche that has since been taken over primarily by the coyote and mountain lion.

2. Another unknown is the reaction(s) of the primary prey species (mule deer and elk) to a predator that has been non-existent for many deer and elk generations. How will the presence of wolves affect ungulate dispersal and behavior?

3. It is unknown what the effects of hunting (gunfire and hunter presence) will have on wolf dispersal.

4. It is unknown what effect recreational activities will have on wolf dispersal.

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5. It is unknown what period of time is required for wolves to become accustomed to a new habitat (development of a cognitive map, territory establishment, etc.).

6. It is unknown what the effects of heavy snowfall areas (250 inches) will have on wolf movement and hunting behavior (Huggard 1993).

Perhaps an insight on some of these unknowns can be gained by the recent experiences recorded by Fritts (In Press 1993) for wolves in Glacier National Park (GNP), Montana:

> Colonizing wolves in Montana have settled in large river valley systems, evidently because of the abundance of deer and easier travel. Four of the seven known Montana packs established outside the Montana recovery area where private land is more common. All Montana packs have spent part of their time on private land, and most current pack territories encompass a mix of public and private land outside the park boundary. Even packs living essentially within GNP are at its western edge and visit parcels of private land outside the park boundary. Those packs often follow the drainage which comprises the western edge of the park, especially in winter (Ream et al. 1991, Pletscher et al. 1991), causing them to live continually at the edge of public lands. Likewise, wolves in and south of Banff Park, Alberta (200 km north of the U.S. border) use lower elevations more extensively. Among thousands of radio-fixes on wolves in that area, some 95% were below 1800 meters, with snow depth, aspect, and slope all thought to be influencing use of habitat there (P. Paquet, personal communication 1993).
>
> Within a national park, designated wilderness, or national forest, extensive use of drainages in lower elevation areas poses no particular problem. however, if most wolves outside protected areas and within human-inhabited areas follow that pattern, the number of wolf-human conflicts may be greater, the number of wolves killed illegally or accidently higher, and recovery more difficult to accomplish than otherwise anticipated. Extensive use of drainage systems will bring wolves into conflict with livestock and increase their encounters with humans, and therefore result in more mortality from illegal killing and from agency wolf control in response to depredations on livestock. Three packs have already depredated on livestock in Montana, all on private land, and a total of 17 problem wolves had to be controlled since 1980 (Bangs et al. in press).
>
> Much remains to be learned about where wolves will try to live in the Northern Rockies and Pacific Northwest and how well humans will tolerate

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them. However, current indications are that more remote and pristine areas of high elevation will at least occasionally be forsaken for areas of high prey density which will bring wolves in proximity with humans. Portions of national parks and designated wilderness in the Northern Rockies may not be used by wolves due to high elevation, very steep terrain, snow depth, and poorer habitat quality for seasonal use by ungulates (cf. Koth et al. 1990)

With these unknowns in mind, the following procedure was established to identify and describe suitable wolf habitat in Colorado.

RESEARCH METHODS

Relevant wolf recovery information was assimilated through a comprehensive literature search and contact with many individuals currently involved with wolf reintroduction in various areas of the United States (i.e., Yellowstone National Park and central Idaho, New Mexico, and Arizona). The following habitat guidelines were developed by comparing the recommendations of the Northern Rocky Mountain Wolf Recovery Plan ; the Eastern Timber Wolf Recovery Team; the Mexican Wolf Recovery Plan; the White Sands Missile Range Study; and the Mexican Wolf Study Public Review Draft published by the Arizona Department of Game and Fish. The following wolf habitat criteria framework was formulated after reviewing the various recovery plans proposed by professional scientists knowledgeable with wolf recovery:

1. Each **potential wolf recovery area (PWRA)** should be of sufficient size capable of sustaining populations of wild ungulates adequate in number to support the number of wolves

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to be released and the anticipated first-generation progeny.

2. Each PWRA should contain a significant portion of habitat capable of sustaining populations of wild ungulates adequate to support a moderate hunter harvest in areas where hunting seasons are currently open on the wild ungulates which are also wolf prey species.

3. Each PWRA should be evaluated on the ability of its habitat to adequately support the principal prey species, particularly large ungulates.

4. Each PWRA should have minimum livestock use.

5. Each PWRA should have minimum human population density and use.

6. Each PWRA should have minimum amount of roads.

7. Each PWRA should have an adequate supply of free water in the more secluded portions of the area.

8. Each PWRA should not have any endangered or threatened species that could be adversely affected by the presence of wolves.

9. Each PWRA should be relatively free of proposed development or habitat alteration that could significantly affect the area's ability to support wolves or their prey.

10. Each PWRA should consist of a significant portion managed by a public agency or by an organization strongly committed to wildlife management and willing to emphasize wolf management in the area.

It should be pointed out that the primary focus of this study was placed on accomplishing the two stated objectives with secondary consideration given to those recommendations that were not of a biological nature. It must be admitted wolf reintroduction is a complex issue and a

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very fine line separates the biological from the political, social, ethical, environmental, and economical aspects because of their close relationship in the holistic sense. However, in the interest of successful wolf recovery, it was felt these closely related aspects should be addressed to identify potential problem areas which may require a more detailed investigation before wolf recovery is attempted. These issues could then be addressed by all concerned parties in a forum such as provided by the Environmental Impact Statement process.

Through a process of "trial and error", the following course-screen framework shown in Table 7 was developed to select potential wolf release areas in the state.

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Table 7. Course-Screen Selection used to Identify Potential Wolf Habitat.

Step 1:

Determine Land Ownership Status.

Step 2:

Determine Counties included in PWRA.

Step 3:

(A). Determine Gross Land Area of PWRA.
(B). Determine Primary Prey Species and Quantify their Distribution and Numbers.
(C). Determine Human Population Density in Counties Adjoining the PWRA.

Step 4:

Identify, Describe and Quantify the Following PWRA Characteristics:

(A). Gross land area of PWRA.
(B). Net land area of PWRA.
(C). Gross land area of designated wilderness area(s) in PWRA.
(D). Percent of wilderness in relation to gross area of PWRA.
(E). Motorized road density in PWRA.
(F). Livestock use of PWRA.
(G). Availability of water in PWRA.
(H). Status of endangered/threatened (T/E) species in PWRA.
(I). Recreational use of PWRA.
(J). Proposed development in PWRA.
(K). Portion of PWRA receiving 250 inches average annual snowfall.
(L). Potential wolf carrying capacity of PWRA.

Step 5.

Summarize and Rank the above Characteristics for each PWRA.

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After completion of this course-screen format, each PWRA was evaluated in the following manner:

Step 1. Determine Land Ownership Status.--land ownership status (public v. private) of all 63 Colorado Counties was determined from data furnished by the USDA Forest Service (FS) and USDI Bureau of Land Management (BLM). These 2 agencies are the largest public land management agencies in Colorado. Lesser holdings of other agencies (i.e., DOE, FWS, State of Colorado, etc.) were not included in this evaluation.

If a portion of a county is located within the unit boundaries of a national forest (NF), it was included within that PWRA (see Table 10). The name of the PWRA reflects the name of the dominant NF that is the "core" of the PWRA (i.e., White River PWRA). This step adjoins the counties to form a block with public land managed by the FS or BLM, which are advanced to step 2 for further evaluation.

Information sources for this step was obtained from:

1. USDA, Forest Service. 1990. Land areas of the National Forest system, Pub. FS-383.
2. USDA, Forest Service. 1993. Report of the Forest Service.
3. USDI, Bureau of Land Management. 1992. Public land statistics 1992.
5. Personal Communication. Kim Barber (FS). 1994
6. Personal Communication. Lee Upham (BLM). 1993

Most of the area data given as acres were converted to square miles by dividing by 640 (640 acres = 1 square mile), however, in a few cases, no conversions were performed.

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The Northern Rocky Mountain Wolf Recovery Plan (1987) recommends that a potential wolf release area should consist of no more than 10% private land, excepting railroad grant lands. This requirement is a subjective statement dependent upon the attitudes of private landowners within the PWRA. Based on current perceived attitudes, the PWRAs were ranked according to their proportion of public land to private land, with the highest ranking going to that PWRA with the largest proportion of public land compared to private land. A significant portion of each PWRA should be managed by a public agency or by an organization strongly committed to wildlife management and willing to emphasize wolf management in the area.

It should be noted that, if wolves are reintroduced into Colorado, the public agencies are mandated by law to conserve them and their habitat. ESA section 7(a)(2)[6] provides that:

> Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical....[7]

Step 2. Determine Counties Included in PWRA.--

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[6] 16 U.S.C. section 1536(a)(2) (1988).

[7] 16 U.S.C. section 1536(a)(2) (1988). 16 U.S.C. section 1532(5)(A) defines "critical habitat" as the specific areas within which is found the biological or physical features essential to the conservation of the species. "[T]o the maximum extent prudent...," the Secretary of the Interior is to designate a critical habitat concurrent with the listing of a species under the ESA. 16 U.S.C. section 1533(a)(3) (1988).

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Step 3: Determine Gross Land Area of PWRA; Type, Distribution and Density of Primary Prey Species, and Human Density.-- The basis for the three characteristics of Step 3 is the assumption that:

> The key components of wolf habitat are fairly simple: (1) a sufficient, year-round prey base of ungulates (big game) and alternate prey, (2) suitable and somewhat secluded denning and rendezvous sites, and (3) sufficient space with minimal exposure to humans....(Northern Rocky Mountain Wolf Recovery Plan 1987; Fritts 1993).

Step 3(A). Determine Gross Land Area of PWRA.--

The size of a territory required for a viable self-sustaining wolf population is dependant upon so many complex, interrelated variables, that it is difficult to state an exact figure without debate. In a 1975 workshop on wolf reintroduction (Henshaw 1979) , Mech recommended that a minimum area of 4000 square miles would be required, whereas Theberge (1991) recognized that the self-perpetuating Isle Royale wolf population occupies an area of only 208 square miles. The Mexican Wolf Recovery Plan concludes that an area of between 1000-5000 square miles would be sufficient for an experimental release of Mexican wolves. The Arizona Game and Fish Department estimate is for a minimum area of 1000 square miles. A minimum area of 200 square miles was selected for this study to preclude overlooking a potential wolf release area based only upon size requirements. Regardless of a specific recommendation, the size of the PWRA should be sufficient enough to include a self-sustaining population of wild ungulates adequate to support the number of wolves to be released and the anticipated first-generation progeny (Mexican Wolf Recovery Team 1982; Arizona G&F 1993).

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Step 3(B). Determine Type, Distribution and Density of Primary Prey Species.-- As previously mentioned, mule deer and elk are expected to be the primary prey species in Colorado. Mule deer and elk distribution and density was calculated using published post-hunt data from *Big Game Hunting Statistics* (1992), a publication of the Colorado Division of Wildlife (DOW). The DOW has divided Colorado into about 170 areas that are referred to as Game Management Units (GMUs). These GMUs are for all big game with the exception of bighorn sheep and mountain goat and are shown in Appendix G. Figures 11-17 shows the relation of these units to the individual PWRAs. Each GMU is delineated by certain legal or otherwise recognizable boundaries based on certain physical characteristics (i.e., topographic features, roads, rivers, etc.). Although big game census techniques have vastly improved over the past few years, it remains impossible to accurately count every mule deer and elk within a given habitat. For this reason, deer and elk populations are estimated by herd. A designated herd may occupy only one GMU, but as is often the case, may occupy several GMUs on an annual basis. The population estimate is given by herd size and reflects the respective buck/doe (mule deer) or bull/cow (elk) ratios. These respective totals were then divided by the area (mi^2) of their habitat to give animals/mi^2

Because of the spacial and temporal distribution variability of the big game herds, two methods were used to calculate their density to provide an estimated range. The minimum estimate of animals/mi^2 was derived by dividing the total available number of mule deer or elk by the total land area of the NF and all included counties. The maximum estimate was derived by dividing total available mule deer or elk by gross land area of the NF proper.

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Perhaps the more realistic density is somewhere between these two estimates.

Step 3(C). Determine Human Population Density in Counties Adjoining the PWRA.--Many times, wolf-human interactions result in the death of the wolf, either unintentionally or through deliberate actions. Robinson (in: Henshaw 1979) studied human population density in areas of Minnesota and Wisconsin with existing and historical wolf populations. He determined that "somewhere between six and twelve persons per square mile is a critical threshold for wolves and humans to successfully inhabit the same general area. I view this as an arbitrary threshold subject to the attitudes of the people residing in the area inhabited by wolves. It should be obvious that a human density of 15 persons per square mile who support wolf reintroduction would have a smaller adverse affect than a human density of 2 per square mile if both were vehemently opposed. It is this disproportionate number of people opposed to wolf reintroduction that can adversely affect the outcome of a successful wolf reintroduction program. Because there is no way of knowing what the general consensus of a given human population is pending completion of the Human Dimensions aspect, I have assumed that the fewer number of persons per square mile equates to the advantage of the wolf, with 0 representing the ideal; 6-12 as satisfactory; and 12+ as unsatisfactory. All human population data was obtained from the 1990 Census (United States Department of Commerce).

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Step 4. Identify, Describe and Quantify the Following PWRA Characteristics:

The information for Steps 4(A)-4(F) was obtained by a request to each NF Supervisor's Office and reflects current (1994) totals. In a few instances I had to rely on published data from, "Land Areas of the National Forest System 1990", to obtain county totals, etc.

Step 4(A). Gross land area of PWRA.

Step 4(B). Net Land Area of PWRA.

Step 4(C). Gross land Area of Designated Wilderness area(s) in PWRA.

Step 4(D). Percent of Wilderness in Relation to Gross area of PWRA.

Step 4(E). Motorized Road Density in PWRA.

Mech (1977) determined that the existence of a road is not a primary threat, except for the danger to wolves directly from vehicles. However, roads allow access to undisturbed areas, giving humans the opportunity to deliberately or accidently kill wolves. Thiel (1985) determined that between 0.94 and 1.06 miles of road per square mile of area was a threshold between successful breeding and unsuccessful breeding attempts or the absence of wolves entirely. This critical point was further supported by Mech (1980; 1988) except that he determined that areas with more than 0.94 miles of road/mi^2 can continue to support wolves when the area is located adjacent to a region of low density roads. This low road density area acts as a reservoir for wolves to replace those killed in the high density road area. The issue of road density is discussed in detail in Appendix L (p 291).

Step 4(F). Livestock Use of the PWRA.

All of the wolf recovery plans reviewed did not recommend a minimum or maximum limit for livestock numbers, but all are in agreement that the PWRA should have a minimum of

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livestock use. The most current study that may be applicable for this study was performed in Minnesota by Fritts et al. (1992). The data in his study indicates that about 234,000 cattle and 91,000 sheep were exposed to about 1,235 wolves in a range of about 23,127 square miles. These values in addition to those published in the recent Yellowstone and Central Idaho DEIS were selected as a comparison to this study. Livestock information was solicited from each of the 7 NF Supervisor's Offices in Colorado as to type, peak number of each type permitted to graze, and the timing/duration of the grazing periods. This report reflects only the livestock use on U.S. Forest Service administered lands.

Step 4(G). Availability of Water in PWRA.

Lopez (1978) observed that, "wolves consume an average of five to ten pounds of meat per day and wash it down with large quantities of water to prevent uremic poisoning from the high production of urea associated with a meat diet." Mech (1970) states:

> Water is necessary for digestion, and wolves require a great deal of it, especially after gorging. Adolph (1943) learned that dogs weighing about forty pounds consume more than a quart of water each day, so wolves probably would need about twice as much.

Bednarz (1988) stated, "it can be reasoned that any habitat that supports a coyote population can support wolves". The present coyote population on the Western Slope is classified as "abundant" with an "increasing trend in numbers" (G. Connally and R. DeLyle, Personal Communication 1993). Colorado has been referred to as "the Mother of Rivers" because of all the rivers it gives the world (Rennicke 1985). Eighteen states in the West and Great Plains derives water from Colorado. Based upon current and historical observations, it is highly probable that water availability in Colorado would not be a habitat limiting factor for wolf reintroduction .

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Step 4(H). Status of Threatened/Endangered Species in PWRA.

To determine the presence/absence of T/E species in the PWRAs, I contacted the U.S. Fish and Wildlife Service, Colorado State Office in Golden, Colorado, and requested the most current listing of threatened, endangered, and candidate species for all areas of Colorado. The list is shown in its entirety in Appendix C and shows T/E species status by county for the entire state.

Step 4(I). Recreational Use of PWRA.

To determine the scope of recreation in Colorado, a request was made to each of the 7 NF Districts to provide recreation visitor-day information. For the purposes of this report, a recreation visitor-day (RVD) is defined as the, "recreational use of National Forest land or water that aggregates 12 visitor-hours. This may entail 1 person for 12 hours, 12 persons for 1 hour, or any equivalent combination of individual or group use, either continuous or intermittent" (USFS 1993).

Step 4(J). Proposed Development in PWRA.

The complexity of this characteristic in Colorado at the present time places it well beyond the regional scale of this study.

Step 4(K). Portion of PWRA Receiving 250 Inches Average Annual Snowfall.

This characteristic was included in the overall evaluation because of its potential effect on

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both ungulate prey and wolf distribution (Huggard 1993). A recently completed "Colorado Average Annual Snowfall (1961-1990) in inches" map was provided by Mr. Nolan Doesken (Assistant State Climatologist, Colorado Climate Center) for this study. The map was enlarged to match the scale of the CDOW map depicting the GMUs. The snowfall map was then blacked out in those areas receiving 250 inches average annual snowfall (Figure 7). A GMU map with an outlined individual PWRA was then placed over the snowfall map on a light table and the 250 inch snowfall areas were traced to the GMU map. A clear engineering graph overlay with 1/4 inch spacing was then placed over the PWRA and an approximation (in percent) was made for the land area of the PWRA receiving 250 inches average annual snowfall.

Step 4(L). Potential Wolf Carrying Capacity of PWRA.

A conservative approach, utilizing only minimum animal weights, was used to determine the potential wolf carrying capacity of each PWRA. The procedure used the following estimated weights for calculation purposes (Colorado Big Game Hunting Statistics 1993):

Mature mule deer buck = 200 lbs
Mature mule deer doe = 130 lbs
Mature bull elk = 437 lbs
Mature cow elk = 339 lbs

a. The estimated minimum available mule deer density/mi^2 was calculated for each PWRA and multiplied by 130 lbs/animal (doe weight) to give an estimated available mule deer biomass/mi^2 in pounds.

b. The same procedure was used for elk using 339 lbs/animal (cow weight).

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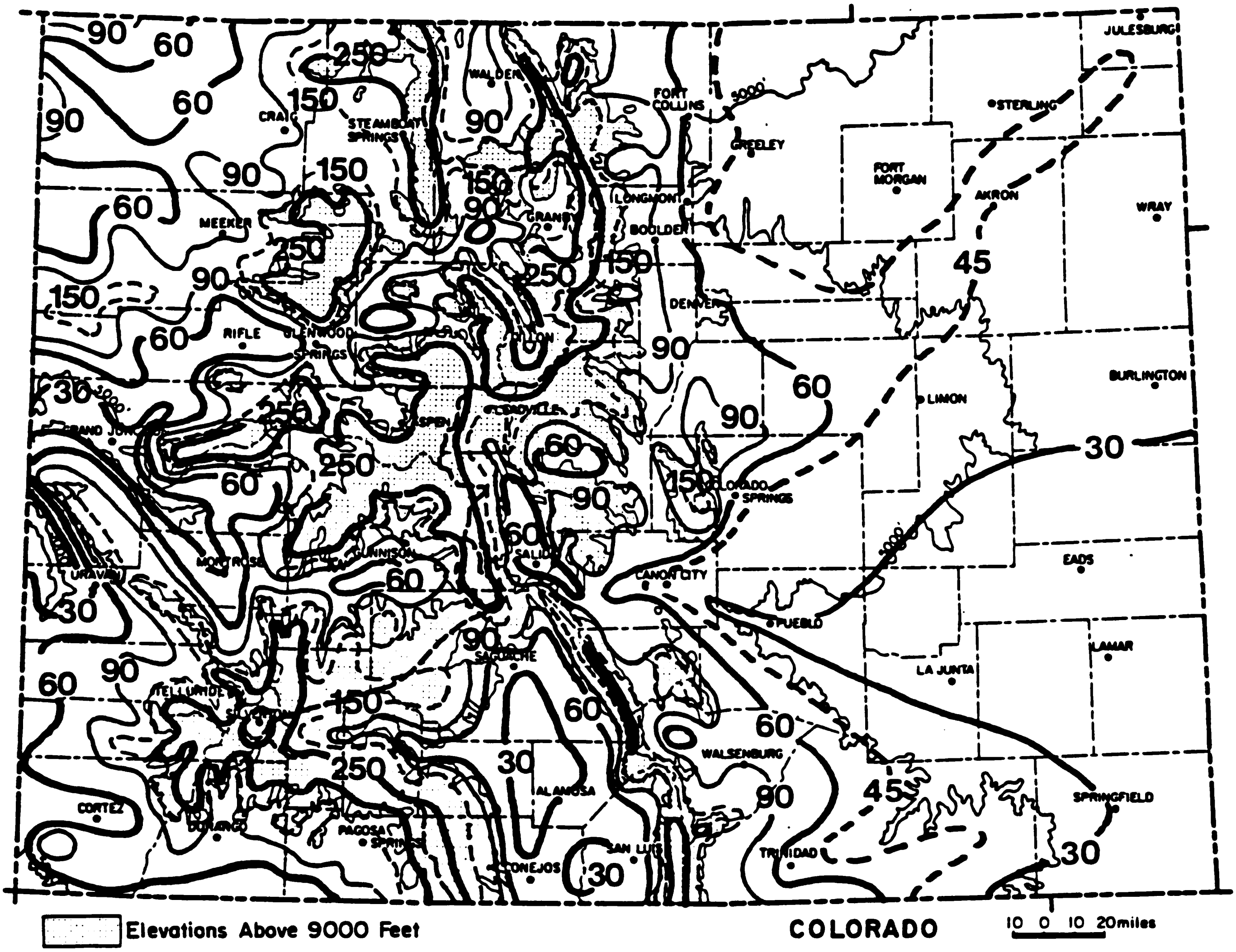

Colorado Average Annual Snowfall (1961-1990) in inches.

Figure 7. Colorado Average Annual Snowfall (1961-1990) in inches (Source Colorado Climate Center).

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c. These two figures were totaled to give an estimated minimum available combined mule deer and elk biomass/mi^2 in pounds.

d. The total from (c) was converted from pounds/mi^2 to kilograms/100 km^2 and located on the x-axis of Fig. 8 (Bednarz 1988). The resulting y-value (wolves/1000 km^2) was then calculated by the equation, $y = 4.87 + (.00064)x$.

Appendix I (p 275) was added after review of the preliminary draft to clarify the calculations and data used to determine estimated wolf density and territory size for each of the PWRAs.

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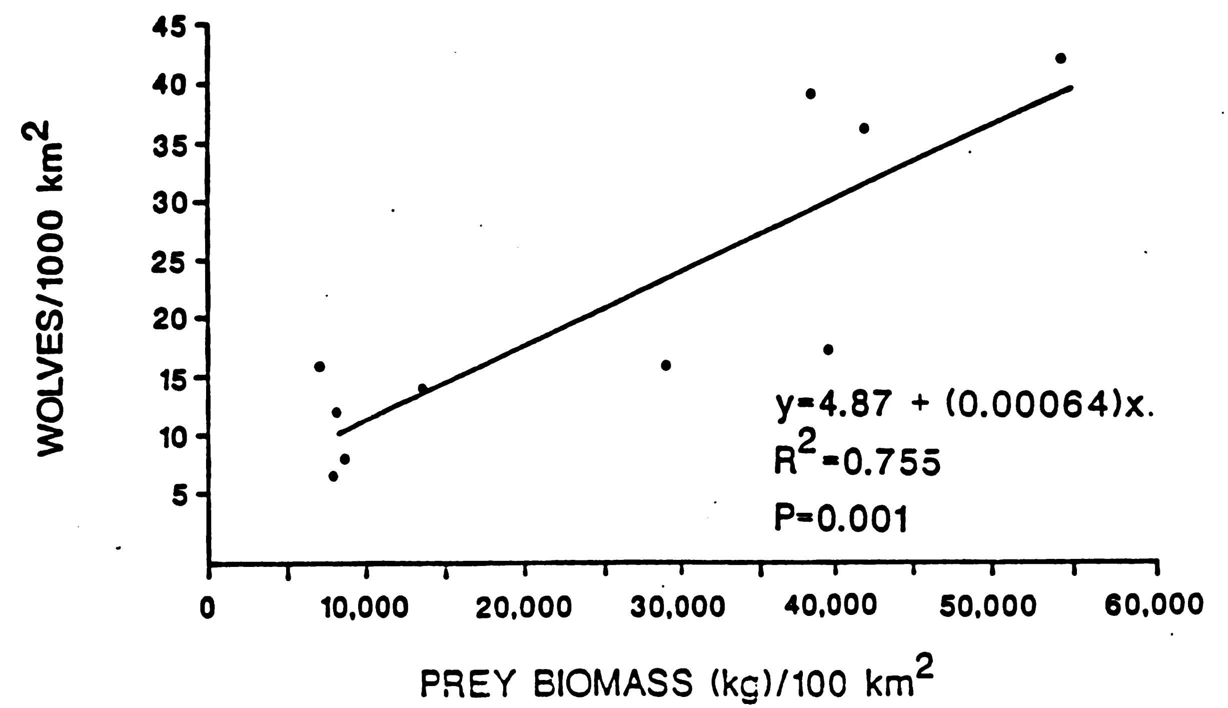

Figure 8. Relationship of Wolf Density and Available Prey Biomass Calculated from Data Recorded in Areas with Extant Wolf Populations (Source: Bednarz 1988).

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Step 5. Rank Each PWRA

The following habitat characteristics were selected to determine the interrelationship of each PWRA. Each characteristic was ranked in order of magnitude with 1 representing the minimum and 7 representing the maximum score:

A. Largest gross NF land area.

B. Largest percentage of public land of adjoining counties.

C. Largest combined mule deer and elk biomass/mi^2.

D. Least human density/mi^2 in adjoining county block.

E. Largest percentage of wilderness gross land area in relation to NF gross land area.

F. Least road density (linear miles/mi^2).

G. Least sheep density.

H. Least cattle density.

I. Least recreation use.

J. Most total land area with less than 250 inches average annual snowfall.

K. Greatest wolf carrying capacity based on ungulate biomass/mi^2.

RESULTS

Step 1 Results - Determine Land Ownership Status.--Land ownership status of all 63 Colorado Counties is shown in Table 8. This step essentially eliminated all 25 counties located east of Interstate 25, thereby reducing the remaining land area to that west of I-25.

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The remaining 38 counties are shown in Table 9 and hereafter will be referred to as the Primary Analysis Area (PAA). The 11 national forests located within the PAA are administered by 7 National Forest Supervisor's Offices. These 7 forest complex's will be referred to as national forests and potential wolf recovery areas throughout the remainder of this document as follows:

Arapaho-Roosevelt PWRA

Grand Mesa-Uncompahgre-Gunnison PWRA

Pike-San Isabel PWRA

Rio Grande PWRA

Routt PWRA

San Juan PWRA

White River PWRA

Foreign ownership of land in the state Colorado amounts to about 585,161 acres (914 mi^2), of which, about 248, 564 acres (388 mi^2) are located in the Primary Analysis Area.

The foreign ownership by county is shown in Appendix K (p 289).

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Table 8. Federal Land Ownership in Colorado.[A]

County	Land Area (Sq. miles)	NFS (Sq. miles)	BLM (Sq. miles)	Total Federal (Sq. miles)	Federal (%)
Adams	1 192.0	0.0	0.0	0.0	0 .0
Alamosa	722.8	40.1	72.8	112.9	16.0
Arapaho	803.2	0.0	0.0	0.0	0.0
Archuleta	1 349.4	664.2	13.9	678.1	50.0
Baca	2 555.9	320.4*	0.8	321.2	13.0
Bent	1 514.0	0.0	2.4	2.4	>1.0
Boulder	742.5	213.5	8.2	221.7	30.0
Chaffee	1 013.5	710.8	85.5	796.3	79.0
Cheyenne	1 781.5	0.0	0.0	0.0	0.0
Clear Creek	395.5	259.4	21.3	280.7	71.0
Conejos	1 287.3	467.5	295.4	762.9	59.0
Costilla	1 227.2	0.9	0.0	0.9	>1.0
Crowley	789.0	0.0	6.9	6.9	>1.0
Custer	738.9	256.3	21.9	278.2	38.0
Delta	1 142.2	299.5	323.3	622.8	55.0
Denver	153.3	0.0	0.0	0.0	0.0
Dolores	1 067.0	522.5	137.0	659.5	62.0
Douglas	840.2	0.0	0.0	0.0	0.0
Eagle	1 688.0	930.7	388.6	1 319.3	78.0
Elbert	1 850.9	0.0	0.0	0.0	0.0
El Paso	2 126.7	0.0	6.5	6.5	>1.0
Fremont	1 533.0	37.1	547.4	584.5	38.0
Garfield	2 947.5	804.8	962.3	1 761.1	60.0
Gilpin	149.9	60.7	3.4	64.1	42.0
Grand	1 849.8	889.1	230.5	1 119.6	61.0
Gunnison	3 239.0	1 880.6	556.5	2 437.1	75.0
Hinsdale	1 117.8	1 091.2	195.2	1 067.4	95.0
Huerfano	1 591.0	22.1	111.5	133.6	8.0
Jackson	1 613.3	522.2	296.8	819.0	51.0
Jefferson	772.2	0.0	1.5	1.5	>1.0
Kit Carson	2 161.0	0.0	0.0	0.0	0.0
Kiowa	1 771.1	0.0	12.8	12.8	>1.0
Lake	376.9	253.8	25.8	279.6	74.0
La Plata	1 692.3	628.1	34.1	662.2	39.0
Larimer	2 601.4	976.8	43.8	1 020.6	39.0
Las Animas	4 773.0	82.2	22.6	104.8	2.0
Lincoln	2 586.3	0.0	3.1	3.1	>1.0
Logan	1 838.6	0.0	1.5	1.5	>1.0
Mesa	3 327.9	401.8	1 519.2	1 921.0	58.0
Mineral	875.8	820.4	0.0	820.4	94.0
Moffat	4 742.5	65.3	2 377.5	2 442.8	52.0
Montezuma	2 036.9	401.3	280.7	682.0	34.0
Montrose	2 240.7	511.2	973.4	1 484.6	66.0
Morgan	1 285.5	0.0	1.3	1.3	>1.0

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Table 8. (Cont.)

County	Land Area (Sq. miles)	NFS (Sq. miles)	BLM (Sq. miles)	Total Federal (Sq. miles)	Federal (%)
Otero	1 262.9	252.1*	3.6	255.7	20.0
Ouray	542.1	198.6	41.6	240.2	44.0
Park	2 200.8	1 017.2	116.1	1 133.3	51.0
Phillips	686.7	0.0	0.0	0.0	0.0
Pitkin	970.5	762.4	41.6	804.0	82.0
Prowers	1 640.5	0.0	1.2	1.2	>1.0
Pueblo	2 388.8	51.2	25.7	76.9	3.0
Rio Blanco	3 221.2	560.1	1 786.5	2 346.6	73.0
Rio Grande	912.6	436.3	85.5	521.8	57.0
Routt	2 361.8	912.3	125.6	1 037.9	44.0
Saguache	3 168.7	1 500.1	553.4	2 053.5	65.0
San Juan	387.4	270.9	70.8	341.7	88.0
San Miguel	1 286.6	268.5	490.0	758.5	59.0
Sedgwick	548.3	0.0	0.4	0.4	>1.0
Summit	608.2	484.9	5.9	490.8	81.0
Teller	557.1	195.4	49.1	244.5	44.0
Washington	2 521.2	0.0	1.2	1.2	>1.0
Weld	2 992.8	301.7**	8.6	310.3	10.0
Yuma	2 366.1	0.0	0.2	0.2	>1.0

* Commanche National Grassland
** Pawnee National Grassland
[A] Sources: BLM, personal communication, Lee Upham, 1993; USDA, FS. 1990. Land areas of the National Forest System, Pub. FS-383; U.S. Dept. of Commerce, Bureau of Census. 1990 Census.

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Step 2. Determine Counties included in PWRA.-- Table 9 shows the Colorado Counties included in the PAA and Table 10 shows the net area of NF and other lands administered by the FS listed by county in Colorado as of September 30, 1990.

Table 9. Colorado Counties included in Primary Analysis Area.

Alamosa	Lake
Archuleta	La Plata
Boulder	Larimer
Chaffee	Mesa
Clear Creek	Mineral
Conejos	Moffat
Costilla	Montezuma
Custer	Montrose
Delta	Ouray
Dolores	Park
Eagle	Pitkin
Fremont	Rio Blanco
Garfield	Rio Grande
Gilpin	Routt
Grand	Saguache
Gunnison	San Miguel
Huerfano	San Juan
Hinsdale	Summit
Jackson	Teller

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Table 10. Approximate Net Area of National Forest and Other Lands Administered by the Forest Service Listed by County in Colorado as of September 30, 1990[A]

County	National Forest	Net Area (mi^2)
Alamosa	Rio Grande	40.1
Archuleta	Rio Grande	35.6
	San Juan	628.6
Boulder	Roosevelt	213.6
Chaffee	San Isabel	710.8
Clear Creek	Arapaho	237.5
	Pike	21.9
Fremont	San Isabel	37.1
Gilpin	Arapaho	20.3
	Roosevelt	40.4
Conejos	Rio Grande	460.9
	San Juan	6.6
Costilla	San Isabel	0.9
Custer	Rio Grande	0.05
	San Isabel	256.2
Delta	Grand Mesa	143.0
	Gunnison	156.5
	Uncompahgre	-
Dolores	San Juan	522.5
Eagle	White River	930.7
Fremont	San Isabel	119.3
Garfield	Grand Mesa	3.2
	Routt	54.9
	White River	746.7
Grand	Arapaho	904.0
	Routt	63.2
Gunnison	Gunnison	1 764.0
	Uncomphagre	116.6

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Table 10. (Cont.)

County	National Forest	Net Area (mi^2)
Hinsdale	Gunnison	169.6
	Rio Grande	315.6
	San Juan	280.5
	Uncompahgre	106.5
Huerfano	San Isabel	219.0
Jackson	Arapaho	7.3
	Routt	514.9
Lake	San Isabel	253.0
La Plata	San Juan	628.1
Larimer	Roosevelt	976.8
Mesa	Grand Mesa394.8	
Mineral	Rio Grande	603.2
	San Juan	217.2
Moffat	Routt	59.5
	White River	5.7
Montezuma	San Juan	401.3
Montrose	Gunnison	18.1
	Uncompahgre	475.8
Ouray	Uncompahgre	198.7
Park	Arapaho	9.7
	Pike	980.0
	San Isabel	27.6
Pitkin	White River	762.4
Rio Blanco	Routt	173.7
	White River	386.4
Rio Grande	Rio Grande	428.1
	San Juan	8.2
Routt	Arapaho	8.5
	Routt	894.2
	White River	9.6

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Table 10. (Cont.)

County	National Forest	Net Area (mi^2)
Saguache	Gunnison	488.3
	Rio Grande	973.7
	San Isabel	38.1
San Juan	Rio Grande	37.0
	San Juan	230.8
	Uncompahgre	3.1
San Miguel	Uncompahgre	268.5
Summit	Arapaho	484.8
	San Isabel	0.09
Teller	Pike	195.4

[A] Source: USDA, Forest Service. 1990. Land areas of the National Forest System, Pub. FS-383.

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Step 3(A). Determine Gross Land Area of Each PWRA.--The gross land area of each NF is shown in Table 11.

Table 11. Current Gross Area of the 7 National Forests Administered by the Forest Service in Colorado as of December 31, 1993.[A]

Unit Name (PWRA)	Gross Area within Unit Boundaries (mi^2)	Current Net Area (mi^2) Managed by the Forest Service
Grand Mesa-Uncompahgre-Gunnison	4 941.1	4 617.9
Rio Grande	3 024.0	2 861.3
Arapaho-Roosevelt	2 498.4	1 971.8
Routt	2 331.3	1 757.5
Pike-San Isabel	5 099.2	3 480.0
San Juan	3 328.1	2 934.4
White River	3 548.3	3 333.3

[A] Source: Compiled from 1993-94 data (personal communication) provided by the individual NF Supervisor's Offices.

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Step 3(B) - Quantify Primary Ungulate Species Type, Distribution and Abundance.--
As previously mentioned, mule deer and elk are believed to be the primary prey species for wolves in Colorado. Figures 9 and 10 shows general elk and mule deer distribution in Colorado respectively. Source material for the maps is from Towry (1983).

Tables 12 and 13 show the estimated 1992 mule deer and elk posthunt populations ranked by herd size.

Step 3(C). Determine Human Population Density in Counties Adjoining the PWRA(s).

Table 14 shows the rural population statistics of the Colorado Counties included in the individual PWRAs.

Step 4. Identify, Describe and Quantify the Following PWRA Characteristics:

Table 15 shows the wilderness area determination of Step 4(C). The other eleven characteristics listed under Step 4 are summarized and presented in Tables 16-22.

Step 5. Summarize and Rank the above Characteristics for each PWRA.

Table 23. shows the results of the unweighted ranking process.

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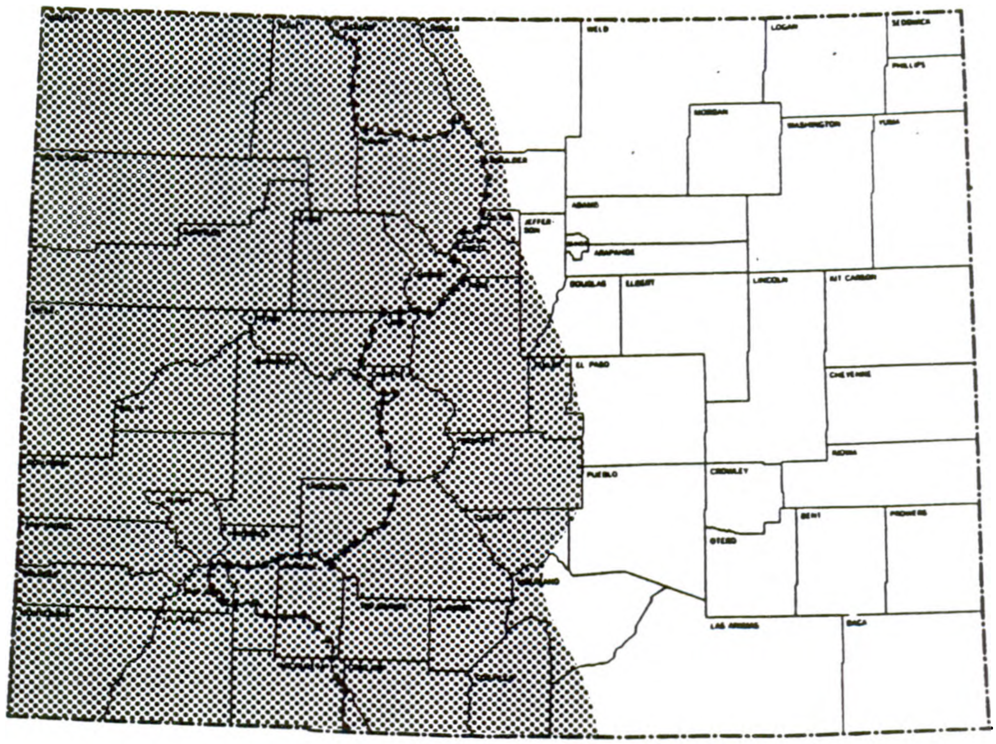

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Figure 10. General Distribution of Elk in Colorado.

ECOSYSTEMS USED

Elk utilize all forested ecosystems in Colorado either seasonally or year-round and may be common to abundant in all these ecosystems within occupied ranges.

SPECIAL REQUIREMENTS.--Free water is needed by elk. This need may be partially met seasonally by snow or succulence. The distance to potable water should not exceed 1/2 mile on optimal ranges.

It is important that elk be relatively free from human disturbances. This is particularly true during parturition, young rearing, and in winter. Vehicles and logging are the more serious sources of disturbances. In order to maintain good elk habitat, **miles of road per square mile of habitat should not exceed 1 for primitive, 1/2 for secondary, and 1/4 for primary roads....**

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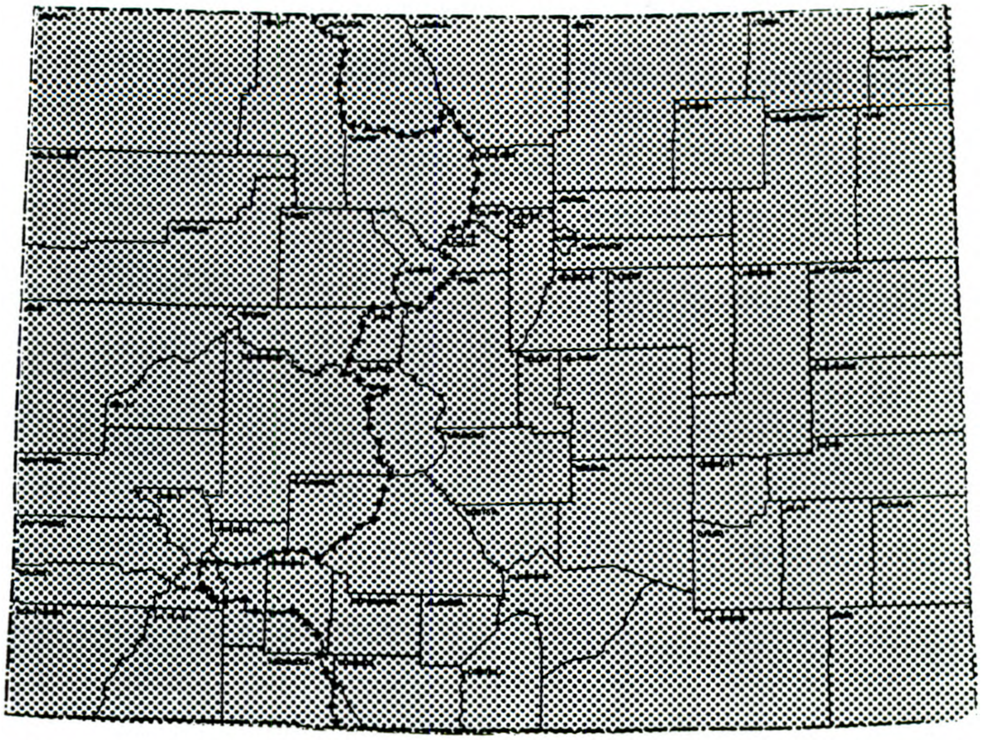

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Figure 9. General Distribution of Mule Deer in Colorado (Note: distribution is statewide).

ECOSYSTEMS USED

Ecosystem used	Season of use	Relative abundance
Subalpine Forest	Summer and fall	Common to abundant
Douglas Fir	Spring, summer, and fall	Common to abundant
Ponderosa Pine	Year-round	Common to abundant
Lodgepole Pine	Year-round	Common to abundant
Aspen	Spring, summer, and fall	Common to abundant
Pinyon-Juniper	Year-round	Common to abundant
Gambel Oak	Year-round	Common to abundant
High Elevation Riparian	Spring, summer, and fall	Common to abundant
Cotton Riparian	Year-round	Common to abundant

SPECIAL REQUIREMENTS.-- ...Roads generally decrease the value of habitat for distances up to 1/2 mile from the road. If roads are to be left open in an area, the combined length of roads should be less than 1 mile per square mile of habitat.

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Table 12. Big Game Game Management Units Ranked by Mule Deer Posthunt Population Size[a]

Herd	Unit(s)	Population	Buck /Doe ratio
White River	11,12,13,22,23 24,131,211,231	82 100	23/100
Bear's Ear	3,4,5,14,214, 301,441	45 700	24/100
Grand Mesa	41,42,52,411, 421,521	44 300	29/100
Cripple Creek	49,57,58,59,581	27 300	39/100
Uncompahgre	61,62	22 500	18/100
Groundhog	70,71,711	22 400	14/100
Bookcliffs	21,30	21 000	14/100
San Juan	75,77,78,751, 771	19 900	12/100
State Bridge	15,35,36,45	18 800	19/100
Mesa Verde	72,73,74,741	17 800	12/100
Wet Mountain	69,84,86,861	16 400	24/100
Logan Mountain	31,32	16 300	20/100
Maroon Bells	43,47,471	13 700	28/100
Little Snake	1,2,202	12 900	37/100
Red Table	44,444	12 710	35/100
Glade Park	40	12 000	37/100
Cimmaron	64,65	11 800	28/100
Red Feather	7,8,9,19,191	11 700	23/100
Middle Park	18,27,28,37, 181,371	11 700	15/100
Rifle Creek	33	11 500	31/100
Trinidad	85,140,851	10 300	39/100

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Table 12. (Cont.)

Herd	Unit(s)	Population	Buck/Doe Ratio
Sweetwater Crk.	25,26,34	8 680	22/100
Cottonwood Crk.	48,56,481,561	8 270	30/100
Bailey	39,46,51,461	6 710	32/100
Saguache	68,681	6 480	15/100
Blue Mountain	10	6 300	22/100
Taylor River	55,551	6 140	22/100
Big Thompson	20	5 990	27/100
Boulder	29,38	5 810	20/100
Powderhorn Crk.	66,67	5 540	15/100
West Elk	54	5 240	29/100
Crawford	53	5 200	9/100
Lower Rio Grande	80,81	4 770	5/100
Trichera	83	4 070	57/100
Fruitland Mesa	63	3 770	14/100
Sand Dunes	82	3 550	15/100
Upper Rio Grande	76,79	2 710	13/100
South Park	50,500,501	2 400	16/100
North Park	6,16,17,161, 171	2 240	4/100
LaSalle	60	2 040	16/100

[A] Source: Colorado Big Game Hunting Statistics 1992.

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Table 13. Game Management Units Ranked by Elk Posthunt Population Size[A]

Herd	Unit(s)	Population	Bull/Cow Ratio
White River	12,13,23,24 25,26,33,131, 211,231	29 500	21/100
Trichera	83,85,140,851	19 400	74/100
Bears Ear	3,4,5,14,214, 301,441	15 600	23/100
San Juan	75,751,77,78, 771	12 700	12/100
Grand Mesa	41,42,52,411, 421,521	12 600	20/100
Disappointment Creek	70,71,711	7 030	14/100
Frying Pan	44,45,47,444	6 160	11/100
Lower Rio Grande	80,81	5 180	11/100
Yellow Creek	21,22,30,31, 32	5 060	19/100
Avalanche Creek	43,471	4 490	10/100
Hermosa	74,741	4 120	21/100
Cimmaron	64,65	4 070	30/100
Gore Pass	15,27	4 000	10/100
William's Fork	28,37,371	4 000	18/100
Saguache	68,681	3 980	6/100
Piney River	35,36	3 970	28/100
Troublesome	18,181	3 650	22/100
Fossil Ridge	55,551	3 550	11/100
North Park	6,16,17,161 171	3 540	14/100

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Table 13. (Cont.)

Herd	Unit(s)	Population	Bull/Cow Ratio
Uncompahgre	61,62	3 500	10/100
Sapinero	54	3 460	13/100
Lake Fork	66,67	3 280	15/100
Poudre River	7,8,9,19,191	3 280	3/100
Buffalo Peaks	49,57,58	3 230	31/100
Upper Rio Grande	76,79	3 230	10/100
Mt. Evans	39,46,51,104, 461	3 000	57/100
St. Vrain	20	2 410	34/100
Rangely	10,11	2 175	85/100
Collegiate Range	48,56,481,561	2 110	32/100
Kenosha Pass	50,500,501	1 980	38/100
Sangre de Cristo	86,861	1 770	33/100
Coal Creek	53	1 720	14/100
Glade Park	40	1 700	64/100
Mesa Verde	72,73	1 580	16/100
Eleven Mile	59,511,581	1 360	16/100
Grape Creek	69,84	1 330	51/100
Sand Dunes	82	1 320	6/100
Cold Springs	1,2,201	1 280	59/100
Clear Creek	29,38	1 070	48/100
LaSalle	60	209	14/100

[A] Source: Colorado big game hunting statistics. 1992.

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Table 14. Rural Population Statistics of Colorado Counties Included Within the Potential Wolf Recovery Areas.

PWRA	County	Land area (mi^2)	Total rural population	Rural human density.mi^2	Percent change 1980-1990
Grand Mesa Uncompahgre Gunnison	Delta	1 142.2	17 191	15.0	-.6
	Garfield	2 957.5	15 773	5.3	7.6
	Mesa	3 327.9	17 162	5.2	-21.5
	Gunnison	3 239.0	5 637	1.7	14.9
	Hinsdale	1 117.8	467	2.4	14.5
	Montrose	2 240.7	15 569	6.9	-.4
	Ouray	542.1	2 295	4.2	19.2
	Saguache	3 168.7	4 619	1.5	17.4
	San Juan	387.4	745	1.9	-10.6
	San Miguel	1 286.6	3 653	2.8	14.4
Rio Grande	Alamosa	722.8	6 038	8.4	21.5
	Archuleta	1 349.4	5 345	4.0	45.9
	Conejos	1 287.3	7 453	5.8	-4.4
	Custer	738.9	1 926	2.6	26.0
	Hinsdale	1 117.8	467	2.4	14.5
	Mineral	875.8	558	1.6	-30.6
	Rio Grande	912.6	6 446	7.1	-2.5
	Saguache	3 168.7	4 619	1.5	17.4
	San Juan	387.4	745	1.9	-10.6
Roosevelt Arapaho	Boulder	742.5	28 008	37.7	-10.2
	Clear Creek	395.5	7 619	19.3	4.3
	Gilpin	149.9	3 070	20.5	25.8
	Grand	1 849.8	7 966	4.3	6.6
	Jackson	1 613.3	1 605	1.0	-13.8
	Larimer	2 601.4	36 801	14.1	-3.0
	Park	2 200.8	7 174	3.2	34.5
	Routt	2 361.8	7 393	0.3	-11.0
	Summit	608.2	12 881	23.1	45.6
Routt	Garfield	2 947.5	15 773	5.3	7.6
	Grand	1 849.8	7 966	4.3	6.6
	Jackson	1 613.3	1 605	1.0	-13.8
	Moffat	4 742.5	3 266	1.5	-34.7
	Rio Blanco	3 221.2	5 972	0.5	-4.5
	Routt	2 361.8	7 393	0.3	-11.0

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Table 14. (Cont.)

PWRA	County	Land area (mi^2)	Total rural population	Rural human density/mi^2	Percent change 1980-1990
San Isabel	Chaffee	1 013.5	7 947	7.8	-4.9
Pike	Clear Creek	395.5	7 619	19.3	4.3
	Costilla	1 227.2	3 190	2.6	3.9
	Custer	738.9	1 926	2.6	26.0
	Fremont	1 533.0	12 868	8.4	39.5
	Huerfano	1 591.0	2 709	1.7	8.6
	Lake	376.9	3 378	9.0	-31.8
	Park	2 200.8	7 174	3.2	34.5
	Saguache	3 168.7	4 619	1.5	17.4
	Summit	608.2	12 881	21.2	45.6
	Teller	557.1	7 858	14.1	45.5
San Juan	Archuleta	1 349.4	5 345	4.0	45.9
	Conejos	1 287.3	7 453	5.8	-4.4
	Dolores	1 067.0	1 504	1.4	-9.3
	Hinsdale	1 117.8	467	2.4	14.5
	La Plata	1 692.3	19 854	11.7	24.1
	Mineral	875.8	558	1.6	-30.6
	Montezuma	2 036.9	11 388	5.6	21.0
	Rio Grande	912.6	6 446	7.1	-2.5
	San Juan	387.4	745	1.9	-10.6
White River	Eagle	1 688.0	15 664	9.3	17.6
	Garfield	2 957.5	15 773	5.3	7.6
	Moffat	4 742.5	3 266	1.5	-34.7
	Pitkin	970.5	7 612	7.8	14.3
	Rio Blanco	3 221.2	5 972	1.9	-4.5
	Routt	2 361.8	7 393	3.1	-11.0

Source: U.S. Dept. of Commerce. 1990. Population and housing unit counts, 1990 CPH-2-7.

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Table 15. Location and Size of Designated National Forest Wilderness Areas in Colorado.

National Forest/Wilderness Area

Grand Mesa-Uncompahgre-Gunnison

Collegiate Peaks	48 986 acres
La Garita	79 822
Maroon Bells-Snowmass	19 194
Raggeds	43 062
West Elk	176 172
Big Blue	98 485
Lizard Head	20 391
Mt. Sneffels	16 505

Note: Land areas of individual Wilderness areas not provided - only gross and net values. The above figures are from: USDA, FS. 1990. Land areas of the National Forest System, FS-383.

Current Gross Area:	923.1 mi^2
Current Net Area:	920.3 mi^2
Current other land area:	2.8 mi^2
Ownership of other lands:	State 1/3rd and private 2/3rds
Livestock allotments:	78 allotments permitted - appx. 12,200 AUMs

Rio Grande

La Garita	24 316 acres
South San Juan	89 160
Weminuche	168 460
Sangre de Cristo*	121 610
Wheeler*	25 154

*1993 Colorado Wilderness Bill additions

Current gross area:	669.8 mi^2
Current net area:	670.1 mi^2
Current area of other lands within the Wilderness area:	0
Livestock allotments:	not stated

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Table 15. (Cont.)

National Forest/Wilderness Area		
Arapaho-Roosevelt		
Cache la Poudre		9 308
Commanche Peaks		66 901
Indian Peaks		70 894
Mount Evans		40 274 (Arapaho portion)
Never Summer		9 924 (includes 267 acres in the Routt)
Rawah		73 934 (includes 1 462 in the Routt)
Vasquez		12 300
Current gross area:		465.6 mi^2
Current net area:		462.6 mi^2
Current other land area:		3.0 mi^2
Ownership of other lands:		all private except 1.4 mi^2 State land
Livestock allotments:		
Neota	2 allotments	/600 AUMs
Rawah	3	500
Commanche Peak	2	161
Cache la Poudre	3	240
Indian Peaks	2	287
Routt		
Flattops	38 870 acres	
Mt. Zirkel	160 648	
Never Summer	6 659	
Platte River	743	
Neota	267	
Rawah	1 462	
Service Creek	39 860	
Current gross area:		388.3 mi^2
Current net area:		388.2 mi^2
Ownership of other land:		80 acres, private
Livestock allotments:		
Flattops	4 allotments (S&G)	/6 870 AUMs
Mt Zirkel	1 (S&G) & 1 (C&H)	110
Service Creek	1 (C&H)	748

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Table 15. (Cont.)

National Forest/Wilderness Area	
Pike-San Isabel	
Collegiate Peaks	83 231 acres
Holy Cross	9 568
Lost Creek	105 451 + 14 700 (new addition)
Mount Evans	34 127
Mount Massive	28 047
Sangre de Cristo ('93 addition)	93 263
Greenhorn Mountain ('93 addition)	22 040
Buffalo Peaks ('93 addition)	43 410
Current gross area:	677.9 mi^2
Current net area:	*675.5 mi^2
*Estimated pending evaluation of '93 additions	
Ownership of other lands:	private - unknown for '93 additions
Livestock allotments:	
Lost Creek	500 AUMs
Sangre de Cristo	600
Greenhorn Mountain	200
Buffalo Peaks	420

San Juan		
Lizard Head		20 816 acres
Weminuche		323 197
South San Juan		70 883
Current gross area:		648.3 mi^2
Current net area:		*648.3 mi^2
* all area managed by the FS (3 300 acres are inactive patented mining claims)		
Livestock allotments:		
Lizard Head	1 allotment/720	AUMs
Weminuche	6	4 000
South San Juan	4	1 520

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Table 15. (Cont.)

National Forest/Wilderness Area	
White River	
Collegiate Peaks	35 671 acres
Eagle's Nest	51 105
Flat Tops	196 360
Holy Cross	113 842
Hunter Fryingpan	82 929
Maroon Bells-Snowmass	163 483
Raggeds	16 832
Ptarmigan/Farr	13 175
Current gross area:	1 052.0 mi^2
Current net area:	1 045.7 mi^2
Other land:	private
Livestock allotments:	
Eagle's Nest	4(C) & 4(H)-751AUMs
	2(S)-1 202 AUMs
Flat Tops	7(C&H)-4 297 AUMs
	9(S)-3 083
Maroon Bells-Snowmass	6(C&H)-2 029 AUMs; 3(S)-1 722 AUMs
Ptarmigan/Farr	3(C&H)-356 AUMs

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Table 16. Evaluation Summary for **GRAND MESA-UNCOMPAHGRE-GUNNISON PWRA.**

Current estimated gross land area of Grand Mesa-Uncomphagre-Gunnison NF:	4 941.1 mi^2
Current estimated net land area managed by the FS:	4 617.9 mi^2
Colorado Counties included in NF unit boundaries:	
Delta, Garfield, Gunnison, Hinsdale, Mesa, Montrose, Saguache, Ouray, San Juan, San Miguel	
Current estimated gross land area of Grand Mesa-Uncompahgre-Gunnison NFs and included counties:	19 399.9 mi^2
Estimated percent public land in total area (avg.):	67%
Game management units within unit boundaries (Fig. 11):	
Estimated available mule deer population:	188 730
Estimated available mule deer density:	9.7 - 38.2 animals/mi^2
Estimated available elk population:	44 960
Estimated available elk density:	2.3 - 9.7 animals/mi^2
Estimated rural human population in adjoining 10 county block:	83 111
Estimated rural human density in adjoining county block:	4.3/mi^2
Estimated gross wilderness area:	923.1 mi^2
Estimated percent wilderness in relation to NF net area:	20%
Estimated total miles of BLM and NFS motorized roads (Appx. L):	5 071.0
Estimated BLM and NFS Road density within PWRA (linear miles/mi^2)(Appx. L):	0.40
Peak number of sheep permitted to graze within NF unit boundaries:	53 000
Peak sheep density/mi^2 within NF unit boundaries:	11.5
Peak number of cattle permitted to graze within NF unit boundaries:	64 000
Peak cattle density/mi^2 within NF unit boundaries:	13.9
Peak number of horses permitted to graze within NF unit boundaries:	5 000
Peak horse density/mi^2 within NF unit boundaries:	1.1
Grazing period:	1 June-15 Oct.
Threatened/endangered species:	see Appx. C
NF Recreation visitor days/year:	4 924 200
Proposed development:	
Estimated portion of PWRA receiving 250 inches total annual snowfall:	15%
Estimated wolf population size range based on a 219 mi^2 territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 15% reduction of available winter range due to 250 inches average annual snowfall (see Appx. I).	95-190

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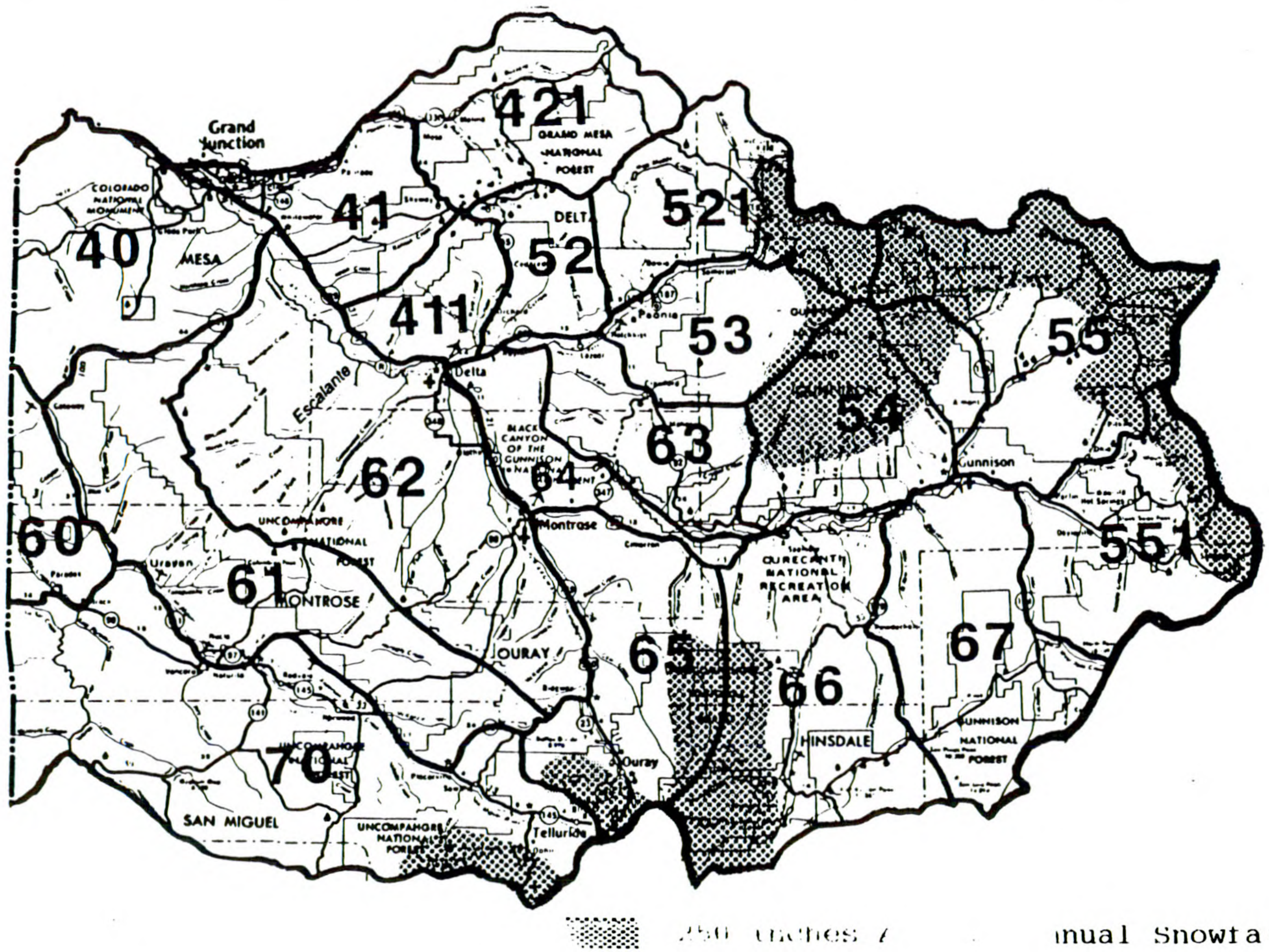

Figure 11. Location Map of Grand Mesa-Uncompahgre-Gunnison Potential Wolf Recovery Area and Respective Big Game Managment Units.

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Table 17. Evaluation Summary for **RIO GRANDE PWRA.**

Current estimated gross land area of Rio Grande PWRA:	3 024.0 mi^2
Current estimated net land area managed by the FS:	2 861.3 mi^2
Colorado Counties include in NF boundaries:	
Alamosa, Archuleta, Conejos, Custer, Hinsdale, Mineral, Rio Grande, Saguache, San Juan	
Current estimated total land area of Rio Grande NF and included counties:	10 560.7 mi_2
Percent public land in total area (avg.):	62%
Game management units within unit boundaries (Fig. 12):	
Estimated available mule deer population:	17 510
Estimated available mule deer density:	1.7 - 5.8 animals/mi^2
Estimated available elk population:	13 710
Estimated available elk density:	1.3 - 4.5/mi^2
Estimated rural human population in 9 county block:	32 597
Estimated rural human density in 9 county block:	3.1/mi^2
Estimated gross wilderness area:	669.8 mi^2
Estimated percent wilderness in relation to NF net area:	23%
Estimated total miles of BLM and NFS motorized roads (Appx. L):	2 814.7
Estimated BLM and NFS road density within PWRA (linear miles/mi^2)(Appx L):	0.41
Peak number of sheep permitted to graze within NF unit boundaries:	27 647
Peak sheep density/mi^2 within NF unit boundaries:	9.7
Peak number of cattle permitted to graze within NF unit boundaries:	17 707
Peak cattle density/mi^2 within NF unit boundaries:	6.2
Peak number of horses permitted to graze within NF unit boundaries:	0
Peak horse density/mi^2 within NF unit boundaries:	n/a
Grazing period:	not provided
Threatened/endangered species:	see Appx. C
NF recreation visitor days/year:	1 279 100
Proposed development:	
Portion of PWRA receiving 250 inches total annual snowfall:	5%
Estimated wolf population size range based on a 933 mi^2 territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 5% reduction of available winter range due to 250 inches average annual snowfall (see Appx I):	40-80

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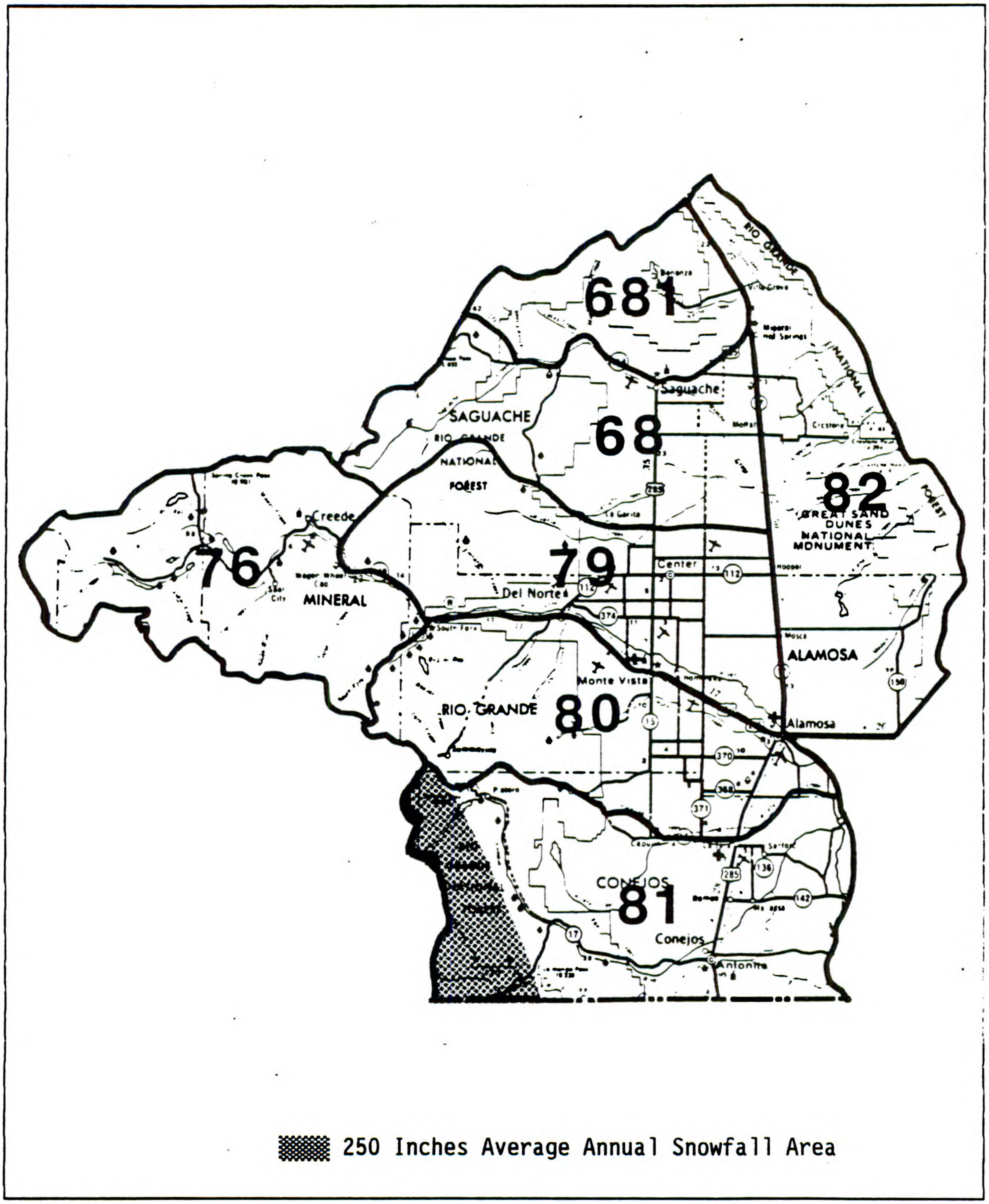

Figure 12. Location Map of Rio Grande Potential Wolf Recovery Area and Respective Big Game Management Units.

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Table 18. Evaluation Summary for **ARAPAHO-ROOSEVELT PWRA.**

Current estimated gross land area of Arapaho-Roosevelt NF:	2 498.4 mi²
Current estimated net land area managed by the FS:	1 971.8 mi²
Colorado Counties included in NF unit boundaries:	
Boulder, Clear Creek, Gilpin, Grand, Jackson, Larimer, Park, Routt, Summit	
Current estimated gross land area of Arapaho - Roosevelt NF and included counties:	12 684.1 mi²
Estimated percent public land in total area (avg.):	51.2%
Game management units within unit boundaries (see Fig. 13):	
Estimated available mule deer population:	47 720
Estimated available mule deer density:	3.8 - 19.0 animals/mi²
Estimated available elk population:	22 480
Estimated available elk density:	1.8 - 9.0 animals/mi²
Estimated rural human population in adjoining 9 county block:	115 587
Estimated rural human density in adjoining 9 county block:	9.1/mi²
Estimated gross wilderness area:	465.6 mi²
Estimated percent wilderness in relation to NF net area:	19%
Estimated total miles of BLM and NFS motorized roads (Appx. L):	2 473.4
Estimated BLM and NFS Road density within unit boundaries (linear mile/mi²)(Appx. L):	0.40
Peak number of sheep permitted to graze within NF unit boundaries:	0
Peak sheep density/mi² within NF unit boundaries:	n/a
Peak number of cattle permitted to graze within NF unit boundaries:	23 900
Peak cattle density/mi² within NF unit boundaries:	12.0
Peak number of horses permitted to graze within NF unit boundaries:	0
Peak horse density/mi² within NF unit boundaries:	n/a
Grazing period:	1 June - 31 Dec.
Threatened/endangered species:	see Appx. C
NF recreation visitor days/year:	5 631 900
Proposed development:	
Estimated portion of PWRA receiving 250 inches total annual snowfall:	20%
Estimated wolf population size range based on a 316 mi² territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 20% reduction of available winter range due to 250 inches average annual snowfall (see Appx. I):	32-64

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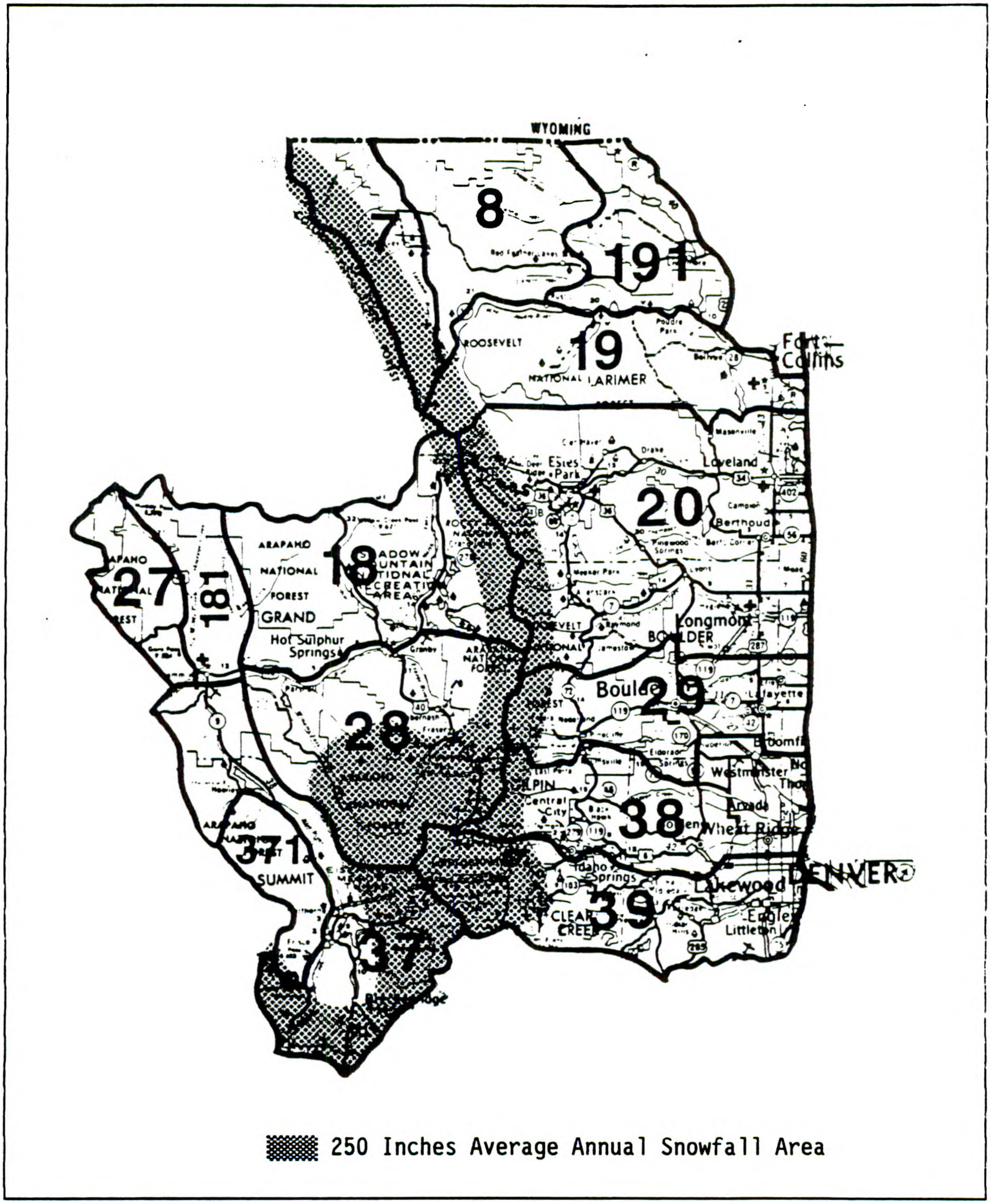

Figure 13. Location Map of Arapaho-Roosevelt Potential Wolf Recovery Area and Respective Big Game Management Units.

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Table 19. Evaluation Summary for **ROUTT PWRA**.

Current estimated gross land area of Routt NF:	2 331.3 mi^2
Current estimated net land area managed by the FS:	1 757.5 mi^2
Colorado Counties included in NF boundaries:	
Garfield, Grand, Jackson, Moffat, Rio Blanco, Routt	
Current estimated gross land area of Routt NF and included counties:	16 736.1 mi^2
Estimated percent public land in total area:	57%
Game management units within unit boundaries (see Fig. 14):	
Estimated available mule deer population:	138 720
Estimated available mule deer density:	8.3 - 59.5 animals/mi^2
Estimated available elk population:	49 040
Estimated available elk density:	2.5 - 21.0 animals/mi^2
Estimated rural human population in adjoining 6 county block:	41 975
Estimated rural human density in adjoining 6 county block:	2.5/mi^2
Estimated gross wilderness area within unit boundaries:	388.3 mi^2
Estimated percent wilderness in relation to NF net area:	22%
Estimated total miles of BLM and NFS system motorized roads (Appx. L):	3 408.2
Estimated BLM and NFS road density within PWRA (linear miles/mi^2)(Appx. L):	0.36
Peak number of sheep permitted to graze within NF unit boundaries:	89 939
Peak sheep density/mi^2 within NF unit boundaries:	51
Peak number of cattle permitted to graze within NF unit boundaries:	14 548
Peak cattle density/mi^2 within NF unit boundaries:	8.3
Peak number of horses permitted to graze within NF unit boundaries:	0
Peak horse density/mi^2 permitted to graze within NF unit boundaries:	n/a
Grazing period:	1 June - 15 Oct.
Threatened/endangered species:	see Appx. C
NF recreation visitor days/year:	2 420 050
Proposed development:	
Estimated portion of PWRA receiving 250 inches total annual snowfall:	40%
Estimated wolf population size range based on a 233 mi^2 territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 40% reduction of available winter range due to 250 inches average annual snowfall (Appx. I):	30-60

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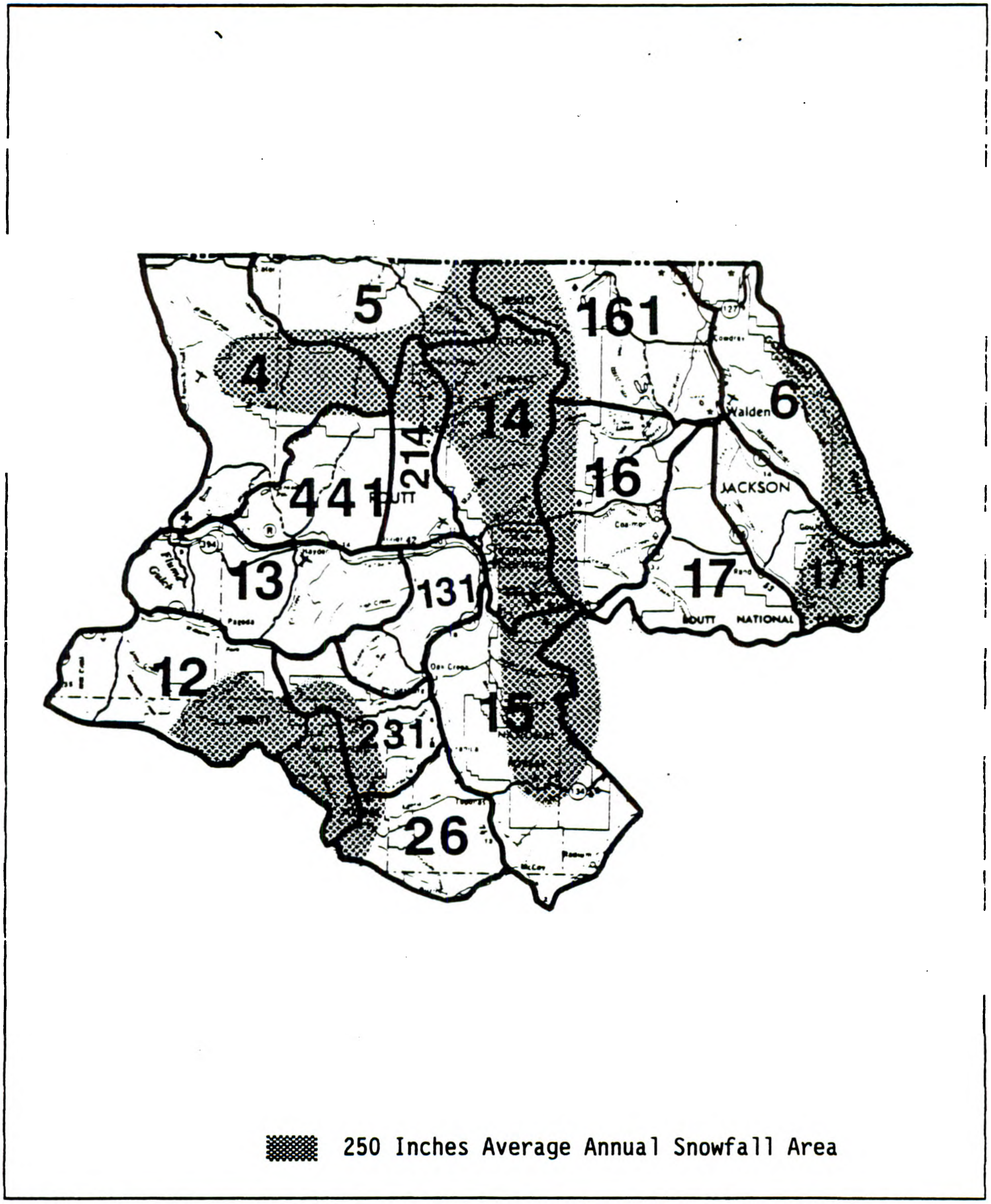

Figure 14. Location Map of Routt Potential Wolf Recovery Area and Respective Big Game Management Units.

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Table 20. Evaluation Summary for **PIKE-SAN ISABEL PWRA.**

Current estimated gross land area of San Isabel - Pike NFs:	5 099.2 mi^2
Current estimated net land area managed by the FS:	3 480.0 mi^2
Colorado Counties in NF unit boundaries:	
Clear Creek, Chaffee, Costilla, Custer, Fremont, Huerfano, Park, Saguache, Summit, Teller	
Current estimated gross area of San Isabel - Pike NFs and included counties:	17 144.6 mi^2
Estimated percent public land in total area:	55%
Game management units within unit boundaries (see Fig. 15)	
Estimated available mule deer population:	101 480
Estimated available mule deer density:	5.0 - 19.0 animals/mi^2
Estimated available elk population:	36 810
Estimated elk density:	2.1 - 7.2 animals/mi^2
Estimated rural human population in adjoining 11 county block:	54 914
Estimated rural human density in adjoining 11 county block:	3.2/mi^2
Estimated gross wilderness area:	677.9 mi^2
Estimated percent wilderness in relation to NF net area:	19%
Estimated total miles of BLM and NFS system motorized roads (Appx. L):	3 640.5
Estimated BLM and NFS road density within PWRA (linear miles/mi^2)(Appx. L):	0.61
Peak number of sheep permitted to graze within NF unit boundaries:	1 600
Peak sheep density/mi^2 within NF unit boundaries:	1.0
Peak number of cattle permitted to graze within NF unit boundaries:	8 164
Peak cattle density/mi^2 within unit boundaries:	2.3
Peak number of horses permitted to graze within NF unit boundaries:	3
Peak horse density/mi^2 within NF unit boundaries:	–
Grazing period:	16 Apr. - 31 Dec.
Threatened/endangered species:	see Appx. C.
NF recreation visitor days/year:	6 225 000
Proposed development:	
Estimated portion of PWRA receiving 250 inches total annual snowfall:	5%
Estimated wolf population size range based on a 289 mi^2 territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 5% reduction of available winter range due to 250 inches average annual snowfall (see Appx. I):	85-170

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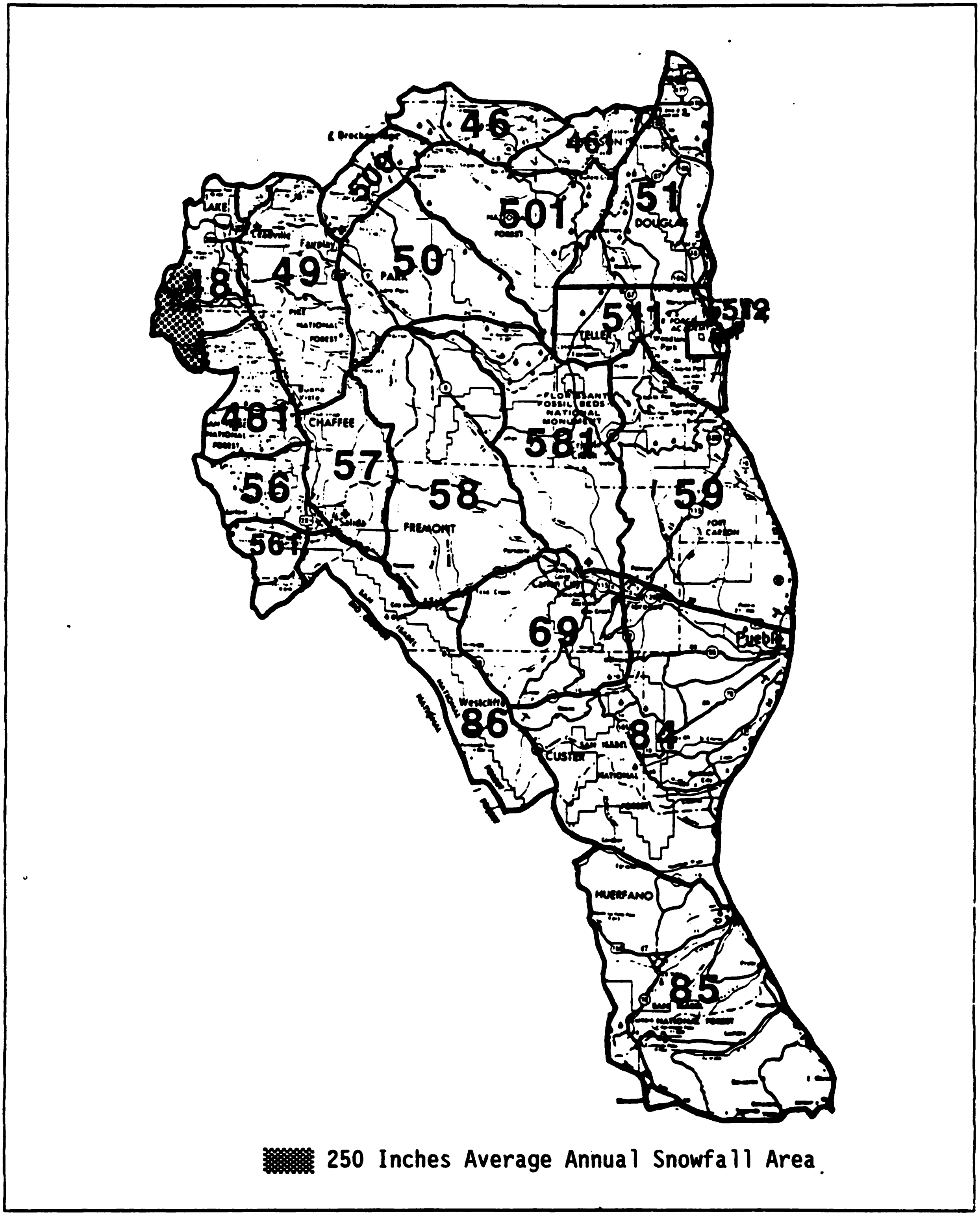

Figure 15. Location Map of Pike-San Isabel Potential Wolf Recovery Area and Respective Big Game Management Units.

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Table 21. Evaluation Summary of **SAN JUAN PWRA.**

Current estimated gross land area of San Juan NF:	3 328.1 mi^2
Current estimated net land areas managed by the FS:	2 934.4 mi^2
Colorado Counties included in NF unit boundaries:	
Archuleta, Conejos, Dolores, Hinsdale, La Plata, Mineral, Montezuma, Rio Grande, San Juan	
Current estimated gross land area of San Juan NF and included counties:	10 726.5 mi^2
Estimated percent public land in total area:	64%
Game management units within unit boundaries (see Fig. 16):	
Estimated available mule deer population:	60 100
Estimated available mule deer density:	5.6 - 18.0 animals/mi^2
Estimated available elk population:	18 400
Estimated available elk density:	1.7 - 5.6 animals/mi^2
Estimated rural human population in adjoining 9 county block:	53 202
Estimated rural human density in adjoining 9 county block:	5.0/mi^2
Estimated gross wilderness area:	648.3 mi^2
Estimated percent wilderness in relation to NF net area:	19%
Estimated total miles of BLM and NFS motorized roads (Appx. L):	4 364.9
Estimated BLM and NFS road density within PWRA (linear miles/mi^2)(Appx. L):	0.68
Peak number of sheep permitted to graze within NF unit boundaries:	20 900
Peak sheep density/mi^2 within NF unit boundaries:	6.2
Peak number of cattle permitted to graze within NF unit boundaries:	29 200
Peak cattle density/mi^2 within NF unit boundaries:	8.8
Peak number of horses permitted to graze within NF unit boundaries:	0
Peak horse density/mi^2 within NF unit boundaries:	n/a
Grazing period:	15 May - 20 Oct.
Threatened/endangered species:	see Appx. C
NF recreation visitor days/year:	2 483 000
Proposed development:	
Estimated portion of PWRA receiving 250 inches total annual snowfall:	30%
Estimated wolf population size range based on a 294 mi^2 territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 30% reduction of available winter range due to 250 inches average annual snowfall (Appx. I):	40-80

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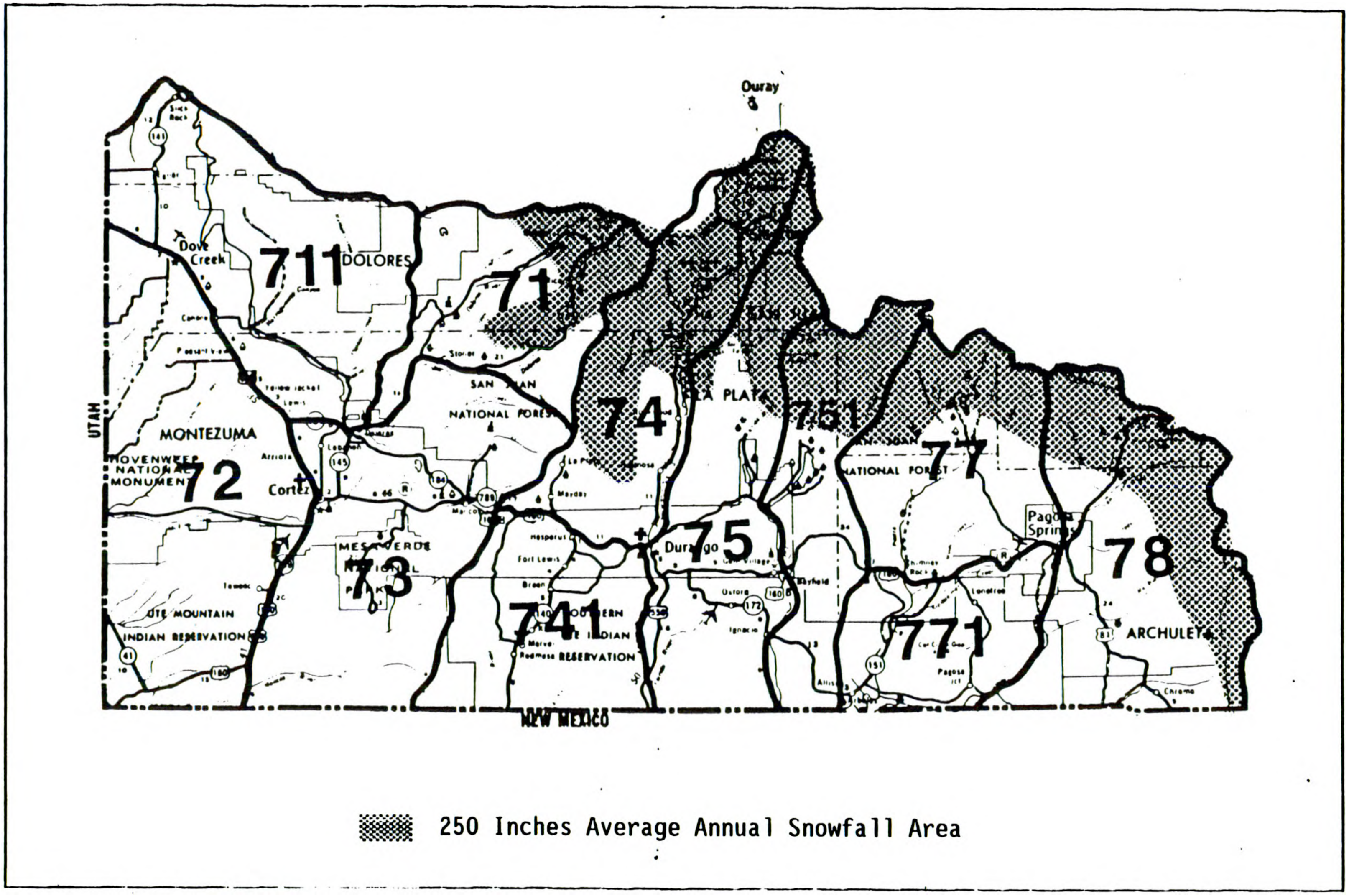

Figure 16. Location Map of San Juan Potential Wolf Recovery Area and Respective Big Game Management Units.

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Table 22. Evaluation Summary of **WHITE RIVER PWRA.**

Current estimated gross land area of White River NF:	3 548.3 mi^2
Current estimated net land area managed by the FS:	3 333.3 mi^2
Colorado counties included in White River NF unit boundaries:	
Eagle, Garfield, Moffat, Pitkin, Rio Blanco, Routt	
Current estimated gross area of White River NF and included counties:	15 929.5 mi^2
Estimated percent public land in total area:	65%
Game management units within unit boundaries (see Fig. 17):	
Estimated available mule deer population:	191 790
Estimated available mule deer density:	12.1 - 54.1 animals/mi^2
Estimated available elk population:	44 120
Estimated available elk density:	2.8 - 13.5 animals/mi^2
Estimated rural human population in adjoining 6 county block:	44 120
Estimated rural human density in adjoining 6 county block:	3.5/mi^2
Estimated gross wilderness area:	1 052.0 mi^2
Estimated percent wilderness in relation to NF net area:	32%
Estimated total miles BLM and NFS motorized roads (Appx. L):	3 768.6
Road density within unit boundaries (linear miles/mi^2)(Appx. L):	0.39
Peak number of sheep permitted to graze within NF unit boundaries:	134 687
Peak sheep density/mi^2 within NF unit boundaries:	38
Peak number of cattle permitted to graze within NF unit boundaries:	54 748
Peak cattle density/mi^2 within NF unit boundaries:	16.4
Peak number of horses permitted to graze within NF unit boundaries:	610
Peak horse density/mi^2 within unit boundaries:	0.2
Grazing period:	Cattle 1 June - 15 Oct.
	Sheep 1 July - 15 Sept.
	Horse 1 June - 30 Dec.
Threatened/endangered species:	see Appx. C
NF recreation visitor days/year:	7 758 800
Proposed development:	
Estimated portion of PWRA receiving 250 inches total annual snowfall:	20%
Estimated wolf population size range based on a 170 mi^2 territory size/social unit with 5 (min) - 10 (max) wolves/social unit and 20% reduction of available winter range due to 250 inches average annual snowfall (see Appx. I):	85-170

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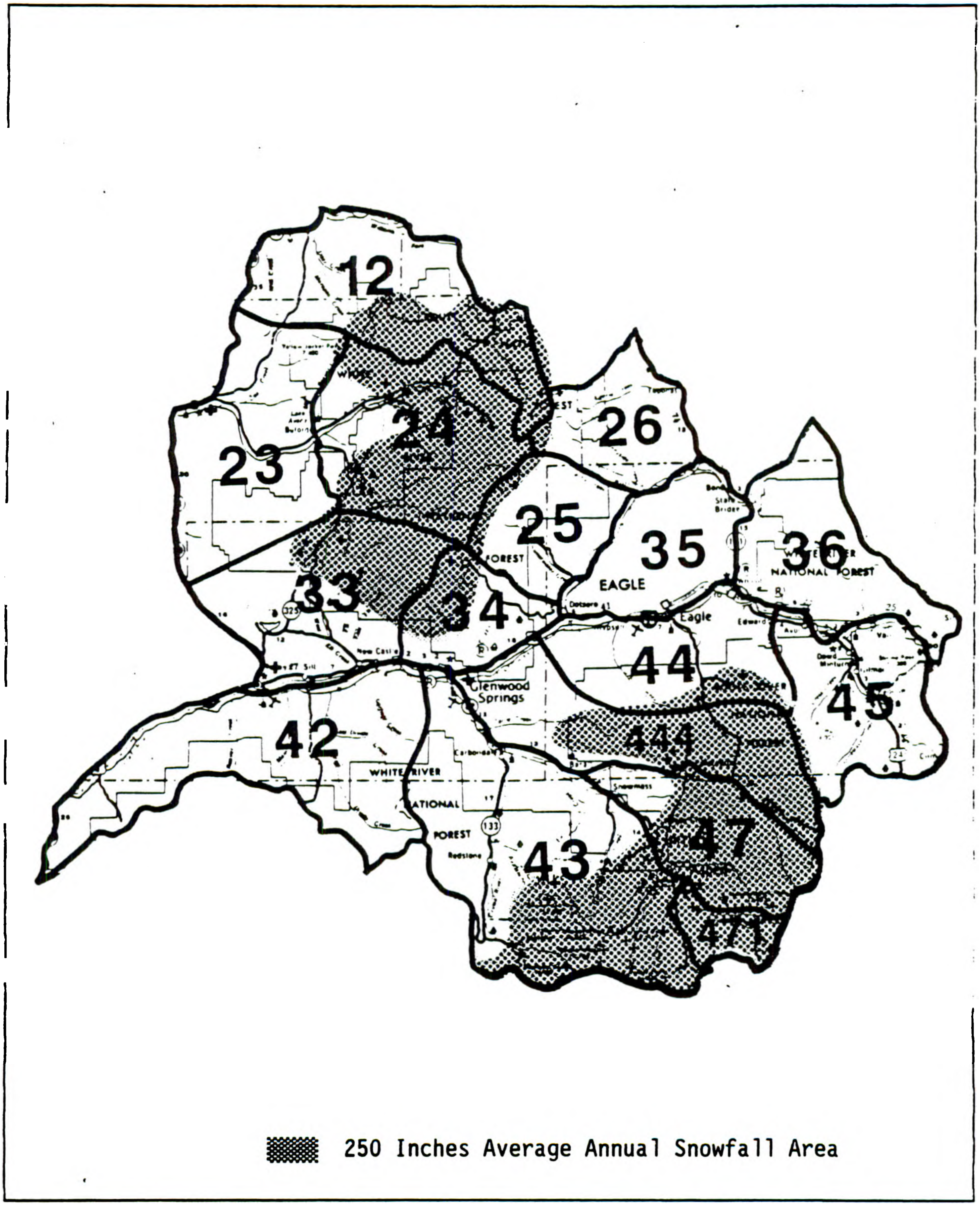

Figure 17. Location Map of White River Potential Wolf Recovery Area and Respective Big Game Management Units.

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Step 5.--Rank each PWRA.

The following Table (Table 23) was created to help visualize the characteristics of each specific PWRA in relation to each other. The data in Table 23 is the basis for the unweighted ranking system as shown in Table 24. Included with the 7 PWRAs is the Regional characteristic (sum or average of the 7 contiguous NFs).

Table 23. Summary of Data used for an Unweighted Ranking System of Selected Potential Wolf Recovery Area Characteristics.

CHARACTERISTIC: Gross Area of Potential Wolf Recovery Area (mi^2):	
Grand Mesa-Uncompahgre-Gunnison	4 941.1
Rio Grande	3 024.0
Arapaho-Roosevelt	2 498.4
Routt	2 331.3
Pike-San Isabel	5 099.2
San Juan	3 328.1
White River	3 548.3
Regional	(sum) 24 770.4
CHARACTERISTIC: Public land/private land proportion of included counties (%):	
Grand Mesa-Uncompahgre-Gunnison	67
Rio Grande	62
Arapaho-Roosevelt	51
Routt	57
Pike-San Isabel	55
San Juan	64
White River	65
Regional	(avg.) 60

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Table 23. (Cont.)

CHARACTERISTIC: Mule deer density (avg. of min. and max. animals/mi²)[A]

Grand Mesa-Uncompahgre-Gunnison	24.0
Rio Grande	3.8
Arapaho-Roosevelt	11.4
Routt	33.9
Pike-San Isabel	12.0
San Juan	11.8
White River	33.0
Regional	(avg.) 18.6

CHARACTERISTIC: Elk Density (avg. of min. and max. animals/mi²):[A]

Grand Mesa-Uncompahgre-Gunnison	6.0
Rio Grande	2.9
Arapaho-Roosevelt	5.4
Routt	11.8
Pike-San Isabel	4.7
San Juan	5.0
White River	8.2
Regional	(avg.) 6.3

CHARACTERISTIC: Rural Human Density (persons/mi²):

Grand Mesa-Uncompahgre-Gunnison	4.3
Rio Grande	3.1
Arapaho-Roosevelt	9.1
Routt	2.5
Pike San Isabel	3.2
San Juan	5.0
White River	3.5
Regional	(avg.) 4.4

[A] Combined mule deer and elk biomass/mi² for each PWRA was used in the ranking process to prevent any bias based upon animal density.

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Table 23. (Cont.)

CHARACTERISTIC: Designated Wilderness Area size (mi^2):

Grand Mesa-Uncompahgre-Gunnison	923.1
Rio Grande	479.8
Arapaho-Roosevelt	465.6
Pike-San Isabel	496.8
Routt	323.3
San Juan	648.3
White River	1 031.0
Regional	(sum) 3 871.1

CHARACTERISTIC: Proportion Wilderness Area to NF gross land area (%)

Grand Mesa-Uncompahgre-Gunnison	20
Rio Grande	16
Arapaho-Roosevelt	19
Routt	14
Pike-San Isabel	14
San Juan	19
White River	29
Regional	(avg.) 18

CHARACTERISTIC: Road density (linear miles/mi^2), **Note: These values represent only BLM and NFS administered roads in the PWRA and underestimate total road density (see Appx. L).**

Grand Mesa-Uncompahgre-Gunnison	0.40
Rio Grande	0.41
Arapaho-Roosevelt	0.40
Routt	0.36
Pike-San Isabel	0.61
San Juan	0.68
White River	0.39
Regional	(avg) 0.46

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Table 23. (Cont.)

CHARACTERISTIC: Peak permitted sheep density (animals/mi^2):

Grand Mesa-Uncompahgre-Gunnison	11.5
Rio Grande	9.7
Arapaho-Roosevelt	0.0
Routt	51.0
Pike-San Isabel	1.0
San Juan	6.2
White River	38.0
Regional	(avg.) 16.8

CHARACTERISTIC: Peak permitted cattle density (animals/mi^2):

Grand Mesa-Uncompahgre-Gunnison	13.9
Rio Grande	6.2
Arapaho-Roosevelt	12.0
Routt	8.3
Pike-San Isabel	2.3
San Juan	8.8
White River	16.4
Regional	(avg.) 9.7

CHARACTERISTIC: NF recreation use (RVDs):

Grand Mesa-Uncompahgre-Gunnison	4 924 200
Rio Grande	1 279 100
Arapaho-Roosevelt	5 631 900
Routt	2 420 050
Pike-San Isabel	6 225 000
San Juan	2 483 000
White River	7 758 800
Regional	(avg.) 4 388 864

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Table 23. (Cont.)

CHARACTERISTIC: PWRA land area receiving 250 inches average annual snowfall (%):

Grand Mesa-Uncompahgre-Gunnison	15
Rio Grande	05
Arapaho-Roosevelt	20
Routt	40
Pike-San Isabel	05
San Juan	30
White River	20
Regional	19

CHARACTERISTIC: Potential wolf carrying capacity based on available prey biomass/mi^2:

Grand Mesa-Uncompahgre-Gunnison	305
Rio Grande	89
Arapaho-Roosevelt	88
Routt	94
Pike-San Isabel	188
San Juan	121
White River	243
Regional	1 128

CHARACTERISTIC: Probable wolf population size with territory size based on minimum available mule deer and elk biomass in PWRA and a social unit of 5 (min) - 10 (max) wolves and reflecting reduction of available winter range due to 250 inches average annual snowfall.

	Min.	Max.
Grand Mesa-Uncompahgre-Gunnison	95	190
Rio Grande	40	80
Arapaho-Roosevelt	32	64
Routt	30	60
Pike-San Isabel	85	170
San Juan	40	80
White River	85	170
Regional	407	814

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Table 24. Unweighted Ranking of Selected Potential Wolf Recovery Area Characteristics.

CHARACTERISTIC	Grand Mesa Uncomphagre Gunnison	Rio Grande	Arapaho Roosevelt	Routt	Pike San Isabel	San Juan	White River
LARGEST GROSS AREA	6	3	2	1	7	4	5
LARGEST % PUBLIC LAND	7	4	1	3	2	5	6
LARGEST COMBINED MULE DEER AND ELK BIOMASS/MI^2	5	1	4	7	2	3	6
LEAST HUMAN DENSITY IN ADJOINING COUNTY BLOCK	3	6	1	7	5	2	4
LARGEST WILDERNESS GROSS LAND AREA	6	3	2	1	4	5	7
LARGEST PROPORTION OF WILDERNESS IN RELATION TO NF GROSS LAND AREA	6	4	5	3	3	5	7
LEAST ROAD DENSITY (Federally Administrated)	5	4	5	7	3	2	6
LEAST SHEEP DENSITY	3	4	7	1	6	5	2
LEAST CATTLE DENSITY	2	6	3	5	7	4	1
LEAST RECREATION USE	4	7	3	6	2	5	1
LEAST TOTAL LAND AREA WITH 250 INCHES TOTAL AVERAGE ANNUAL SNOWFALL	6	7	5	3	7	4	5
GREATEST WOLF CARRYING CAPACITY BASED ON UNGULATE BIOMASS/MI^2	7	1	2	3	5	4	6
TOTALS	60	50	40	47	53	48	56

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CONCLUSIONS AND RECOMMENDATIONS

The unweighted ranking system used in this study was useful in evaluating the overall potential of each PWRA. It is evident, at least from a biological point of view, that all 7 PWRAs include an ample primary prey base capable of supporting wolves. It is interesting to compare the estimated potential regional wolf population of 1 128 wolves calculated in this study to the speculated population of 1 072 in 1915.

Table 25 is a summary evaluation of each PWRA compared to the recommendations previously discussed in the Approach to Research and Methods Section. I have attempted to point out those characteristics that are suitable or not suitable to successful to wolf reintroduction based on my interpretation of the current literature. This opinion is based on the analyses presented in this report and are defined as follows:

good (++) = probably more than acceptable for the reintroduction of gray wolves;

satisfactory (+) = probably acceptable for gray wolves;

unsatisfactory (-) = probably not acceptable for gray wolves;

insufficient data on wolf requirements or not evaluated in this study = (0).

It should be noted at this point that no Federally listed species should be adversely affected by the presence of wolves in any of the PWRAs in Colorado.

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Table 25. Summary Evaluation of Individual Potential Wolf Recovery Areas.

Grand Mesa-Uncompahgre-Gunnison PWRA

Characteristics:	Good (++) Satisfactory (+) Unsatisfactory (-) Insufficient data or not evaluated (0)
Gross land area	++
Percentage Public Land	++
Mule deer availability	++
Elk availability	++
Human density	++
Designated Wilderness Area	++
Proportion of wilderness to NF gross land area	++
Road density	0
Sheep density	+
Cattle density	++
Recreation use	0
Snowpack limitations	++
Potential wolf carrying capacity	++

Comments: Wolf reintroduction potential: Good

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Table 25. (Cont.)

Rio Grande PWRA	
Gross land area	++
Percentage Public land	++
Mule deer availability	+
Elk availability	+
Human density	++
Designated Wilderness Area	++
Proportion of wilderness to NF gross land area	++
Road density	0
Sheep density	++
Cattle density	++
Recreation use	0
Snowpack limitations	++
Potential wolf carrying capacity	+

Comments: Wolf reintroduction potential — Satisfactory

Arapaho-Roosevelt PWRA	
Gross land area	++
Percentage Public Land	+
Mule deer availability	++
Elk availability	++
Human Density	-
Designated Wilderness Area	+
Proportion of wilderness to NF gross land area	++
Road density	0
Sheep density	++
Cattle density	++
Recreation use	0
Snowpack limitations	++
Potential wolf carrying capacity	++

Comments: Five of the 9 counties in the Arapaho-Roosevelt significantly exceed the recommended threshold of 12 persons/mi^2.

Recommendation: Exclude that portion of Arapaho-Roosevelt NF east of the Continental Divide as suitable for wolf reintroduction.

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Table 25. (Cont.)

Routt PWRA

Gross land area	++
Percentage Public Land	++
Mule deer availability	++
Elk availability	++
Human density	++
Designated Wilderness Area	++
Proportion of wilderness to NF gross land area	+
Road density	0
Sheep density	-
Cattle density	++
Recreation use	0
Snowpack limitations	+
Potential wolf carrying capacity	+

Comments: The high number of sheep permitted to graze in the Routt NF may pose a potential conflict for wolf reintroduction in this NF.

Recommendation: Identify and resolve this issue as a priority in any future recovery plan.

Pike-San Isabel PWRA

Gross land area	++
Percentage Public Land	++
Mule deer availability	++
Elk availability	+
Human density	+
Designated Wilderness area	++
Proportion of wilderness to NF gross land area	++
Road density	0
Sheep density	++
Cattle density	++
Recreation use	0
Snowpack limitations	++
Potential wolf carrying capacity	++

Comments: Summit and Teller Counties exceed the human density recommendation and are showing positive growth. This characteristic should be receive priority in any future recovery plan.

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Table 25. (Cont.)

San Juan PWRA	
Gross land area	++
Percentage Public land	++
Mule deer availability	++
Elk availability	++
Human Density	++
Designated Wilderness Area	++
Proportion of wilderness to NF gross land area	++
Road density	0
Sheep density	++
Cattle density	++
Recreation use	0
Snowpack limitations	++
Potential wolf carrying capacity	++
Comments: Wolf reintroduction potential	Good

White River PWRA	
Gross land area	++
Percentage Public Land	++
Mule deer availability	++
Elk Availability	++
Human density	++
Designated Wilderness Area	++
Proportion of wilderness to NF gross land area	++
Road density	0
Sheep density	-?
Cattle density	-?
Recreation use	0
Snowpack limitations	++
Potential wolf carrying capacity	++

Comments: As with the Routt NF, the large number of sheep and cattle permitted to graze in these NFs point out that the need to resolve this issue in any future wolf recovery plan. Notwithstanding the livestock issue, this PWRA is comparable to the Grand Mesa-Uncompahgre-Gunnison as good wolf habitat.

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Selection of Wolves to be Released.--A primary consideration of wolf recovery is the selection of wolves from areas that are similar in topography and vegetation to the proposed release area. More importantly, the primary prey species should be identical. Theberge (1991) discusses the importance of prey-based wolf ecotypes and their distribution in Canada (Figure 18). I have assumed for the purposes of this study that relocated wolves would probably be captured in Canada in the area labeled "F" which is associated with the Mid-Cordillera geographic region described by Theberge.

Green (1951) states that the primary ungulates in Banff National Park are elk, mule deer, bighorn sheep, and moose, but wolves prey mainly on mule deer and elk. He believes this selection is due to two factors: (1) the ability of the wolf to employ successfully its specialized cursory hunting techniques in prey habitats of an entirely new topographic character, an (2) the proportional abundance of prey in terrain where it can be taken with success. He notes that the rugged terrain occupied by bighorn sheep usually prevented them being taken by wolves.

Prey Relationships of Other Ungulates in Colorado.--Although mule deer and elk are believed to be the primary prey species of wolves in Colorado, other species may also be affected because of the wolf's opportunistic hunting habits. Figures 19-23 show the distribution of these ungulates with a brief description of their habitats.

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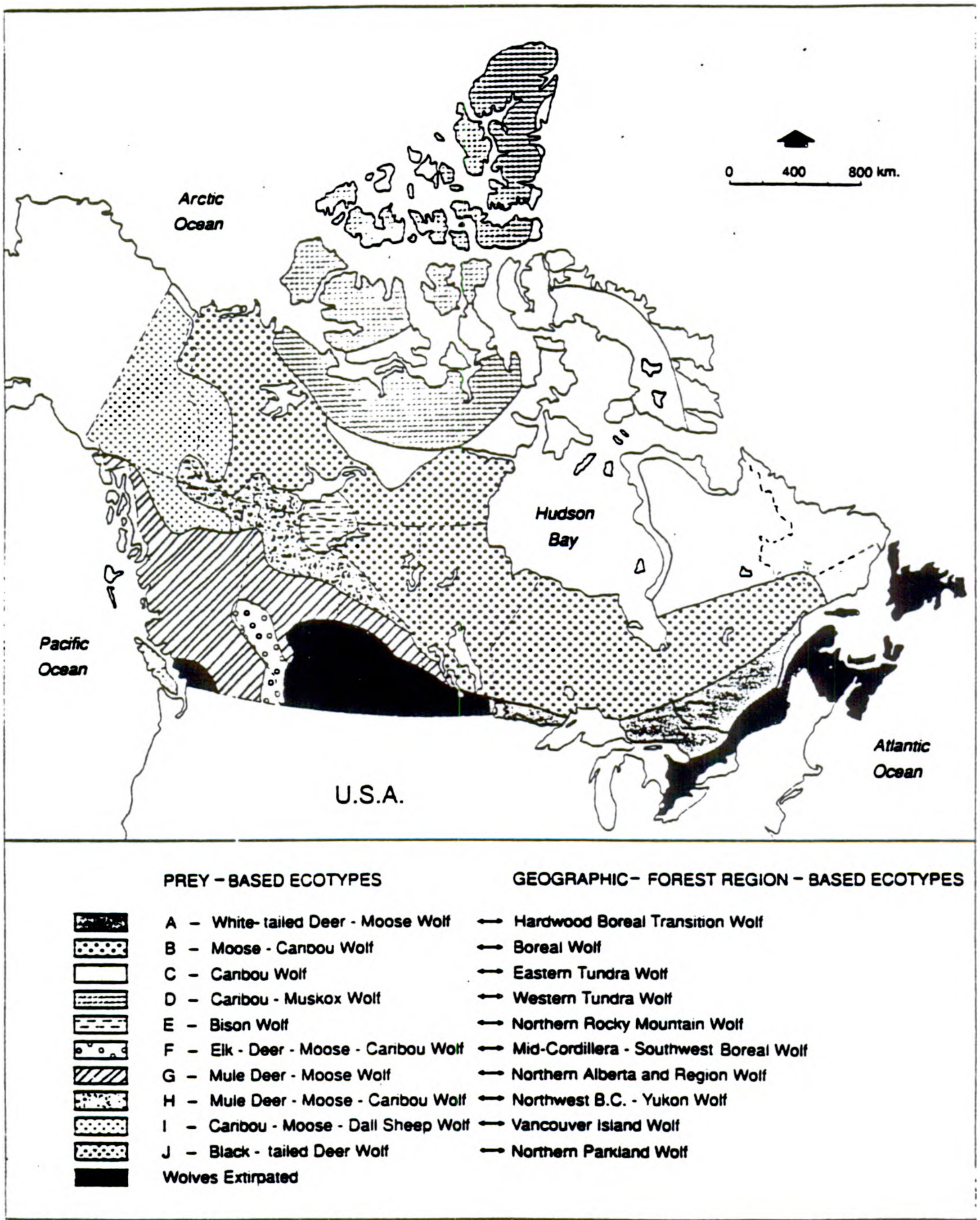

Figure 18. Prey-Based Wolf Ecotype Distribution in Canada (Source: Theberge 1991).

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The following Figures (19-23) and text are from: Towry, R. K. 1983. Wildlife Habitat Requirements. Pages 73-209 in R. L. Hoover and D.L. Wills,.ed, Managing Forested Lands for Wildlife. Colorado Div. of Wildl. in cooperation with USDA For. Serv., Rocky Mount. Reg., Denver, Colo. The maps were modified and the text abstracted by the author.

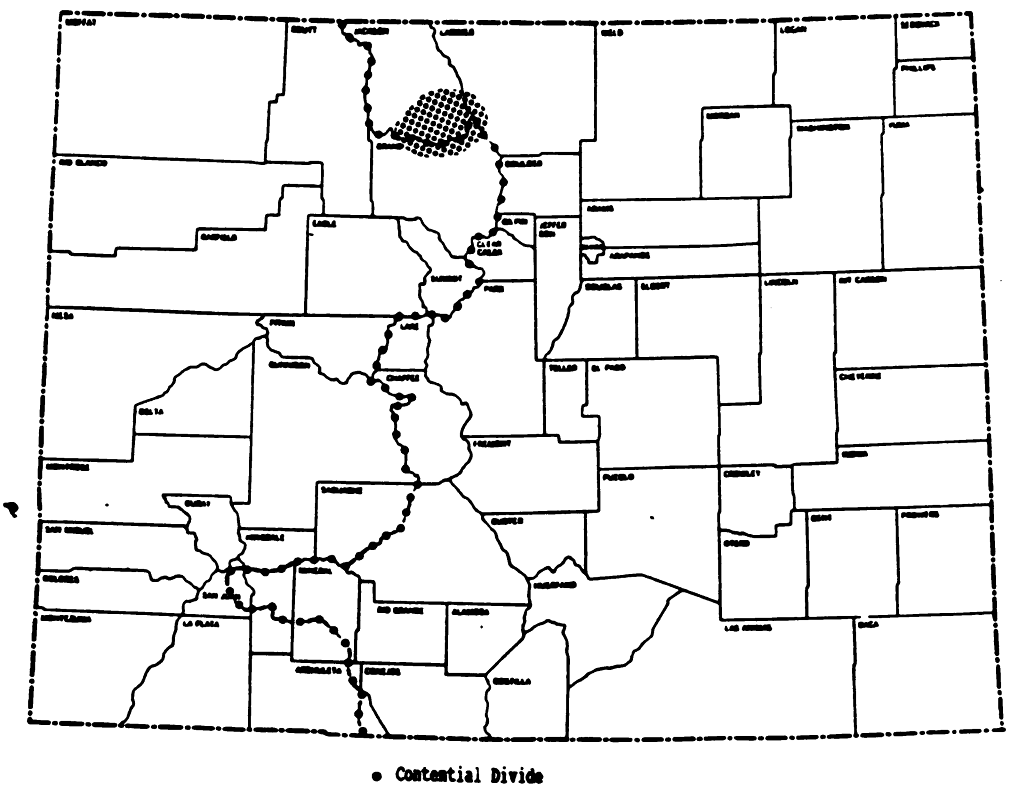

Figure 19. General Distribution of Moose in Colorado.

Ecosystems used: Moose are uncommon, year-round inhabitants of Subalpine Forest, Lodgepole Pine, Aspen, and High Elevation Riparian ecosystems in northern Colorado.

Minimum viable population and habitat area: A minimum viable pre-breeding population of 10 adult moose, consisting of 2 bulls and 8 cows, would need a minimum of 10,000 acres of suitable habitat.

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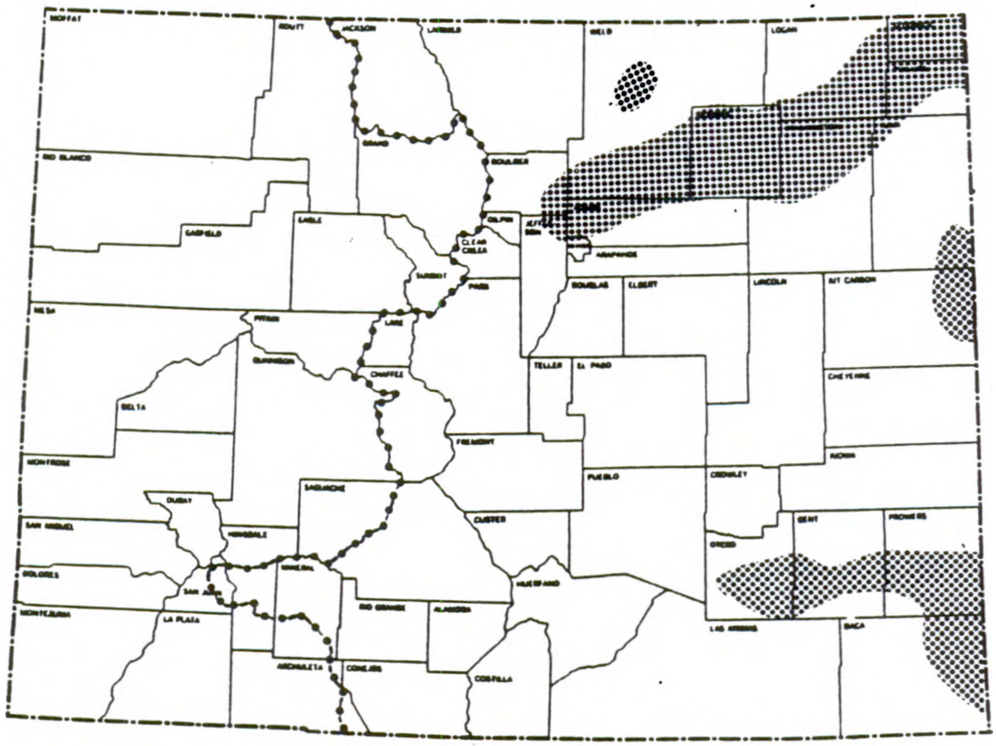

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Figure 20. General Distribution of White-Tailed Deer in Colorado.

Ecosystems used: Generally speaking, white-tails are limited to the Cottonwood Riparian Ecosystem. Although they may frequent Ponderosa Pine, Gambel Oak, and Pinyon-Juniper ecosystems in Colorado, populations are usually not significant enough to warrant specific habitat management measures. Within the Cottonwood Riparian Ecosystem, this deer is considered common locally in eastern Colorado and uncommon in northwestern Colorado.

Minimum viable population and habitat area: A minimum viable population of white-tailed deer is estimated to be 75 animals, of which 1/2 should be mature females. It would require at least 1,125 acres of optimum habitat in Colorado.

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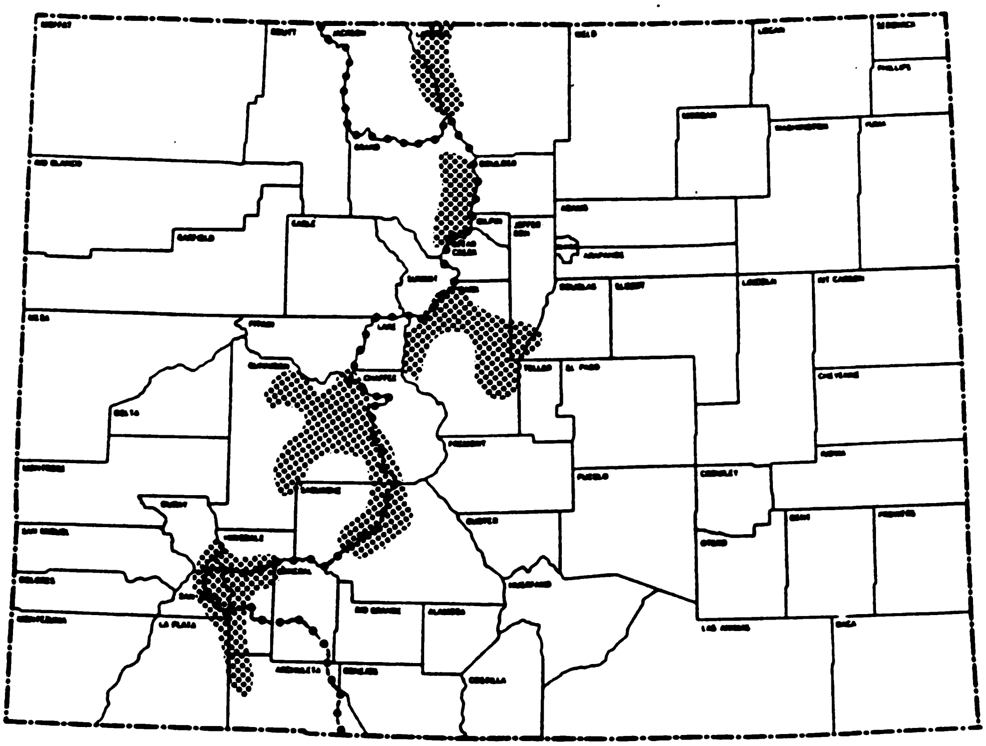

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Figure 21. General Distribution of BigHorn Sheep in Colorado (Source: Bailey 1990)

Ecosystem used	Season of use	Relative abundance
Subalpine Forest	Year-round	Common locally
Douglas Fir	Year-round	Common locally
Ponderosa Pine	Year-round	Common locally
Lodgepole Pine	Year-round	Common locally
Aspen	Spring and winter	Common locally

Minimum viable population and habitat area: ...a minimum viable population bighorn sheep population is defined as one numbering 60 individuals, of which, up to 45 could be females and lambs. It is estimated that a minimum viable population of 60 bighorns would require 7,500 acres of optimum habitat.

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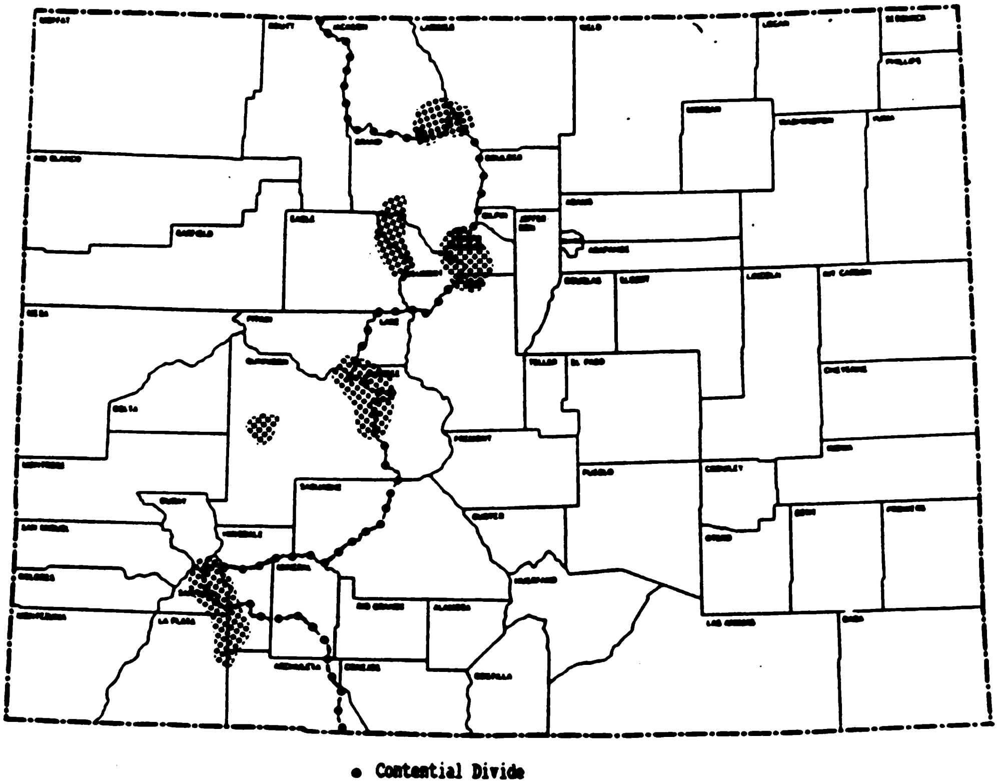

Figure 22. General Distribution of Mountain Goat in Colorado.

Ecosystems used: The Subalpine Forest is the only forested ecosystem used by mountain goats in Colorado. Although this species may be found in the Subalpine Forest Ecosystem year-round and may be common locally, it is more likely to be found here during the more severe winter months.

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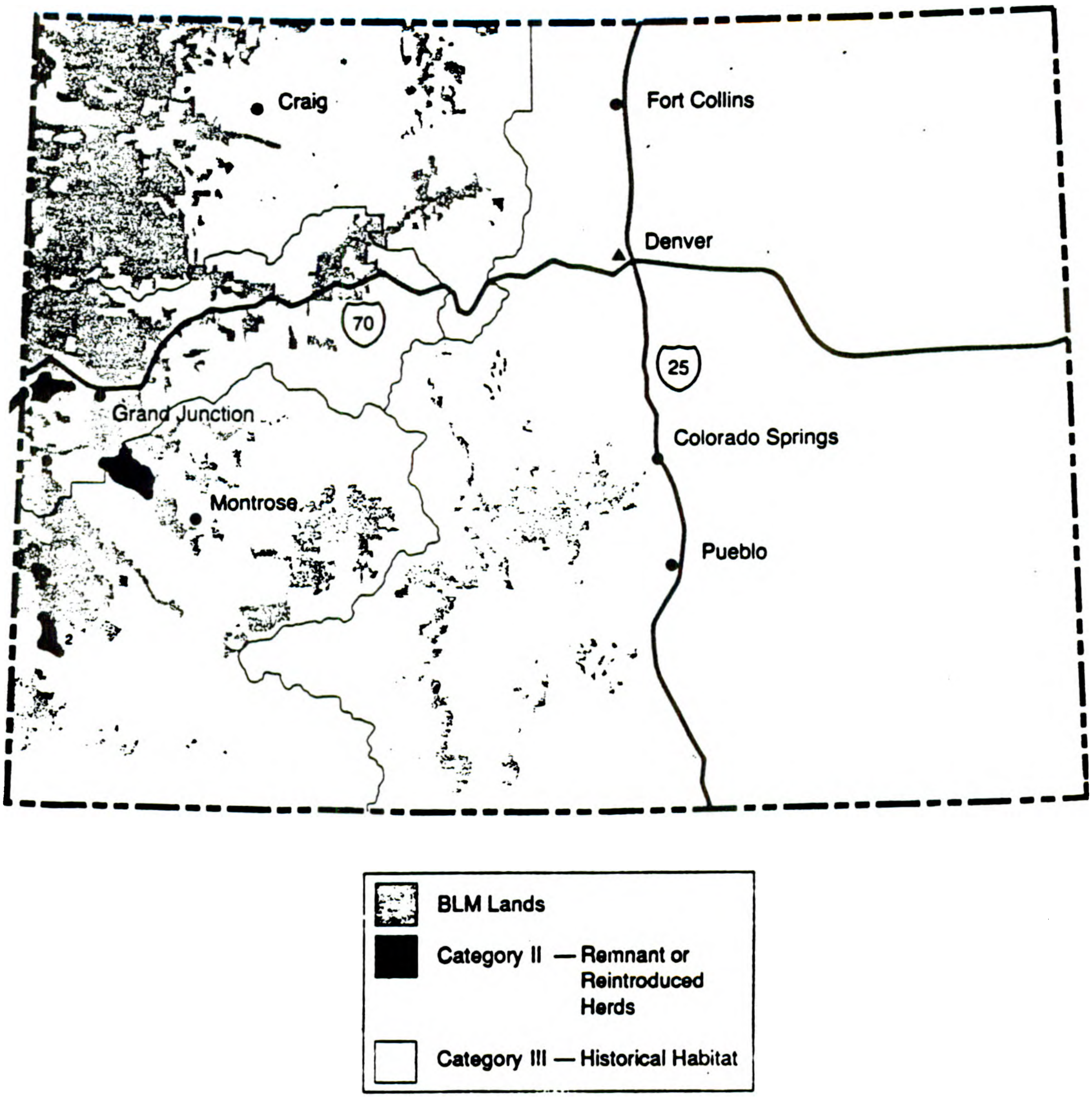

Figure 23. General Distribution of Desert Bighorn Sheep in Colorado (Source: USDI, BLM. 1988).

Desert bighorn sheep in Colorado are restricted to the xeric areas of the western portion of the state. The BLM identifies 3 habitat areas (Devils-Mee Canyon, Upper Dolores River, and West Gunnison) as areas supporting about 1,000 animals in 1988.

A viable population of desert bighorn sheep is considered by the BLM to be 100±20 animals. The minimum habitat size required to support this size herd would be about 32,000 acres (BLM 1988).

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Pronghorn Antelope populations are greater on the eastern plains of Colorado than in the areas evaluated in this report. However, the Great Divide herd of northwestern Colorado is substantial with an estimated 1992 posthunt herd size of 6,490 animals. Other small populations the western portion of the state in the Fruita and Delta areas, North Park, Middle Park, North Park, and the southeastern portion of the wolf recovery area west of I-25.

Impacts on Domestic Livestock.--A controversial aspect of wolf reintroduction is the depredation potential of wolves on domestic livestock. The following discussion is quoted verbatim from the "The Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho" draft EIS (1993) and contains the most current information that could be located on wolf depredation.

> Minnesota.--Wolves frequently encounter livestock in Minnesota without depredations occurring (Fritts and Mech 1981). In Minnesota, the USDA, (ADC) administers a wolf control program in response to complaints of wolf depredations on domestic livestock. Wolves are controlled on a reactive site-specific basis where complaints of livestock depredation by wolves are verified (Fritts 1982). The estimated population of wolves in Minnesota is about 1,500-1,750 (Fuller et al. 1992).
>
> From 1979 to 1991, of cattle taken by wolves an average of 23 calves and 4 adult cattle were lost each year (Mack et al. 1992b, Table 26). Calves comprised 85% and adults 15%. Depredation rates for cattle ranged from 0.04/1,000 to 0.18/1,000 with an annual average of 0.12/1,000 or 0.012% of those available.
>
> Sheep losses from 1979-1991 ranged from 1 to 112/year and averaged 50/year in Minnesota. The rate of sheep killed or injured ranged from 0.03/1,000-7.04/1,000 with an annual average of 2.11/1,000 or 0.211% of those available (Table 4-2). A higher proportion of lambs than adults were killed. Compensation payments averaged 22.5/year for adult sheep versus 51.5/year for lambs or a 1:2.3 adult to lamb ratio (Fritts et al. 1992).
>
> Depredations varied widely among years. Annual variation in verified livestock losses in Minnesota ranged from 1-9 adult cattle and 8-35 calves with an average of 4 adults and 23 calves. Annual variation for sheep was greater....

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Northwestern Montana.--A small population of wolves have been recolonizing northwestern Montana since the early 1980s. The first reproduction was documented in 1986 within Glacier National Park, Montana. From 1987 to 1992 wolves killed an average of 3 cattle and 2 sheep per year (Table 27). Depredation rates on cattle ranged from 0 to 0.08/1,000 with an average of 0.04/1,000 or 0.004 of those available. Depredation rates on sheep ranged from 0 to 0.88/1,000 with an average of 0.18/1,000 or 0.018% of those available (Mack et al. 1992b).

Table 26. Number of cattle and sheep lost to wolves, and cattle and sheep available in wolf range in northern Minnesota, 1979-1991.[a]

	Cattle				Sheep		
	Killed or Injured						
Year	Adults	Calves	Available[b]	Killed/1,000 Available	Killed or Injured[c]	Available	Killed/1,000 Available
1979	5	12	220,970	0.08	1	30,839	0.03
1980	4	12	225,244	0.07	56	32,950	1.70
1981	6	24	241,291	0.12	110	39,569	2.78
1982[d]	1	23	241,724	0.10	12	34,698	0.35
1983	3	32	242,156	0.15	29	29,827	0.97
1984	2	8	242,589	0.04	92	24,956	3.69
1985	4	19	243,021	0.10	75	20,085	3.73
1986	7	19	220,141	0.12	13	15,904	0.82
1987	5	19	220,141	0.11	9	15,904	0.57
1988	3	28	220,141	0.14	68	15,904	4.28
1989	9	31	220,141	0.18	47	15,904	2.96
1990	2	35	220,141	0.17	112	15,904	7.04
1991	5	30	220,141	0.16	31	15,904	1.95
Mean	4	23	229,065	0.12	50	23,719	2.11

[a] Losses are verified wolf caused kills and maulings, and include verified "probable" wolf losses. Data are from S. H. Fritts (unpubl. data), and W. J. Paul (1991) unpubl. annual prog. report. Adapted from Mack et al. 1992b.
[b] Available livestock are based on Minnesota agricultural statistics for 1979, 1980, 1981, 1985 and 1986 (S.H. Fritts unpubl. data).
[c] Includes only total sheep. Lambs and adult sheep lost to wolves were not tabulated in the available datasets.
[d] Interpolation was used between 1981 and 1985 to estimate cattle and sheep availability.

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Table 27. Wolf depredation on cattle and sheep in northwestern Montana, 1987-1991[a].

	Numbers of Livestock							
	Available[b]		Confirmed Killed		Possible additional killed[c]		Losses/1,000 Available	
Year	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep
1987	75,000	11,000	6	10	0	0	0.08	0.88
1988	75,000	11,000	0	0	0	0	0	0
1989	75,000	11,000	3	0	7	0	0.04	0
1990	75,000	11,000	5	0	0	0	0.07	0
1991	75,000	11,000	2	2	0	2	0.03	0.18
1992	75,000	11,000	1	0	0	0	0.01	0
Mean	75,000	11,000	2.8	2.0	1.2	0.3	0.04	0.18

[a] Data are from S. H. Fritts, unpubl. data. Adapted from Mack et al. 1992b.
[b] Livestock available are based on 1989 Montana agricultural statistics for portions of 9 northwestern Montana counties. A correction factor was used for each county to estimate numbers of livestock available to wolves within possible wolf range. If more livestock were available, the depredation rate would be lower. Numbers rounded to the nearest 1,000.
[c] Suspected wolf involvement, no physical evidence of wolf depredation.

Summary.--A review of several biogeographical areas in North America (Mack et al. 1992b) indicates that wolf predation is highly variable among years and within areas. Overall, the rate of wolf depredation on domestic livestock across large geographical area is very low, averaging usually less than 0.1% of livestock within wolf range....

On average, wolf depredation affects a small number of available livestock and a small percentage of livestock operators, usually less than 1% of the livestock operators in an area each year. In most areas where livestock live with wolves, few operators experience loss of livestock to wolves; the vast majority do not. However, this means that, while on an industry-wide basis the loss of livestock to wolf depredation is very small, a few individual operators may be quite adversely affected in any one year because these few operators may sustain a large portion of the annual loss within a large geographic area....

Projections of depredation rates from after areas should be done with great caution, because terrain, vegetation, weather, size of farms, husbandry practices, and prey populations differ between areas (Fritts et al. 1992). However to provide some estimate of potential impacts of a recovered wolf population on livestock, the following equation was developed to standardize depredation rates from other areas in relation to total livestock in wolf range and wolf numbers:

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$$\frac{\text{Number of livestock in Analysis Area}}{\text{Number of livestock in Other area}} \times \frac{\text{Number wolves in Analysis Area}}{\text{Number wolves in Other area}} \times \text{Average annual depredation rate in other area} = \text{Estimated annual depredations in Analysis Area}$$

Wolf depredation is an important issue for any potential wolf recovery plan and Appendix J was added to address this question in greater detail using the above equation for each of the PWRAs evaluated for this study. Cattle and sheep were the primary animals considered and no attempt was made to calculate impacts to chickens, turkeys, goats, hogs, and domestic/feral horses.

Potential Coyote Control Conflicts.--An issue that will surface with wolf reintroduction is the use of present coyote control methods in areas where wolves are reintroduced. Perhaps the most current approach to this dilemma is being formulated by the BLM in Wyoming. The following is quoted from the recent: USDI, BLM. March 1994. Decision Record and Finding of No Significant Impact for the Environmental Assessment - Predatory Animal Damage Control on Public Lands - Sweetwater, Lincoln, Uinta, and Sublette Counties, Wyoming.

> 6. (p 13) **Threatened/Endangered and Candidate Species** - In compliance with section 7 of the Endangered Species act:
>
> ...Gray Wolf and Grizzly Bear Habitat - Because of the potential for the gray wolf and grizzly bear, a conservative and cautious approach to protect any potential resident or dispersing wolves or grizzlies will be implemented. Control activity in the foothill areas of the Wind River and Wyoming Range Mountains (potential habitat) will implement the following conservation measures: 1) Where wolves and/or grizzlies , or sign of wolves and/or grizzlies are observed, APHIS-ADC will report this information to the U.S. Fish and Wildlife Service within 48 hours. APHIS-ADC will immediately remove neck snares, and traps (larger than 3) in the vicinity of any wolves or grizzly bears or where there is any recent evidence thereof. A meeting will follow between APHIS-ADC and the U.S. Fish and Wildlife Service and WGFD to cooperatively re-evaluate the control activity

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evidence thereof. A meeting will follow between APHIS-ADC and the U.S. Fish and Wildlife Service and WGFD to cooperatively re-evaluate the control activity and identify alternative means to accomplish the identified goals (control of target species) while minimizing the potential for accidental take of nontarget wolves or grizzlies; 2) APHIS-ADC personnel will be trained in the identification of wolves and grizzlies and their sign; 3) Before using gas cartridges, positive identification that the species using the den is not the gray wolf will be made; 4) More use will be made of calling and shooting to ensure species identification; 5) Any snares will be checked will be checked at least daily; and 6) Aerial gunning will be by APHIS-ADC personnel trained in the identification of wolves and grizzly bear.

I have included the EPA labels for the Sodium Nitrate gas cartridge (Figure 24) and M-44 Cyanide capsules (Figure 25) for those who may not be familiar with these devices.

(Label source: USDA, APHIS in cooperation with USDA, FS and USDI, BLM. 1993. Animal Damage Control Program-Supplement to the DEIS, Vol.1).

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PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

WARNING

After ignition, cartridge produces the toxic gas, carbon monoxide. Fumes may be harmful if inhaled.

ENVIRONMENTAL HAZARDS

This product is highly toxic to wildlife. Check all burrows for signs of nontarget species. If present, do not treat burrows.

CHEMICAL HAZARDS

Once ignited by the fuse, this cartridge will burn vigorously until completely spent and is capable of causing severe burns to exposed skin and clothes, and of igniting dry grass, leaves and other combustible materials.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.
Do not use in those areas where the following Endangered Species may be known to have dens: red wolf, gray wolf, and San Joaquin kit fox.

GAS CARTRIDGE FOR COYOTES

For control of coyotes (Canis latrans) in dens only.

NOT FOR SALE TO PERSONS UNDER 16 YEARS OLD

ACTIVE INGREDIENTS:

Sodium Nitrate	65.0%
Charcoal	35.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

WARNING

STATEMENT OF PRACTICAL TREATMENT
CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If inhaled and person has poisoning symptoms (headache, nausea, dizziness, weakness), transfer victim to fresh air. Have victim lie down and keep warm. If respiration is adequate, recovery will be rapid. If breathing has stopped, use artificial respiration. If available, pure oxygen should be given.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-21

Net Weight 240 grams

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in cool, dry place away from fire, heat and direct sunlight.

PESTICIDE DISPOSAL: To dispose of unused cartridges, soak in water, crush and bury at least 6" in loose soil.

CONTAINER DISPOSAL: Place in trash collection

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

For control of coyotes (*Canis latrans*) in dens only on rangelands, and crop and non-crop areas. Do not use near flammable material or inside buildings.

APPLICATION DIRECTIONS

First select den for treatment. Make sure cartridge will pass easily into opening and obtain material to plug the entrance. Then, with a nail at least 1/8" in diameter, puncture cap at end of cartridge at points marked. Insert fuse in one of center holes. Insure there is a minimum of 3 inches of exposed fuse. Hold cartridge away from face and body, then light.

NOTE: The minimum burn time for these fuses is 5 seconds.

Place cartridge, fuse-end first, as far into the entrance as possible. Close entrance to burrow immediately. (If burrow is steep, contents of cartridge may flow out of lighted end. If so, place cartridge as deep in burrow as possible with fuse-end up, light, and close burrow.

6/89

Figure 24. EPA Label for Sodium Nitrate Cartridge.

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PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Sodium Cyanide may be fatal if swallowed or inhaled. Use only with adequate ventilation and do not breathe the gas or dust. When handling, setting out or checking M-44 cyanide capsules, always have at least six pearls of Amyl Nitrite readily available in case sodium cyanide is swallowed or inhaled.

While handling sodium cyanide capsules, protect hands with gloves and shield eyes to prevent eye burns and skin irritation. Wash thoroughly before eating or smoking.

Do not use in areas frequented by humans or domestic dogs.

ENVIRONMENTAL HAZARDS

This pesticide is TOXIC TO WILDLIFE. Keep out of lakes, ponds or streams. Do not contaminate water by cleaning of equipment or disposal of wastes. The M-44 ejector device cannot be used in areas inhabitated by endangered canids and felids.

CHEMICAL HAZARDS

Contact with acid liberates poisonous and flammable hydrogen cyanide gas.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For use in specific situations to reduce canids (coyotes, red fox, gray fox and wild dogs) that depredate livestock and poultry or federally designated threatened or endangered species. For use on pastures, range land and forest land only. Do not place in areas where food crops are planted.

__IMPORTANT__ - Before handling or placing M-44 cyanide capsules or M-44 ejector devices, consult the Use Restriction Bulletin for specific use directions, additional precautions, information on endangered species, warning signs and antidotal measures.

__WARNING SIGNS__
Bilingual (Spanish/English) warning signs must be posted in the general area and at the application site.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification

M-44 CYANIDE CAPSULES

For use in the M-44 ejector device to control coyotes (Canis latrans), red fox (Vulpes vulpes), grey fox (Urocyon cinereoargenteus) and wild dogs that depredate livestock and poultry or federally designated threatened or endangered species.

ACTIVE INGREDIENT:	
Sodium Cyanide	88.62%
INERT INGREDIENTS:	11.38%
TOTAL :	100.00%

50 Capsules Net Weight 45.5 grams

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

IF SWALLOWED OR INHALED - Prompt treatment is of the utmost importance. Carry patient to fresh air, have him lie down. Patient should breathe the contents of an Amyl Nitrite pearl 15-30 seconds each minute if necessary, until five pearls have been used. Use artificial respiration if breathing has stopped. Remove contaminated clothing, but keep patient warm. CALL A PHYSICIAN IMMEDIATELY.

IF ON SKIN - Immediately flush with plenty of water.

IF IN EYES - Immediately flush with plenty of water and call a physician.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-15

STORAGE AND DISPOSAL

STORAGE: Store M-44 Cyanide capsules under lock and key in a dry place away from food, domestic animals and acids. Do not contaminate feed or food stuffs.

DISPOSAL: Dispose of defective and used M-44 capsules by burial in a safe location in the field or at a proper land fill site.

Figure 25. EPA Label for M-44 Cyanide Capsules.

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ENVIRONMENTAL PROTECTION AGENCY

M-44 CYANIDE CAPSULE
M-44 USE RESTRICTIONS
[EPA Registration No. 56228-15]
July 15, 1993

1. Use of the M-44 device shall conform to all applicable Federal, State, and local laws and regulations.

2. Applicators shall be subject to such other regulations and restrictions as may be prescribed from time-to-time by the U..S. Environmental Protection Agency (EPA).

3. Each applicator of the M-44 device shall be trained in: (1) safe handling of the capsules and device. (2) proper use of the antidote kit, (3) proper placement of the device, and (4) necessary recordkeeping.

4. M-44 devices and sodium cyanide capsules shall not be sold or transferred, or entrusted to the care of any person not supervised or monitored by the Animal and Plant Health Inspection Service (APHIS). Animal Damage Control (ADC) program or any agency not working under an APHIS-ADC cooperative agreement.

5. The M-44 device shall only be used to take wild canids suspected of preying on: (1) livestock or poultry; (2) Federally designated threatened or endangered species, or; (3) that are vectors of a communicable disease.

6. The M-44 device shall not be used solely to take animals for the value of their fur.

7. The M-44 device shall only be used on or within 7 miles of a ranch unit or allotment where losses due to predation by wild canids are occurring or where losses can be reasonably expected to occur based upon recurrent prior experience of predation on the ranch unit or allotment. Full documentation of livestock depredation, including evidence that such losses were caused by wild canids, will be required before applications of the M-44 is undertaken. This use restriction is not applicable when wild canids are controlled to protect Federally designated threatened or endangered species or are vectors of a communicable disease.

8. The M-44 device shall not be used: (1) In areas within national forests or other Federal lands set aside for recreational use, (2) areas where exposure to the public and family and pets is probable, (3) in prairie dog towns, or, (4) except for the protection of federally designated threatened or endangered species, in National and State Parks; National or State Monuments; federally designated wilderness areas; and wildlife refuge areas.

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9. The M-44 device shall not be used in areas where federally listed threatened or endangered animal species might be adversely affected. Each applicator shall be issued a map, prepared by or in consultation with the U.S. Fish and Wildlife Service, which clearly indicates such areas.

10. One person other than the individual applicator shall have knowledge of the exact placement location of all M-44 devices in the field.

11. In areas where more than one governmental agency is authorized to place M-44 devices, the agencies shall exchange placement information and other relevant facts to ensure that the maximum number of M-44s allowed is not exceeded.

12. The M-44 device shall not be placed within 200 feet of any lake, stream, or other body of water, provided that natural depression areas which catch and hold rainfall only for short periods of time shall not be considered "bodies of water" for purposes of this restriction.

13. The M-44 device shall not be placed in areas where food crops are planted.

14. The M-44 device shall be placed at least at a 50-foot distance or at such a greater distance from any public road or pathway as may be necessary to remove it from the sight of persons and domestic animals using any such public road or pathway.

15. The maximum density of M-44s placed in any 100-acre pastureland area shall not exceed 10; and the density in any 1 square mile of open range shall not exceed 12.

16. No M-44 device shall be placed within 30 feet of a livestock carcass used as a draw station. No more than four M-44 devices shall be placed per draw station and no more than five draw stations shall be operated per square mile.

17. Supervisors of applicators shall check the records, warning signs, and M-44 devices of each applicator at least once a year to verify that all applicable laws, regulations, and restrictions are being strictly followed.

18. Each M-44 device shall be inspected by the applicator at least once every week, weather permitting access, to check for interference or unusual conditions and shall be serviced as required.

19. Damaged or nonfunctional M-44 devices shall be removed from the field.

20. An M-44 device shall be removed from an area if, after 30 days, there is no sign that a target predator has visited the site.

21. All persons authorized to possess and use sodium cyanide capsules and M-44 devices shall store such capsules and devices under lock and key.

22. Used sodium cyanide capsules shall be disposed of by deep burial or at a proper landfill site. Incineration may be used instead of burial for disposal. Place the capsules in an incinerator or refuse hole and burn until the capsules are completely consumed. Capsules may be incinerated using either wood or diesel fuel.

23. Bilingual warning signs in English and Spanish shall be used in all areas containing M-44 devices. All such signs shall be removed when M-44 devices are removed.

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a. Main entrances or commonly used access points to areas in which M-44 devices are set shall be posted with warning signs to alert the public to the toxic nature of the cyanide and to the danger to pets. Signs shall be inspected weekly to ensure their continued presence and ensure that they are conspicuous and legible.

b. An elevated sign shall be placed within 25 feet of each individual M-44 device warning persons not to handle the device.

24. Each authorized or licensed applicator shall carry an antidote kit on his person when placing and/or inspecting M-44 devices. The kit shall contain at least six pearls of amyl nitrite and instructions on their use. Each authorized or licensed applicator shall also carry on his person instructions for obtaining medical assistance in the event of accidental exposure to sodium cyanide.

25. In all areas where the use of the M-44 device is anticipated, local medical people shall be notified of the intended use. This notification any be through a poison control center, local medical society, the public health service or directly to a doctor or hospital. They shall be advised of the antidotal and first-aid measures required for treatment of cyanide poisoning. It shall be the responsibility of the supervisor to perform this function.

26. Each authorized M-44 applicator shall keep records dealing with the placement of the device and the results of each placement. Such records shall include, but need not be limited to:

a. The number of devices placed.
b. The location of each device placed.
c. The date of each placement, as well as the date of each inspection.
d. The number and location of devices which have been discharged and the apparent reason for each discharge.
e. Each species of animals taken.
f. All accidents or injuries to humans or domestic animals.

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Hyattsville, MD 20782
July 15, 1993

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Dispersal into Areas not Deemed Suitable for Wolf Recovery.--Based on the recent observations in Montana of wolves using the major river drainages for movement, a map of likely dispersion routes that would be utilized by wolves is shown in Figure 26. As far as can be determined, the greatest potential for wolf/human conflict would be for wolves that disperse along the major river basins that flow easterly from the Continental Divide (i.e. Arkansas River, South Platte, etc.), placing the wolf in direct contact with the densely populated counties of the Front Range corridor. On the other hand, it is not known if wolves would elect to disperse in this direction because of the large human population.

A potential problem may arise with the fall movement of deer and elk to their winter ranges. This movement is an elevational migration that usually begins in October and in most cases would bring the wolves into a greater proximity with humans and private land. A good example of this dilemma is in Rocky Mountain National Park (RMNP) is shown in Figure 27. As shown by the map, the summer distribution of the resident RMNP elk herds would probably not conflict with human activities. However, the winter ranges of the resident elk herds is mostly outside of park boundaries, or in the case of the Estes Valley elk herd, is extremely close to the town of Estes Park. It would be purely conjectural, at this point in time, to guess how wolves would react to this scenario. Considering the unknown variables in this situation, a cautious approach seems appropriate in this particular situation.

Based on historical accounts, it seems more likely that wolves would disperse to the west (Utah) and south (New Mexico) using the cover of forested areas and sparsely populated badland-type

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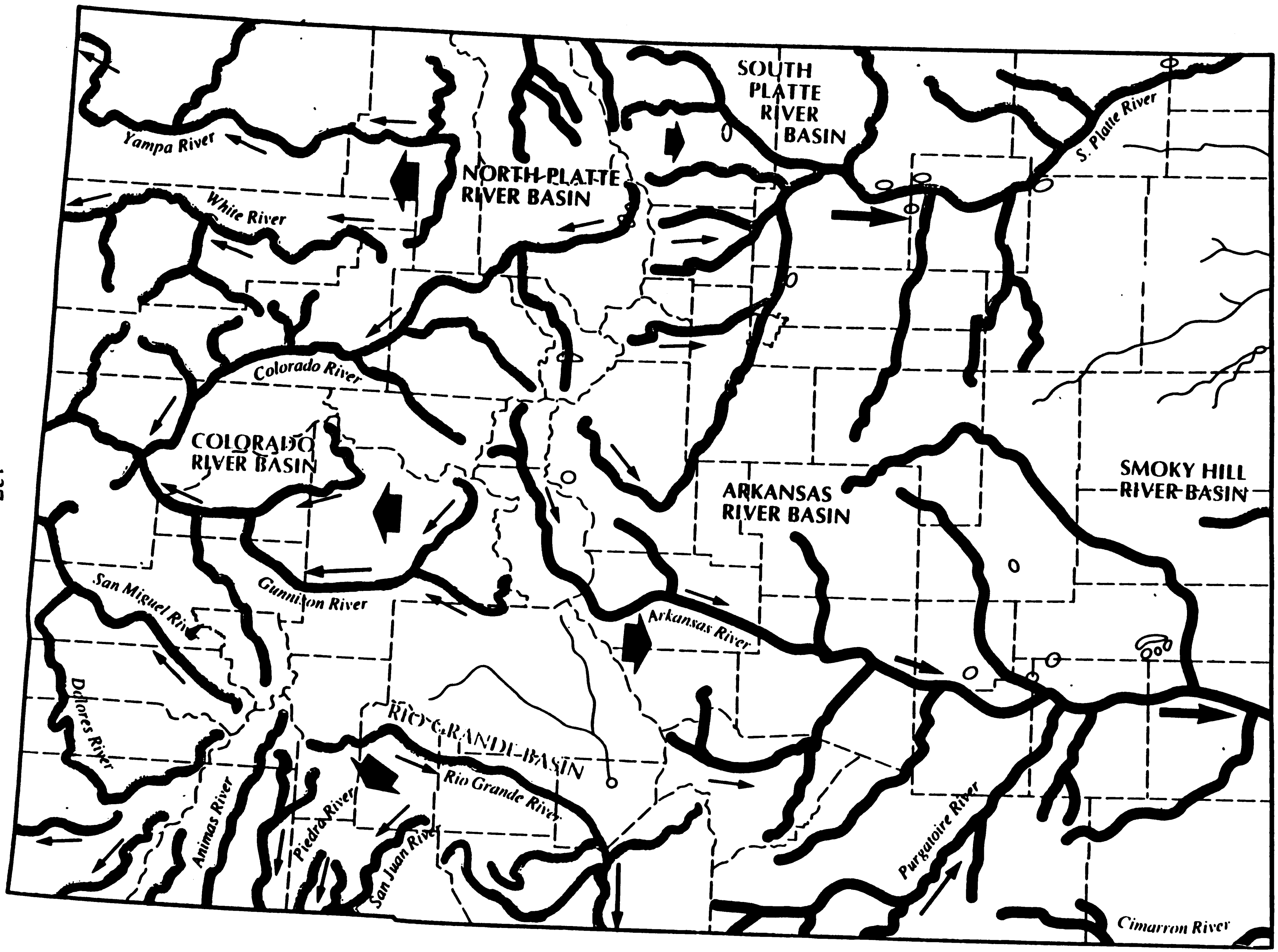

...re 26. Probable Dispersion Routes Utilized by Wolves in Colorad...

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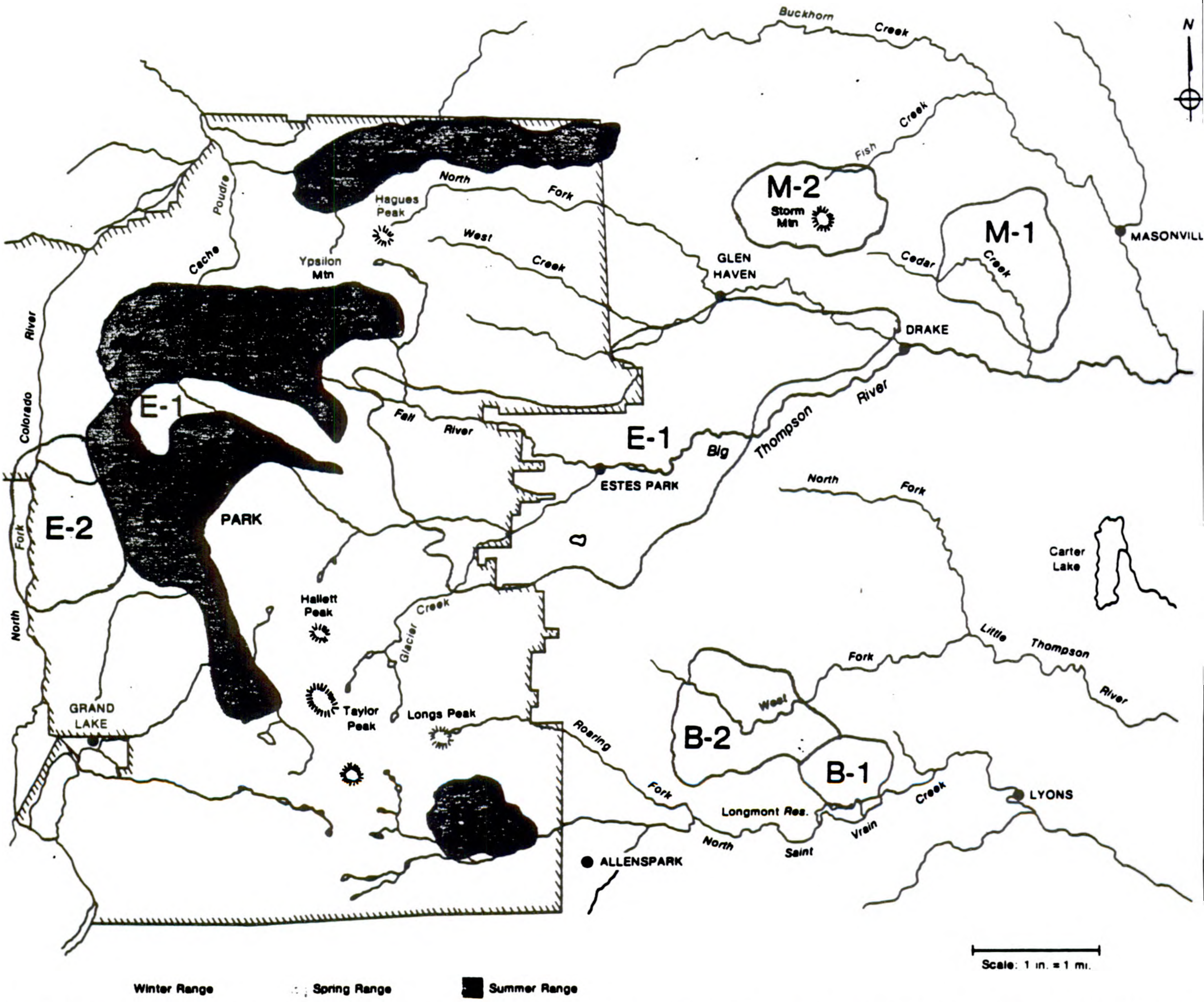

Fig. 8. Seasonal distribution of radio-collared elk. E-1, E-2, and E-3 are winter, spring, and summer ranges of the Estes Valley elk. M-1, M-2, and M-3 are winter, spring, and summer ranges of the Greenridge elk. B-1, B-2, and B-3 are winter, intermediate, and summer ranges of the Longmont Reservoir elk.

Source: Bear, G.D. 1989. Seasonal Distribution and Population Characteristics of Elk in Estes Valley, Colorado. Terrestrial Wildlife Research Special Report No. 65. Colorado Division of Wildlife.

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country. Dispersal to the south into New Mexico would not involve crossing much private land as the NFs in Colorado are more or less continuous from the Wyoming border to the New Mexico border. Dispersal to the west into Utah or northwest into Wyoming would involve crossing checkerboard (public/private) land with the predominant acreage being administered by the Bureau of Land Management (BLM). Figure 28 shows the distribution of public land administered by the BLM in Colorado, New Mexico, Utah, and Wyoming. Table 28 shows county land area and human density of the adjoining counties of the 3 neighboring states. Table 29 show the key habitat areas and their acreage in these areas by BLM District in Colorado and the adjoining states of New Mexico, Utah, and Wyoming. Major big game species are listed with the corresponding habitat areas. Table 30 shows the designated BLM Wilderness Areas in Colorado.

Contemporary wolf recovery plans focus on forested ecosystems, but if wolf reintroduction is undertaken on a regional scale, these public lands should be included in the recovery plan for evaluation because of their strategic location and large acreage. These BLM lands, in conjunction with NF lands provide an almost unbroken corridor from Montana to Mexico. Historically, the wolf was common in these areas (Appx. B).

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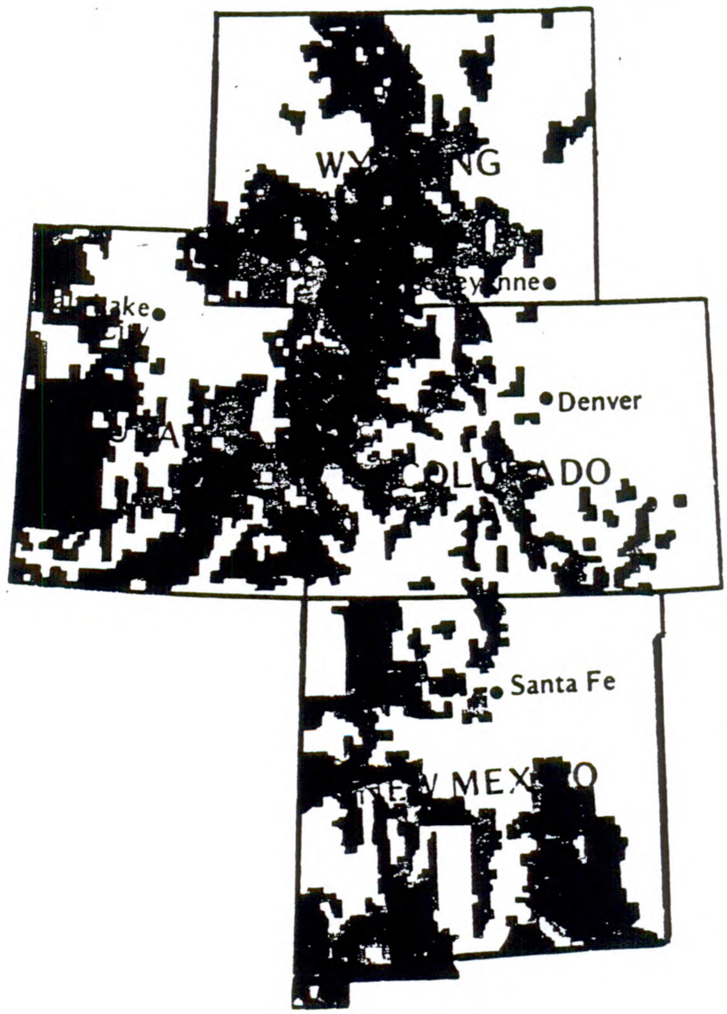

Figure 28. Location Map of Public Lands in Colorado, New Mexico, Utah, and Wyoming Administered by the Bureau of Land Management (Source: USDI, BLM. 1991. Final Environmental Impact Statement - Vegetation Treatment on BLM Lands in Thirteen Western States).

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Table 28. County Land Area and Human Density in Counties Adjoining the Primary Analysis Area.

State	County	Land Area (mi^2)	Population	Persons/mi^2
WYOMING				
	Unita	2,081.8	18,705	9.0
	Evanston city		10,903	
	Adjusted rural population		7,802	3.7
	Sweetwater	10,425.9	38,823	3.7
	Rock Springs city		10,050	
	Green River city		12,711	
	Adjusted rural population		16,062	1.5
	Carbon	7,896.6	16,659	2.1
	Rawlins city		11,547	
	Adjusted rural population		5,112	0.6
	Albany	4,273.8	30,797	7.2
	Laramie city		26,687	
	Adjusted rural population		4,110	1.0
	Total land area of adjoining Wyoming counties = 24,678.1 mi^2			
UTAH				
	Dagget	698.4	690	1.0
	Unitah	4,477.3	22,211	5.0
	Grand	3,681.8	6,620	1.8
	San Juan	7,820.7	12,621	1.6
	Total land area of adjoining Utah counties = $16,678.2^2$			
NEW MEXICO				
	Rio Arriba	5,858.1	34,365	5.9
	San Juan	5,414.4	91,605	16.6
	Farmington city		33,997	
	Adjusted rural population		57,608	10.6
	Taos	2,203.3	23,118	10.5
	Colfax	3,756.9	12,925	3.4
	Total land area of adjoining New Mexico counties = 17,232.7 mi^2			

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Table 29. Key Habitat Areas and Major Big Game Species by BLM District in Colorado, New Mexico, Utah, and Wyoming (Source: USDI. BLM. 1993. Fish and Wildlife 2000 - Big Game Habitat Management).

Colorado

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
MONTROSE DISTRICT		
Gunnison Basin	Mule Deer, R.Mtn.Elk	148
Uncompahgre Plateau E	Mule Deer, R.Mtn.Elk, Pronghorn	185
South East Montrose	Mule Deer, R.Mtn.Elk	30
Gunnison Gorge	Mule Deer, R.Mtn.Elk	130
North Fork	Mule Deer, R.Mtn.Elk	50
Uncompahgre Plateau W	Mule Deer, R.Mtn.Elk	140
Naturita Ridge	Mule Deer, R.Mtn.Elk	30
Paradox Valley	Mule Deer, R.Mtn.Elk	60
Upper San Miguel/Pl.	Mule Deer, R.Mtn.Elk	25
Pagosa South	R.Mtn.Elk, Mule Deer	25
Durango/Animas V.	R.Mtn.Elk, Mule Deer	50
Dry Creek Basin	R.Mtn.Elk, Mule Deer	150
Disappointment Valley	Mule Deer, R.Mtn.Elk, Pronghorn	200
Monograma Mesa	R.Mtn.Elk, Mule Deer, Pronghorn	125
W. Cortez/Hovenweep	Mule Deer, R.Mtn.Elk	150
Mesa Verde/Mancos	Mule Deer, R.Mtn.Elk	50
GRAND JUNCTION DISTRICT		
Roan Creek	Mule Deer, R.Mtn.Elk	259
Kannah Creek	R.Mtn.Elk, Mule Deer, Pronghorn	62
Grand Valley	Pronghorn	147
Book Cliffs	Mule Deer, R.Mtn.Elk, Black Bear	274
Collbran	R.Mtn.Elk, Mule Deer	81
Ute/Mesa Creek	Mule Deer, R.Mtn.Elk	68
Unaweep	Mule Deer, R.Mtn.Elk	30
Dolores West	Mule Deer, R.Mtn.Elk	33
Bangs-Dominques	Mule Deer, R.Mtn.Elk	132
Glade Park	Mule Deer, R.Mtn.Elk	78
NOSR	Mule Deer, R.Mtn.Elk	79
Battle Mesa	Mule Deer, R.Mtn.Elk	76
Piceance/Hogback	Mule Deer, R.Mtn.Elk	92

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Table 29. (Cont.)

Colorado (continued)

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
GRAND JUNCTION DISTRICT *(continued)*		
Storm King-King Mtn.	Mule Deer, R.Mtn.Elk	80
Castle Peak	Mule Deer, R.Mtn.Elk	118
Roaring Fork	Mule Deer, R.Mtn.Elk, Black Bear	57
Hardscrabble	Mule Deer, R.Mtn.Elk, Black Bear	62
CRAIG DISTRICT		
Red Wash/Wolf Creek	Pronghorn, R.Mtn.Elk	60
Oak Ridge	R.Mtn.Elk, Mule Deer	3
Blue Mountain	R.Mtn.Elk, Mule Deer	104
L. Wolf/Crooked Wash	R.Mtn.Elk, Pronghorn, Mule Deer	74
Danforth Hills	R.Mtn.Elk, Mule Deer	38
E. Douglas/Cathedral	R.Mtn.Elk, Mule Deer	75
South Piceance	R.Mtn.Elk, Mule Deer	110
Piceance Triangle	R.Mtn.Elk, Mule Deer	81
Piceance Basin	Mule Deer, R.Mtn.Elk	431
Crooked Wash	Mule Deer, R.Mtn.Elk, Pronghorn	53
White River Dome	Mule Deer, R.Mtn.Elk	45
S. Rim Blue Mountain	Mule Deer, R.Mtn.Elk	50
Spring Creek	Mule Deer, R.Mtn.Elk	51
Scullion/Coal Reef	Mule Deer, R.Mtn.Elk	43
Blue Mountain Ridge	Mule Deer, R.Mtn.Elk	60
Douglas Pass/E. Doug	Mule Deer, R.Mtn.Elk	65
Douglas Basin	Mule Deer, R.Mtn.Elk	176
Cathedral/Big Ridge B	Mule Deer, R.Mtn.Elk	21
Cedar Sp. Draw/Peck M.	R.Mtn.Elk, Mule Deer, Pronghorn	60
Godiva Rim/Bald Mtn.	R.Mtn.Elk	51
L.S. River Corridor	Pronghorn, Mule Deer	42
Fourmile Creek	Pronghorn, Mule Deer	12
Axial Basin	Mule Deer, R.Mtn.Elk	50
Brown's Park	Mule Deer	19

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Table 29. (Cont.)

Colorado (continued)

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
CRAIG DISTRICT *(continued)*		
Sandwich Basin	Pronghorn	158
Cold Spring Mtn.	Mule Deer, R.Mtn.Elk	100
Douglas Mountain	R.Mtn.Elk	80
Laramie River	Mule Deer, R.Mtn.Elk, Pronghorn	27
Middle Park	Mule Deer, R.Mtn.Elk, Pronghorn	42
North Park	Pronghorn, R.Mtn.Elk, Mule Deer	47
CANON CITY DISTRICT		
Reinecker Ridge	R.Mtn.Elk, Mule Deer	13
Mtn. Meastas	R.Mtn.Elk, Black Bear, Mule Deer	12
Black Mountain	Mule Deer	19
Queens Reservoir	Mule Deer, Wt-Tailed Deer	5
Shavano/Pass Creek	R.Mtn.Elk, Mule Deer	11
Granite	R.Mtn.Elk, Mule Deer	9
Trickle Mountain	R.Mtn.Elk, Pronghorn, Mule Deer	20
Los Mogotes	Mule Deer, R.Mtn.Elk, Pronghorn	33
	Total	5,626

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Table 29. (Cont.)

New Mexico

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
ROSWELL DISTRICT		
E. Guadalupe Escarpment	Mule Deer, Barbary Sheep, Pronghorn	160
Querecho Pl./Caprock	Pronghorn, Mule Deer	70
Penasco R./Elk Canyon	Mule Deer, Pronghorn, Barbary Sheep	35
Gypsum Hills-XT Draw	Mule Deer, Barbary Sheep	180
Pecos R./Burton Flat	Mule Deer	20
ALBUQUERQUE DISTRICT		
San Antonio/Pot Mtn.	Mule Deer, R.Mtn.Elk, Pronghorn	96
Copper Hill Ridge	Mule Deer, R.Mtn.Elk	16
Chama/Cebolla	R.Mtn.Elk, Mule Deer	72
Sabinosa	Mule Deer, R.Mtn.Elk, Barbary Sheep	32
Arroyo Co./Cerro Verde	Pronghorn	124
Cebollita Canyon	Mule Deer, R.Mtn.Elk	7
Elk Springs ACEC	Mule Deer, R.Mtn.Elk	10
Ignacio Chavey Grant	Mule Deer, R.Mtn.Elk	11
Rosa/Carracas Mesa	Mule Deer, R.Mtn.Elk	30
LAS CRUCES DISTRICT		
Hatchet/Alamo Heuco	Mule Deer, Javelina	184
Florida Mountains	Iranian Ibex, Mule Deer	62
Gila Lower Box	Javelina, Mule Deer	3
Organ Mountains	Mule Deer	68
Cedar Mountains	Mule Deer, Pronghorn, Javelina	187
Columbus	Pronghorn	67
Las Uvas Mountains	Mule Deer	84
Nutt	Pronghorn, Mule Deer	228
Robedo Mountains	Mule Deer, Pronghorn	149
West Potrillos Mtn.	Mule Deer	109
Peloncillo Mtn.	Mule Deer, Wt-Tailed Deer, Javelina	170
San Simon Cienega	Javelina, Mule Deer	1

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Table 29. (Cont.)

New Mexico (continued)

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
LAS CRUCES DISTRICT *(continued)*		
Nogal	Pronghorn, Mule Deer	134
Chupadera	Mule Deer, R.Mtn.Elk, Pronghorn	121
Jornado North	Pronghorn, Mule Deer	167
Boxquecito	Mule Deer	141
Magdalena	Mule Deer, Pronghorn	16
San Augustine	Mule Deer, Pronghorn, R.Mtn.Elk	128
Fence Lake	Mule Deer, Pronghorn	66
Quemado	Mule Deer, Pronghorn	324
Horse Mountain	Mule Deer, R.Mtn.Elk	6
Ladrones Mountain	Mule Deer	142
Pelona Mountain	Mule Deer, R.Mtn.Elk, Pronghorn	92
Bent/Sacramento Mtn.	R.Mtn.Elk, Mule Deer	7
Otero Mesa	Pronghorn	400
Cornucopia Hills	Mule Deer	192
Brokeoff Mountains	Mule Deer	60
North McGregor Range	Mule Deer	50
Jornada del Muerto	Pronghorn	418
San Andres Mountains	Mule Deer	24
Caballo Mountains	Mule Deer	100
Rio Grande Bajada	Pronghorn	35
	Total	4,798

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Table 29. (Cont.)

Utah

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
CEDAR CITY DISTRICT		
Parowan Front	Mule Deer, R.Mtn.Elk	28
Bumblebee	Mule Deer	7
New Castle	Mule Deer	15
Sevier	Mule Deer, R.Mtn.Elk	18
Beaver Front	Mule Deer, R.Mtn.Elk	29
New Harmony	Mule Deer, R.Mtn.Elk	4
Minerals	Mule Deer	7
Fremont	R.Mtn.Elk, Mule Deer	4
Woolsey	Mule Deer	6
Indian Peak/Pine V.	R.Mtn.Elk, Mule Deer, Pronghorn	200
Herd Unit #58	Mule Deer	69
Herd Unit #61-A	Mule Deer	23
Herd Unit #61-B	Mule Deer	110
Herd Unit #61-C	Mule Deer	194
Herd Unit #19	Mule Deer	30
Antimosy	Mule Deer, R.Mtn.Elk, Pronghorn	46
Buckskin	Mule Deer	11
Zion Park-Sandhills	Mule Deer	48
Panguitch #1	Mule Deer, Pronghorn	8
Panguitch #2	R.Mtn.Elk, Mule Deer, Pronghorn	2
East Clark Bench	Pronghorn	32
Panguitch Valley	Pronghorn, Mule Deer, R.Mtn.Elk	44
Panguitch SW	R.Mtn.Elk, Mule Deer, Pronghorn	6
Sheep Ck.-Willis Ck.	R.Mtn.Elk	2
SALT LAKE DISTRICT		
Crawford Mountains	Mule Deer, Pronghorn, R.Mtn.Elk	24
Aspen Springs	Moose, Mule Deer	30
Dog Hollow	Mule Deer, Pronghorn, R.Mtn.Elk	3
Pilot Mtn.- Patt.	R.Mtn.Elk	4
Raft River-Bovine	Mule Deer	21

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Table 29. (Cont.)

Utah (continued)

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
SALT LAKE DISTRICT *(continued)*		
Puddle Valley	Pronghorn	205
Rush Valley	Pronghorn	140
Stansbury/Onaqui Mt.	Mule Deer, Pronghorn	125
Deep Creek Mtn.	Mule Deer, Pronghorn	77
Cedar Mountain	Mule Deer, Pronghorn	370
Oquirrh Mountain	Mule Deer, R.Mtn.Elk	45
Simpson/Sheeprock M.	Mule Deer, Pronghorn	121
Tintic Mountains	Mule Deer	33
Gold Hill	Pronghorn, Mule Deer	220
MOAB DISTRICT		
Cisco Desert	Pronghorn, Mule Deer	250
Potash-Confluence	Mule Deer, R.Mtn.Elk	500
Hatch Point	Pronghorn, Mule Deer	150
Dolores	Mule Deer, R.Mtn.Elk	100
La Sal Mountains	Mule Deer, R.Mtn.Elk	100
San Rafael Desert	Pronghorn	538
Icelander	Mule Deer, R.Mtn.Elk	43
Manti Foothills	Mule Deer, R.Mtn.Elk	120
Price Canyon	Mule Deer, R.Mtn.Elk, Moose	46
West Tavaputs	Mule Deer, R.Mtn.Elk, Moose	140
Gordon Creek	Mule Deer, R.Mtn.Elk, Moose	392
Cedar Mountain	R.Mtn.Elk, Mule Deer	46
Grassy Trail	Pronghorn	551
Hatch Point	Mule Deer, Pronghorn	150
Beef Basin	Mule Deer	175
Montezuma Creek	Mule Deer	161
RICHFIELD DISTRICT		
Parker Mountains	Pronghorn, Mule Deer, R.Mtn.Elk	214
Henry Mountains	Bison, Mule Deer, Pronghorn	300
Little Rocks/D.Dev.	Mule Deer, Pronghorn	363

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Table 29. (Cont.)

Utah (continued)

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
RICHFIELD DISTRICT *(continued)*		
Antelope V. Mtn. Home	Pronghorn, Mule Deer, R.Mtn.Elk	113
Conger	Pronghorn, Mule Deer	159
WahWah-Tule	Pronghorn, Mule Deer, R.Mtn.Elk	220
Cricket	Pronghorn, Mule Deer	126
Amasa	Mule Deer	20
Fountain Green	Mule Deer	7
South Sanpitch	Mule Deer	58
Mayfield/Salina FR.	Mule Deer, R.Mtn.Elk	24
Gypsum Sanfledge	Mule Deer, R.Mtn.Elk, Pronghorn	27
Plateau/Bear V/N. C.	Mule Deer, R.Mtn.Elk	11
Fishlake/Cedar Cove	Mule Deer, R.Mtn.Elk, Pronghorn	33
Grass Valley	Mule Deer, R.Mtn.Elk, Pronghorn	67
Kingston Canyon	Mule Deer, R.Mtn.Elk	32
Durkee Spgs./Elkow R.	R.Mtn.Elk	22
Deer Peak	Mule Deer, R.Mtn.Elk	42
Maysvale/Circleville F.	Mule Deer	27
Glenwood/Monroe/ Elkrow	Mule Deer	67
Sheeprocks #13	Mule Deer	119
Tintic Mountains #14	Mule Deer	188
S. Nebo Mountains #42	Mule Deer	23
N. Oaks Creek Mtn. #53	Mule Deer	5
Valley Mtns. #54	Mule Deer	4
Swasey Mtns. #62B	Mule Deer	143
Deep CK/Fish Sprg. #62A	Mule Deer	112
Nebo Elk #11	R.Mtn.Elk	10
VERNAL DISTRICT		
Brown's Park	Mule Deer, R.Mtn.Elk	102
Book Cliff's Cons. Area	Mule Deer, R.Mtn.Elk, Black Bear	319
	Total	8,780

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Table 29. (Cont.)

Wyoming

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
WORLAND DISTRICT		
Absaroka Front	R.Mtn.Elk	214
Bighorn R./GreyBull R.	Mule Deer, Wt-Tailed Deer	8
Basin Floor	Pronghorn, Mule Deer	900
West Slope	R.Mtn.Elk, Mule Deer, Pronghorn	530
Nowater	Pronghorn, Mule Deer	383
Big Horn River	Mule Deer, Wt-Tailed Deer	2
Sand Creek	Pronghorn, Mule Deer	122
W. Bighorn Mtns.	R.Mtn.Elk, Mule Deer	161
Carter Mt.-Absaroka	R.Mtn.Elk, Mule Deer	141
RAWLINS DISTRICT		
Red Desert	Pronghorn, R.Mtn.Elk	164
Ferris/Seminoe	R.Mtn.Elk, Mule Deer, Pronghorn	106
Shirley Mountains	R.Mtn.Elk, Mule Deer, Pronghorn	180
Sage Creek Basin	Pronghorn, Mule Deer	10
South Desert	Pronghorn, Mule Deer	100
Saratoga Valley	R.Mtn.Elk, Mule Deer, Pronghorn	141
Laramie Peak	R.Mtn.Elk, Mule Deer, Pronghorn	58
Jelm Mountain	Mule Deer, Pronghorn, R.Mtn.Elk	20
Lander RA #1	Pronghorn	420
Lander RA #2	Mule Deer	210
Lander RA #3	R.Mtn.Elk, Black Bear	105
Lander RA #4	Moose	28
ROCK SPRINGS DISTRICT		
Prospect Mountains	R.Mtn.Elk, Pronghorn, Mule Deer	355
Hickey Mtn./Ceder MT	R.Mtn.Elk, Mule Deer, Pronghorn	93
West Red Desert	Pronghorn	591
Tri-State	R.Mtn.Elk, Mule Deer, Pronghorn	282
Winter Range	Mule Deer, Pronghorn, R.Mtn.Elk	300
Big Piney-LaBarge	Mule Deer, Pronghorn, R.Mtn.Elk	175
Mesa	Mule Deer, Pronghorn	50

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Table 29. (Cont.)

Wyoming (continued)

Key Habitat Areas by District	Major Big Game Species	Public Land Acreage (000)
ROCK SPRINGS DISTRICT *(continued)*		
Bench Corral	R.Mtn.Elk, Pronghorn, Mule Deer	50
Deadline-Graphite	R.Mtn.Elk, Pronghorn, Mule Deer	17
Miller Mountain	R.Mtn.Elk, Mule Deer, Pronghorn	20
CASPER DISTRICT		
Buffalo Ck.-Badwater	R.Mtn.Elk, Mule Deer, Pronghorn	220
South Bighorns	R.Mtn.Elk, Mule Deer, Pronghorn	140
Powder River Breaks	R.Mtn.Elk, Mule Deer, Pronghorn	600
New Castle	Pronghorn, Mule Deer	291
	Total	7,187

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Table 30. BLM Wildlands in Western Colorado.

Name	Location	Elevation Range	Vegetation Ecosystem	Roadless Acreage
Black Mountain and Windy Gulch	12 miles west of Meeker	6,100-7,205 ft.	Sagebrush; pinion-juniper Douglas-fir	22,206
Bull Canyon, Willow Creek and Skull Creek	One mile north of the town of Dinosaur	5,600-8,200 ft.	Pinion-juniper forest; sagebrush	44,800
Cold Springs Mt.	Immediately north of Brown's Park	5,800-8,600 ft.	Pinion-juniper; sagebrush meadows and aspen; Douglas-fir	50,872
Cross Mountain	45 miles west of Craig	5,600-8,800 ft.	Sagebrush; pinion-juniper	16,760
Diamond Breaks	On Colo-Utah state line adjacent to Dinosaur National Monument	5,400-8,700 ft.	Pinion-juniper; mountain-mahogany-oakbrush	41,040
Dinosaur Natl. Monument adjacent area	North boundary of Dinosaur Natl. Monument, 25 miles northwest of the town of Dinosaur	5,800-8000 ft.	Ponerosa pine; pinion-juniper; sagebrush	31,340
Oil Spring Mt.	25 miles south of Rangely	6,000-8,550 ft.	Sagebrush; pinion-juniper Douglas-fir; mountain-mahogany-oakbrush	17,740
Pinion Ridge	30 miles nw of Meeker	5,600-7,400 ft.	Pinion-juniper; sagebrush	20,100
Vermillion Basin	80 miles west of Craig	5,700-8,120 ft.	Pinion-juniper forest; saltbush desert	88,340
Yampa River	15 miles sw of Craig	6,200-7,000 ft.	Pinion-juniper; cottonwood riparian zone	15,960
			Total acreage	349,158
			(miles^2)	[illegible]

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Developmental and Recreation Issues.--Anyone familiar with Colorado can attest to the fact that the state is an outdoor wonderland and anything written about it appears like a tourist promotion. The down side to Colorado's popularity as a recreation ground is the severe stress these activities place on all wildlife, including future (?) wolves.

In a recent publication, (USDI, BLM. 1993. Fish and Wildlife 2000 Big Game Habitat Management), each BLM field office was questioned as to 3 significant factors impacting future management of big game habitat. The response to this questionnaire is shown in Table 29. In almost every case the response involved recreation demands.

In 1992, the total recreation use on National Forest System lands in Colorado was 29 053 000 recreation visitor-days. Only California is ranked ahead of Colorado. A breakdown of these activities are (Report of the Forest Service 1992):

Camping, picnicking & swimming:	6 179 600 RVDs
Mechanized travel & viewing scenery:	8 598 100
Hiking, horseback riding and water travel:	2 404 004
Winter sports:	6 632 000
Resorts, cabins & organization camps:	744 008
Hunting:	1 791 900
Fishing:	1 648 200
Non-consumptive fish and wildlife use:	138 200
Other recreational activities:	915 800

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Table 31. Summary of Significant Factors Affecting Future Management of Big Game Habitat and Number of BLM Field Offices Identifying Factors.

Big Game Species	Number of Field Offices Managing Habitat for Species	Significant Factors Affecting Futurs Habitat Management	Percentage of Field Offices Identifying Each Factor
Black Bear	58	Recreation Demands Vegetation Harvesting Road Density	100 78 62
Black-Tailed Deer	19	Veg. Monoculture Urbanization Road Density	100 100 76
Grizzly Bear	13	Road Density Recreation Demands Mineral Development	100 91 73
Javelina	9	Water Availibility Wild Burros	100 87
Moose	23	Recreation Demands Mineral Development Road Density	86 86 81
Mule Deer	109	Road Density Recreation Demands Vegetation Harvesting	83 82 67
Pronghorn	93	Recreation Demands Vegetation Harvesting Water Availibility	80 70 69
Rocky Mountain Elk	80	Recreation Demands Road Density Vegetation Harvesting	100 93 80
White-Tailed Deer	32	Recreation Demands Vegetation Harvesting Urbanization	97 83 63

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In 1992, the estimated recreation visitation to public lands administered by the BLM in Colorado was (USDI,BLM. 1992. Public Land Statistics):

Number of visits:	3 860 000 visitor hours
Off-highway vehicle travel:	1 436 000
Other motorized travel:	6 311 000
Non-motorized travel:	945 000
Camping:	5 902 000
Hunting:	5 058 000
Misc. site based:	1 627 000
Fishing:	761 000
Boating:	1 774 000
Misc water based:	65 000
Winter sports:	218 000
Snowmobiling:	126 000

In conclusion, the results of this study indicate there are suitable areas with adequate primary prey populations in Colorado capable of supporting gray wolves. The recommendations I would offer for any future "specific" wolf recovery plan for Colorado are as follows:

RECOMMENDATIONS

(1) The 7 contiguous NFs and included areas evaluated in this study should be considered as one unit for any future wolf recovery plan. The exceptions would be those areas of the Arapaho-Roosevelt and possibly the Pike-San Isabel NFs that are located east of the Continental Divide and possibly other areas that may be identified pending a more in-depth analysis than provided by this study. It seems appropriate that this regional complex could be identified as the "Southern Rocky Mountain Potential Wolf Recovery Area".

(2) Potential transboundary movements and wolf dispersal suggests that any wolf recovery plan for Colorado include adjacent areas of New Mexico, Utah, and Wyoming. This approach would require the effort and cooperation of the several states and their agencies, Federal agencies, Tribal and local governments. The large acreage and strategic location of BLM administered lands would require a substantial input from their agency. It seems plausible that a cooperative interstate effort would enhance any future regional wolf recovery plan.

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(3) I would suggest that any future wolf reintroduction efforts in Colorado consider linking of the Southern Rockies Potential Wolf Recovery Area to existing proposed experimental population areas in New Mexico and Wyoming. In the case of Wyoming, the existing proposed experimental population area includes the entire state (USFWS 1993). The northern boundary of the proposed experimental wolf (Mexican Wolf) population area in New Mexico and Arizona is roughly on a line from Flagstaff, extending eastward through Albuquerque to the New Mexico/Texas line (Parsons 1993). The creation of a corridor in northwestern New Mexico would effectively link the three areas into one experimental area.

(4) Because of the great recreational demands placed on Colorado's back country, an in-depth investigation seems warranted to determine the effects of recreational activities on wolves and dispersion patterns. It is extremely difficult to correlate RVDs to wolf behavior when the RVDs include everything from bird watching to hunting. Winter activities (i.e., downhill skiing) account for a majority of RVDs in Colorado, but almost all of the ski areas are located in the 250 inch snowfall areas which big game (and probably wolves) forsake for lower altitudes for the winter. In this case, the negative side of wolf habitat loss due to excessive snowfall and high elevation (9 500 ft +) is offset by the positive aspect that wolves will be absent from these areas of intense winter use by humans.

(5) A more detailed accounting of livestock numbers and distribution is warranted. It is apparent that a large number of livestock (esp. sheep) are shipped into Colorado during summer grazing season which confuses the overall numbers that could be exposed to depredation. The soon-to-be released Federal Census of Agriculture will give a clearer picture of county totals, but a more detailed analysis needs to be performed to determine **actual** numbers and distribution in the PWRAs. This would involve specific information from both the BLM and NFS down to the allotment level. Access to county tax assessor records may be required.

(6) A more detailed investigation is warranted to determine actual road density in the PWRAs. I estimate it will take 3-4 months of effort in cooperation with federal, state, county, and local agencies to compile this data. I must point out that I am in agreement with the Northern Rocky Mountain Wolf Recovery Team's observation that road density guidelines seem unlikely to be employed as a wide spread land management strategy to support wolf recovery.

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APPENDIX A

Manifesto and Guidelines on Wolf Conservation

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MANIFESTO AND GUIDELINES ON WOLF CONSERVATION[1]

1. Wolves, like all other wildlife, have the right to exist in a wild state. This right is in no way related to their known value to mankind. Instead, it derives from the right of all living creatures to co-exist with man as part of natural ecosystems.

2. The wolf pack is a highly developed and unique social organization. The wolf is one of the most adaptable and important mammalian predators. It has one of the widest natural geographic distributions of any mammal. It has been, and in some cases still is, the most important predator of big-game animals in the northern hemisphere. In this role, it has undoubtedly played an important part in the evolution of such species and, in particular, of those characteristics which have made them desirable game animals.

3. It is recognized that wolf populations have differentiated into sub-species which are genetically adapted to particular environments. It is of first importance that these local populations be maintained in their natural environments in a wild state. Maintenance of genetic purity of locally adapted races is a responsibility of agencies that plan to reintroduce wolves into the wild as well as zoological gardens that may provide a source for such introductions.

4. Throughout recorded history man has regarded the wolf as undesirable and has sought to exterminate it. In more than half of the countries of the world where the wolf existed, man has either succeeded, or is on the verge of succeeding, in exterminating the wolf.

5. This harsh judgement on the wolf has been based, first, on fear of the wolf as a predator of man and, second, on hatred because of its predation on domestic livestock and large wild animals. Historical perspectives suggest that to a considerable extent the first fear has been based on myth rather than on fact. It is now evident that the wolf can no longer be considered a serious threat to man. It is true, however, that the wolf has been, and in some cases still is, a predator of some consequence on domestic livestock and wildlife.

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[1]Proceedings of the First Working Meeting of Wolf Specialists and of the First International Conference on the Conservation of the Wolf. Douglas H. Pimlott (ed), Stockholm, Sweden, 5-6 September 1973.

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6. The response of man, as reflected by the actions of individuals and governments, has been to try and exterminate the wolf. This is an unfortunate situation because the possibility now exists for the development of management programs which would mitigate serious problems, while at the same time permitting the wolf to live in many areas of the world where its presence would be acceptable.

7. Where wolf control measures are necessary, they should be imposed under strict scientific management, and the methods used must be selective, highly discriminatory, of limited time duration and have minimum side-effects on other animals in the ecosystem.

8. The effect of major alterations of the environment through economic development may have serious consequences for the survival of wolves and their prey species in areas where wolves now exist. Recognition of the importance and status of wolves should be taken into account by legislation and in planning for the future in any region.

9. Scientific knowledge of the wolf in ecosystems is inadequate in most countries in which the wolf still exists. Management should be established only on a firm scientific basis, having regard for international, national, and regional situations. However, existing knowledge is at least adequate to develop preliminary programs to conserve and manage the wolf throughout its range.

10. The maintenance of wolves in some areas may require that society at large bear the cost, e.g., by giving compensation for the loss of domestic livestock; conversely there are areas having high agricultural value where it is not desirable to maintain wolves and where their introduction would not be feasible.

11. In some areas there has been a marked change in public attitudes towards the wolf. This change in attitudes has influenced governments to revise and even to eliminate archaic laws. there is a continuing need to inform the public about the place of the wolf in nature.

12. Socio-economic, ecological and political factors must be considered and resolved prior to reintroduction of the wolf into biologically suitable areas from which it has been extirpated.

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APPENDIX B

A Chronology of Wolf-Related Events from Pre-European Settlement to the Present.

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It is unusual when reviewing the literature to compare livestock depredation rates in the late 1800s-early 1900s to those reported in more contemporary times. There is a vast difference between living almost exclusively on cattle to the reported depredation rates of more modern times. What are the reasons, and are current attitudes derived from these historical observations? Perhaps it might be worthwhile to examine the cumulative sequence of events that set the stage for the extirpation of the wolf in Colorado and the west. For the purpose of this discussion I will use the term "cumulative impact" as defined in the Council of Environmental Quality (CEQ) regulations of 29 November 1978 (40 CFR parts 1508.7 and 1508.8, effective date 30 July 1979):

> Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The slaughter of the buffalo that began ca. 1830 was essentially completed by 1888 (Roe 1970). The rapid decline of the buffalo population along with other large native ungulates had striking biological and ecological implications on the wolf population in an exceedingly short period of time. In less than 60 years, one of the most severe man-caused perturbations probably ever imposed on any historic or modern ecosystem had been accomplished. Most researchers agree that even the megafauna extinction of the Late-Pleistocene probably occurred over a span of several thousand years.

When the first Euroamericans began arriving on the Great Plains, the wolf displayed an indifference to their presence. For at least 10,000 years, man and wolf had existed together

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in Colorado with a mutual respect for each other. The struggle for survival was intense and each learned from the other. On these common grounds the wolf was probably the superior predator of the two because of his superior senses. Human intelligence did not play a role in the wolf's destruction as much as did the introduction of firearms capable of long-distance killing, steel traps, and poison. The following statements are indicative of this early indifference. Long (1830) described the area of southcentral Kansas as:

> Notwithstanding the immense numbers of bison, deer, antelopes, and other animals, the country is less strewn with bones than almost any we have seen; affording the evidence that it is not a favorite hunting-ground of any tribe of Indians. The animals also appear wholly unaccustomed to the sight of men. The bisons and the wolves move off slowly to the right and left, leaving a lane for the party to pass, but those on the windward often linger for a long time, almost within reach of our rifles, regarding us with little appearance or regard....

In 1845, Hastings described the behavior of wolves along the Oregon Trail in Wyoming.

> The cause for there being such an abundance of all the different kinds of wolves is, perhaps, that they are never killed...|travelers| do not kill them, because they are entirely worthless, and because the people in that country have not a superabundance of ammunition. In traveling through the valleys of this section, you will pass many hundreds of them during the day, which appear to evince no timidity, but with heads and tails down, in their natural crouching manner, they pass within a few rods of you.

During the winter of 1846-47, Frederick Ruxton describes a scene that occurred near the north end of the San Luis Valley in Colorado:

> ...At length, as a band of some three thousand of them (antelope) almost ran over us, human nature, although at a freezing point, could no longer stand it. I jumped off Panachito, and, kneeling down, sent a ball form my rifle into the thick of the band. At the report two antelopes sprang into the air, their forms being distinct against the horizon above the backs of the rest; and when the herd had passed, they were lying kicking in the dust, one shot in the neck, through which the ball into the body of another. We packed a mule with the choice pieces of meat, which was a great addition to our slender stock of dried provisions. As I was "butchering" the antelope, half a dozen wolves hung around the spot, attracted by the smell of blood; they were so tame, and

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hungry at the same time, that I thought they would have actually torn the meat from under my knife. Two of them loped round and round, gradually decreasing their distance, occasionally squatting on their haunches, and licking their impatient lips, in anxious expectation of a coming feast. I threw a large piece of the meat towards them, when the whole gang jumped upon it, fighting and growling, and tearing each other in the furious melee. I am sure I might have approached near enough to have seized one by the tail, so entirely regardless of my vicinity did they appear. They were doubtless rendered more ravenous than usual by the uncommon severity of the weather, and, from the fact of the antelopes congregating in large bands, were unable to prey upon these animals, which are their favorite food. Although rarely attacking a man, yet in such seasons as the present I have no doubt that they would not hesitate to charge upon a solitary traveler in the night, particularly as in winter they congregate in troops of from ten to fifty. They are so abundant in the mountains that the hunter takes no notice of them, and seldom throws away upon the sulking beasts a charge of powder and lead.

Compare the last sentence in this statement regarding abundance to another early observation by Miles (1896):

> There are several varieties of wolves on the plains, the most numerous being the coyote and the most formidable being the gray wolf, often as large as a Newfoundland dog. They are gregarious, being sometimes seen in packs of fifty or sixty. They were always to be seen following about in the vicinity of the herds of buffalo, standing ready to pick the bones of those the hunters left on the ground or to overtake or devour those that were wounded, and which consequently fell an easy prey to them. While the herd of buffaloes were together they seemed to have little dread of the wolf, and allowed them to come close to the herd. It was this habit of the wolf which suggested the above described stratagem....

It becomes evident, based on these observations, that wolf numbers were abundant throughout both the mountain and plains habitats and that other ungulates besides buffalo were preyed upon. It should also be noted that coyote numbers were equal to or greater than wolf numbers.

The event that portended the future fragmentation of the Great Plains was the mass

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human movement along the corridor known as the Oregon Trail in the early 1840s.

Roe (1970) comments that:

> In the era of their (buffalo) final extermination it is known that there were at least two grand aggregates, known respectively as the "Northern " and the "Southern" herd. The opening of the Oregon Trail, along the general line of which the Union Pacific Railway, for some distance at least, was later built, either foreshadowed this division, or as Allen thinks, caused it.

Hornady evidently agreed with Allen and said," In a few years the tide of overland travel became so great that the buffaloes learned to keep away from the dangers of the trail, and many a pioneer has crossed the plains without ever seeing a live buffalo." Grinnell (1923) later commented:

> The year 1841 was a turning point in the history of the plains tribes, for that season the first emigrant train passed up the Platte on its way to Oregon. Hitherto the fur men had been almost the only ones who crossed the northern plains, and they were few in number; but from this year on an annually-increasing swarm of emigrants poured up the Platte. The Indians, at first astonished, soon became alarmed, and with good reason. The emigrants cut down and wasted the scant supply of wood along the road; their herds of oxen, horses, and mules gnawed the bottoms bare of grass; the buffalo were shot down and left to rot on the ground, and worse still, the herds were frightened from the country....

The next event to divide the ancestral range of the buffalo and wolf was the construction and completion of the Union Pacific Railroad. Construction of the railroad began in Omaha in 1865; it reached Cheyenne in November, 1867, and was completed at Promintory, Utah, in 1869. The completion of the track not only divided the buffalo into two major components, but allowed easy access to the new territory for settlers, including buffalo hunters. In 1870 the Denver & Pacific Railroad was completed to link Denver to the Union Pacific at Cheyenne and the Kansas Pacific entered Colorado from the Missouri River. These new transportation routes enabled the great slaughter to begin. It was during the period of

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1866-67 that wolf pelts became valuable (Condit 1956) and the wolf was hunted as hard as the buffalo.

Prior to the completion of the Union Pacific Railroad across Wyoming, buffalo numbers were exceedingly abundant along the Front Range and to the east. Luke Voorhees (ex-Territorial treasurer of Wyoming) traveled this area in 1859 and made these observations:

> In 1857, I made a trip from Lawrence, Kansas, west up the Kansas River to the confluence of the Smoky Hill and Republican Rivers, thence in a westerly direction to the Rocky Mountains about 150 miles in the then buffalo country for a buffalo hunt. Saw a great many and killed six or eight fat ones, all and more than we needed to dry or jerk, as the old plainsmen called that way of curing the meat. The herds that I saw on that hunt surprised me as to the great numbers, were nothing to compare, not even worth mentioning, to what I saw two years later during the spring and summer of 1859, when on a trip up the Arkansas River via Bent's old fort to Pike's Peak to where Denver now stands, I made a trip across the country from the South Platte to Pawnee Buttes, as near as I can recollect near where the town of Kimball, Nebraska, now stands. From the South Platte as far north as I then traveled there was one vast herd. To estimate or comprehend the numbers would have been entirely futile. I had traveled over 200 miles, buffalo being on both sides as far as the eye could see. To say there was millions would not express it. As near as I can now recollect locations, on coming over from Pawnee Buttes to some pine-covered bluffs, which are now called Pine Bluffs (Wyoming), was a most magnificent sight. It was the thickest of the great herds and was in the vicinity of where the dry farmers are now raising wheat and oats. The entire country east, west, and north from the bluffs that I stood upon that bright day in August, 1859, was one brown-colored group of buffalo cows and calves. The bulls evidently being farther north....(Voorhees 1927)

The role of the new railroads in the slaughter of buffalo is described by Hornady (1897):

> Of course the slaughter was greatest along the lines of the three great railways -- the Kansas Pacific, the Atchinson, Topeka and Santa Fe, and the Union Pacific, about in the order named. It reached its height in the season of 1873. During the year the Atchinson, Topeka and Santa Fe Railroad carried out of the buffalo country 251,443 robes, 1,617,000 pounds of meat, and 2,743,100 pounds of bones. The end of the southern herd was then near at hand. Could the southern buffalo range been roofed over at that time it would have made one vast charnel house. Putrifying carcasses, many of them with their hide still on, lay thickly scattered over thousands of square miles of the

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> level prairie, poisoning the air and water and offending the sight. The remaining herds had become mere scattered bands, harried and driven hither and thither by the hunters, who now swarmed as thickly as the buffaloes....

After his visit to Fort Hays (Kansas), Allen in 1874 wrote:

> The great "buffalo country" of the United States is now mainly restricted to Western Kansas and Eastern Colorado, between the Arkansas and Platte Rivers, -- a region extending about two hundred miles in a north and south direction and nearly three hundred miles in an easterly and westerly direction, over much of which they still range in countless hordes. They are, however, partially migratory, moving eastward in summer and westward in winter. In the northern part of the state their summer range, in 1871, extended eastward from the western boundary of the state to the vicinity of Fort Harker (Ellsworth County, Kansas). In winter their eastern limit hardly extended east of Ellis (in Ellis County), on the Kansas Pacific Railway, while they ranged westward to eastern Colorado. These movements of the buffalo are evidently influenced by the climate, the prairies west of Ellis being rarely long covered with snow, while to the eastward of this point the snow is much ore constant, and the country hence much less favorable for the existence of buffalo there in winter than it is more to the westward. Every year, however, their range is becoming more circumscribed, owing to the rapid reduction of their numbers by hunters, and, in consequence also of constant persecution, their movements are much more uncertain than formerly. Although the number of buffalo to be met with in this portion of Kansas is still almost beyond conception, the country sometimes seeming alive with them as far as the eye can reach, their diminution is rapid, and at the present rate of destruction a few years will suffice to exterminate them wholly.

This statement by Allen was prophetic at the time and was collaborated by Hornady (1897 p. a few years later. Hornady (1897, p.492-4)) vividly describes the extermination of the southern herd:

> The geographical center of the great southern herd during the few years of its existence previous to its destruction was very near the present site of Garden City, Kansas. On the east, even as late as 1872, thousands of buffalo ranged within ten miles of Wichita, which was then the headquarters of a great number of buffalo-hunters, who plied their trade vigorously during the winter. On the north the herd ranged within 25 miles of the Union Pacific, until the swarm of hunters coming down from the north drove them farther and farther south. On the west, a few small bands ranged as far as Pike's Peak and the

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South Park, but the main body ranged east of the town of Pueblo, Colorado. In the southwest, buffaloes were abundant as far as the Pecos and the Staked Plains [Llano Estacado], while the southern limit of the herd was about on a line with the southern boundary of New Mexico....

During the years from 1866 to 1871, inclusive, the Atchison, Topeka and Santa Fe Railway, and what is now known as the Kansas Pacific, or Kansas division of the Union Pacific Railway, were constructed from the Missouri River westward across Kansas, and through the heart of the southern buffalo range. The southern herd was literally cut to pieces by railways, and every portion of its range rendered easily accessible. There had always been a market for buffalo robes at a fair price, and as soon as the railways crossed the buffalo country the slaughter began. The rush to the range was only surpassed by the rush to the gold mines of California in earlier years. The railroad builders, teamsters, fortune-seekers, "professional" hunters, trappers, guides, and everyone out of work turned out to hunt buffalo for hides and meat. The merchants who had already settled in all the little towns along the three great railways saw an opportunity to make money out of the buffalo product, and forthwith began to organize and supply hunting-parties with arms, ammunition, and provisions, and send them to the range. An immense business of this kind was done by the merchants of Dodge City, Wichita, Leavensworth, and scores of smaller towns did a corresponding amount of business in the same line. During the years 1871 to 1874 but little else was done in that country except buffalo killing. Central depots were established in the best buffalo country, from whence hunting parties operated in all directions. Buildings were erected for the curing of meat, and corrals were built in which to heap up the immense piles of buffalo skins that accumulated....

At first the utmost wastefulness prevailed. Every one wanted to kill buffalo, and no one was willing to do the skinning and curing. Thousands upon thousands of buffalo were killed for their tongues alone, and never skinned. Thousands more were wounded by unskillful marksmen and wandered off to die and become a total loss....

The final blow to the southern herd is described by Hornady (1897):

By the close of the hunting season of 1875 the great southern herd had ceased to exist. As a body, it had been utterly annihilated. The main body of the survivors, numbering about ten thousand head, fled southwest, and dispersed through that vast tract of wild, desolate, and inhospitable country reaching southward from the Cimmaron country across the "Public Land Strip," [Oklahoma Panhandle] the Pan-handle of Texas, and the Llano Estacado, or Staked Plain, to the Pecos River. A few small bands of stragglers maintained a precarious existence for a few years longer on the headwaters of the

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> Republican River and in southwestern Nebraska near Ogalalla, where calves were caught alive as late as 1885. Wild buffaloes were seen in southwestern Kansas for the last time in 1886, and the two or three score of individuals still living in the Canadian River country of the Texas Pan-handle are the last wild survivors of the Great Southern Herd.

With the annihilation of the southern herd, the buffalo hunters now turned their attention to the so-called northern herd. Hornady (1897) describes the demise of the northern herd:

> The year 1881 witnessed the same kind of a stampede for the northern buffalo range that occurred just ten years previously in the south, it was the ability of a single hunter to destroy an entire bunch of buffalo in a single day that completely annihilated the remaining thousands of the northern herd before the people of the United States even learned what was going on...The hunting season which began in October, 1882, and ended in February, 1883, finished the annihilation of the great northern herd, and left but a few small bands of stragglers numbering only a very few thousand individuals all told...Curiously enough, not even the buffalo-hunters were at the time aware of the fact that the end of the hunting season of 1882-'83 was also the end of the buffalo, at least as an inhabitant of the plains and a source of revenue. In the autumn of 1883 they all nearly outfitted as usual, often at an expense of many hundreds of dollars, and blithely sought "the range" that had up to that time been so prolific in robes. The end was in nearly every case the same--total failure and bankruptcy. It was indeed hard to believe that not only the millions, but also the thousands, had actually gone, and forever....

Of the millions of buffalo that once freely roamed the great North American prairies only a handful remained. Garretson (1938) states that:

> In 1889 between twenty-five and thirty buffalo were seen near the east side of the Red Desert in Wyoming and were shortly afterward killed. These, with the exception of a few individuals and those that took refuge in the Yellowstone National Park, were the last of the northern herd...
>
> As late as 1897, a small herd of wild buffalo, numbering between twenty and thirty animals, ranged in Lost Park near Bison Peak, Park County, Colorado. They had been protected by ranch and cattle men, but occasionally some unprincipled person would kill one, and the increase was less than the loss. Through the work of these vandals, the herd dwindled until there were but four left; two bulls, one cow and one calf. These are believed to be the last wild buffalo killed in the United States.

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The final extermination of the buffalo (in hindsight) is described by Hornaday (1897 p.486-7)).

> We come now to a history which I would gladly leave unwritten. Its record is a disgrace to the American people in general, and the Territorial, the State, and General Government in particular. It will cause succeeding generations to regard us as being possessed of the leading characteristics of the savage and the beast of prey--cruelty and greed. We will be likened to the blood-thirsty tiger of the Indian jungle, who slaughters a dozen bullocks when he knows he can eat only one.
>
> In one respect, at least, the white man who engaged in the systematic slaughter of the bison were savages just as much as the Piegan Indians, who would drive a whole herd over a precipice to secure a week's rations of meat for a single village. The men who killed buffaloes for their tongues and those who shot them from the railway trains were murderers. In no way does civilized man so quickly revert to his former state as when he is alone with the beasts of the field. Give him a gun and something which he may kill without getting himself into trouble, and presto! he is instantly a savage again, finding exquisite delight in bloodshed, slaughter, and death, if not for gain, then solely for the joy and happiness of it. There is no kind of warfare against game animals too unfair, too disreputable, or too mean for white men to engage in if they can only do so with safety to their own precious carcasses. They will shoot buffalo and antelope from running railway trains, drive deer into the water with hounds and cut their throats in cold blood, kill does with fawns a week old, kill fawns by the score for their spotted skins, slaughter deer, moose, and caribou in the snow at a terrible disadvantage, just as the wolves do; exterminate the wild ducks on the whole Atlantic seaboard with punt guns for the metropolitan markets; kill off the Rocky Mountain goats for hides worth only 50 cents apiece, destroy wagon loads of trout with dynamite, and so on to the end of the chapter....

It was not only the buffalo that felt the onslaught of the hunters. By 1886, elk and pronghorn had been hunted to extinction in Kansas. In conjunction to the threat from hunters, elk and antelope were now being killed because of their perceived threat to the emerging cattle industry. Peake (1937) describes the stockmen's attitude in Colorado:

> Elk and antelope were numerous, and stockmen killed them in great number. However, they were not a sufficient menace to warrant the payment of a

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bounty. The range between Julesburg to Greeley in 1878 was reported to be alive with antelope. The Bartholf Brothers killed ten hundred eighty on their range northeast of Greeley from August 1, 1885 to January 20, 1886. Elk sometimes mixed with cattle on the range. Stockmen objected for they believed it made their animals wild.

Young (1944) states that the height of the wolf poisoning campaign was between the years 1860 to 1885. The unrelenting poisoning effort begun by beaver trappers in the north was joined later by unemployed buffalo hunters, Civil War veterans, and other settlers in the Great Plains. Hanna (1965) describes the transition of the beaver trapper to wolfer:

> The wolfer succeeded the trapper when the beaver became scarce in the streams. The trapper turned his attention to wolfing, which became quite a profitable industry in Montana and Wyoming. It was a hard and dangerous life, as all Indians were hostile to the wolfer, because they lost so many of their dogs from eating the poison bait. The Indians would often destroy the skins, steal the horses and do other damage...Sometimes a Chinook wind would come up, causing hundreds of skins to spoil and the loss of thousands of dollars. In December of 1870, five of us went down the Yellowstone River to trap and poison wolves. We ventured as far as Clark's Fork. We knew the Indians wintered in the Powder River country, but we felt it was not taking too much of a chance, although it was one hundred seventy-five miles from Bozeman and any civilization. **In order to find plenty of wolves we had to go out where there was plenty of buffalo**. As soon as we had selected our camp we made a place to live in out of rocks and had portholes so that if the Indians should find us, we would be able to defend ourselves. Our method of poisoning wolves was to put strychnine into the dead buffalo, plenty of it, and we would have a dead wolf if he ate any of the buffalo meat. We would drag a large piece of meat along the trail so the wolves would smell it, planting the small pieces at intervals in every direction. The next day we would go out and follow the trails and pick up the dead wolves, sometimes twenty-five or thirty. Our worse trouble was the wolves freezing before we could skin them, as then they must be thawed out.
>
> This was slow process. We piled the frozen wolves up until we had a pile as high as a box car. We had about three-hundred when a Chinook wind came in February and they thawed out and were in good shape. Our next move was to get them skinned before the Indians would be coming into that country. In addition to the wolves we trapped some wildcats, bob-cats, and beaver, and had a lot of fine pelts. We had them all packed into bunches and were ready to move out in a few days, when one day we heard shots down in the valley

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> and presently Sweeney came with about fifty Indians after him. He got into camp alright, but his horse was shot. We went out to help him and made a hard fight to save our horses, but they got thirteen of them and when night came on all we could do was to get into our breastworks. We each took turns at watching, but when morning came not an Indian was to be seen and most of the hides were gone. The next night we took what provisions we could carry and started back to Bozeman, in March, one hundred seventy-five miles, on foot. We had stayed a little too long. It was a hard trip for the snow had melted and the slush was up to our knees at times. In the middle of the day we would stop, build a fire, try to dry ourselves and get some rest, one man always on guard. We finally arrived at Benson's Landing, where we found friend, but as tired a bunch of wolfers that ever came out of the Yellowstone country. There were times when we had good luck on an expedition and came out with several hundred of dollars worth of pelts and furs, but this was not one of them.

Evidently the economic benefits of poisoning wolves outweighed the risks involved during the period after the Civil War. Frison (1970) describes the economic conditions from a rancher's viewpoint during the years following The Civil War which may help to explain why wolfing was so popular:

> This was a day and a time in America that followed on the heels of the Civil War. It was a period of dilemma. Poverty stalked many section of the south. Strife and suffering were running rampart. Unemployment and unrest were to be found everywhere. The bank vaults were empty, and pocketbooks were bare. This was time when thousands of people walked the streets and byways--destitute and hungry. Arbuckle's coffee was selling at 10 cents per pound, if you could find the money with which to buy it. Jobs were few and hard to find, because no one had the money to pay wages at $10.00 to $15.00 per month....

Compare this statement with the following statement by Mead (1986) who lived and hunted the Smoky Hill area of Kansas just before the Civil War (1859) and the years following.

> The love I had of hunting and trading and wildlife took me onto the plains (1859) and incidently, I found it a very profitable business...when I came on the plains I had nothing but a fine riding horse, a team, two rifles as good as could be made, plenty of good clothes, and provisions for six months, with a little money in my pockets. Within three years I made a trip back to my childhood home on the farm near Davenport, Iowa, and I had a nice wife and

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> baby boy, $7,000 in the bank, $1,500 in my pocket, and did not owe a dollar in the world. I had made it all with my rifle and trafficking on the plains.

It becomes obvious when comparing these two statements why buffalo hunting and poisoning of wolves became do popular during these years. Mead (1986) continues:

> During the winter season, sandwiched in along between our trading expeditions, we used to take an occasional hunt for the sport it afforded. We found it a very profitable business killing the big gray wolves which lived with the buffalo and traveled with them, and also the coyotes, which were numerous and seemed to live in the vicinity, not following the buffalo in their migrations as the gray wolves did.
>
> Our method of killing buffalo (to poison wolves) was to shoot down two or three old bull buffalo in different places apart from each other, and usually at some distance from our camp. We would let the buffalo lie one night in order to attract the wolves. The next night, just before dusk, we would go and scatter poisoned bait about the carcasses, each bait containing about one thirtieth part of a dram of strychnine. The reason we put our baits out after sunset was on account of thousands of ravens that seemed to live with the buffalo, and which were confined exclusively to the country occupied by them. They would come back and pick up the baits if put out before dark, so that instead of killing wolves, we would find we had a whole field of ravens killed. We also found it necessary to go out early to get our wolves next morning, as the ravens and sometimes eagles would come shortly after sunrise and tear holes in their flanks and damage their skins. After the wolves were skinned we would allow the carcasses to lie where they were, and the ravens in eating their stomachs and intestines would also eat the partially digested baits. This would kill them, and the prairie about the carcasses would soon be dotted with the glossy, shining bodies of the defunct ravens, with an occasional bald eagle among them.
>
> Along in the winter, after the buffalo became scarce, these ravens, roosting along the streams in thousands, would eat the flesh of the hundreds of wolves which we had skinned and left lying around over the prairie. This meat would in time kill them, and they would drop from their roosts along the banks of the streams until the ground would be covered with them, and thousands of them would be found on the prairie dead.
>
> ...The buffalo, the gray wolves, and the ravens--companions in life--mingled their bones when swift destruction overtook them. The buffalo were killed by the bullets of the hunters, the wolves were killed by strychnine for their furs, and the ravens died from eating the poisoned carcasses of both, so that they all

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became practically extinct at the same time. The prairie dogs also disappeared over the larger part of the buffalo range, but they died from natural causes, as they are not able to live in a country which is not tramped bare and eaten down close to the ground by animals. In other words, wherever the buffalo ceased to eat, the prairie grass and the rank grass grew up , and the prairie dogs perished. Occasionally a colony located on hard pan, where the coarser grass does not grow, survives.

Mead touches upon the effects of using strychnine on non-target species in the area he was familiar with. Young (1944) further expands the cumulative impact of this poisoning campaign:

> Destruction by this strychnine poisoning campaign that covered an entire empire hardly has been exceeded in North America, unless by the slaughter of the passenger pigeon, the buffalo, and the antelope. There was a sort of unwritten law of the range that no cowman would knowingly pass by a carcass of any kind without inserting in it a goodly dose of strychnine sulfate, in the hopes of eventually killing one more wolf. The hazard to other kinds of wildlife involved by this lavish use of strychnine was not taken into consideration by stock interests at the time. Kit foxes, so prevalent at the time on the plains, were poisoned by the thousands, for they were generally the first to take the poisoned meat. The predominating thought was "to get the wolf by any and all means possible."
>
> Not only the wolves were killed but also innumerable other carnivores, including the kit fox (*Vulpes velox*), just mentioned, the northern plains red fox (*Vulpes regalis*), the northern plains skunk (*Mephitis mephitis hudsonica*), and the Texas skunk (*Mephitis mephitis varians*). In addition, many birds, such as hawks, eagles, magpies, and ravens perished from feeding on poison baits.

The impact of hunting, trapping, and poisoning was still evident at the turn of the century. In 1906, Andersch Brothers, a trapping supply house and fur buyer company, published a list showing the geographical distribution and abundance of North American furbearers. The list for Colorado included the following information:

Muskrat	Animal is numerous
Bear	Animal is rather scarce

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Badger	Animal is scarce
Beaver	Animal is scarce
Wild cat	Animal is numerous
Civet cat	Animal is rather scarce
Ring Tail cat	None exist or unknown
Fisher	Animal extinct
Black fox	None exist or unknown
Silver fox	None exist or unknown
Cross fox	None exist or unknown
Red fox	Animal is rather scarce
Grey fox	Animal is numerous
Swift fox	None exist or unknown
Lynx	Animal is scarce
Marten	Animal is nearly extinct
Mountain lion	Animal in sections only
Otter	Animal is nearly extinct
Opossum	Animal is nearly extinct
Raccoon	Animal is rather scarce
Skunk	Animal is rather scarce
White weasel or ermine	None exist or unknown
Wolverine	Animal is extinct
Wolf	Animal is numerous

The larger game did not fare much better than did the furbearers. Cary (1911) investigated the mammals of Colorado and published his findings in *North American Fauna No. 33 - A biological survey of Colorado.* Cary states:

> ...The elk is now exterminated over much of its former range in Colorado and the few bands which remain in the wildest part of the western plateaus and mountains are small and widely scattered....
>
> The mule deer...is found in every county west of the Continental Divide, being probably more abundant in Routt and Rio Blanco Counties...Apparently none remain on the plains east of the mountains, where they were common in the early times.
>
> Antelope are now comparatively scarce even in the thinly settled parts of the eastern plains region, and few remain on the sage plains of North Park and Routt County, where formerly there were thousands...In 1898 the state game warden placed the number at 25,000, while in 1908 the game commissioner estimated not over 2,000. A conservative estimate based on data collected by the Biological Survey would not be over 1,200 in 1909.

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> The buffalo was formerly present over much of the state, even ranging in summer to timberline in certain sections of the mountains, as is proved by the bleached and weathered skulls occasionally found at that elevation. While most numerous on the plains east of the mountains, they nevertheless must have been common in the higher mountain parks, especially on the sage plains of North Park, where the bleached skulls, now rapidly disappearing after more than twenty years' exposure may still be seen in considerable numbers. A favorite range of the buffalo was the extensive region of sage plains in western Routt County, where in sections least frequented by range cattle the deeply worn trails can still be distinguished.

I will now summarize the previous events to set the stage for how they affected the wolf populations of the Great Plains and Rocky Mountain states. In about 58 or so years, somewhere between 40 to 60 million (maybe more) buffalo had been eliminated; at least this many antelope had been reduced to a handful; furbearers, elk and deer populations had been severely reduced or eliminated in certain areas. As the events were unfolding, the first cattle herd was introduced into the Arkansas Valley of Colorado in 1862 (Peake 1937). The cattle industry grew rapidly in Colorado and by 1891 the estimated number of farm animals in Colorado is shown in Table 30.

Table 32. Estimated number of farm animals in Colorado in 1891 (source: USDA, Bureau of Animal Industry Fourteenth Annual Report).

Animal	Number of head
Milk cows	60,416
Other cattle	1,037,814
Sheep	1,710,395
Hogs	23,842
Horses	161,268
Mules	5,184

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At first thought it would seem likely that wolf numbers would increase dramatically during the extermination of the buffalo, due in part, to a stable food supply created by the millions of carcasses left by the hunters. However, this period of time was the peak years for an extensive strychnine poisoning campaign that resulted in unknown (but large) number of wolf deaths. The number of wolves taken during this campaign cannot be quantified, but perhaps a better idea can be realized by looking at some reported wolf densities during the buffalo years. We know from the historical account that the greatest wolf densities were in association with the buffalo herds on the Great Plains. Webb (In: Young 1944), writing of the Santa Fe trade, said:

> To give some idea of the numbers of wolves on the prairies in the buffalo range, I will give an account of two men formerly conductors of the mail from Independence to Santa Fe. I think it was in 1854 or 1855 [that] they went to Walnut Creek and built a small mud fort, and in the summer they would sell what few knickknacks they could to traders and other passing travelers, and in winter their business was to kill wolves for their skins. They would kill a buffalo and cut the meat in small pieces and scatter it about in all directions a half a mile or so from camp, and so bait the wolves for about two days. Meantime all hands were preparing meat in pieces about two inches square, cutting a slit in the middle and opening it and putting a quantity of strychnine in the center and closing the parts upon it. When a sufficient amount was prepared, and the wolves were well baited, they would put out the poisoned meat. One morning after putting out the poison, they picked up sixty-four wolves, and none of them over a mile and a half from camp....
>
> As a further aid in comprehending the number of wolves that were killed at the height of the poisoning campaign we may consider what Fouquet saw near Sun City, Kans., at the mouth of Turkey Creek, where there was a little cave village of buffalo and wolf hunters during 1871. He states: "Not far above this cave village was a road going thro (sic) the swampy creek valley, about 75 yards wide, and this had been artistically and scientifically paved with gray wolf carcasses and I drove over this bone road several times (Fouquet 1925, In: Young 1944).

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The toll of wolf poisoning was so great that Roe (1970) states:

> It was thought by General Meigs and General Sheridan that around 1870-71 there were, "more buffalo than ever before, possibly because the use of strychnine in the slaughter of wolves for their hides had considerably curtailed the ravages of these animals on the buffalo..."

In 1874, Allen commented on the wolf predicament near the present site of Hays City, Kansas.

> *Canis lupus*, Gray Wolf, Buffalo Wolf. Formerly very abundant, but during the last few years their numbers have greatly diminished, thousands having been killed for their skins every winter by means of strychnine. Comparatively few now remain (Allen 1874, In: Young 1944).

This observation raises an interesting question; did the poisoning campaign eliminate the wolf population of the Great Plains, or did many surviving wolves move to the west to escape persecution? I will speculate that, most probably, it did both based on the following historical observations. Young (1944) notes:

> Success in poisoning wolves with strychnine is attained more often with young wolves than with those which are fully matured. In that stage of its life cycle wolves are more prone to eat carrion than when adult. Exceptions to this statement are the old, toothless or so-called "gummer wolves" previously mentioned...Apparently, a large proportion of the wolves killed by strychnine on the plains were of the younger age.

There can be no doubt that many thousands of young and adult wolves were taken with poison, especially in the early years (1840-50s), but I suspect the end result of the poisoning campaign was an extreme selection pressure which resulted in a surviving wolf population that by the 1880s was both extremely trap-shy and also very poison wary.

It must be remembered that the events previously discussed were interrelated and dynamic in

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both space and time. Figure 30 shows the compression of the buffalo range beginning in 1730 until the final stand of the northern herd in 1883. I have assumed that the ancestral range of the wolf in the Great Plains closely parallelled that of the buffalo and was subject to the same diminution. If this assumption is valid, then it seems probable that the range of the wolf was shifting westward in advance of the "settlement wave" and buffalo hunters. Chitterton (in: Roe 1970) states that, "It was a common saying in the era of the fur trade that the buffalo were retreating before the white man at the rate of ten miles a year, and this is perhaps not an exaggerated measure of his certain and continuous disappearance...." Roe (1970) believes this statement should be taken only in a loose sense, but also states that, "The ten miles may perhaps represent a rude measure of the annual advance of settlement westward across a wide front." What is important in this observation is not an exact mileage estimate for the retreat, but that a westward shift was occurring. The extermination of the southern herd in 1875 probably forced the wolf against the front range of the Rocky Mountains and beyond in Wyoming, Colorado, and New Mexico. Evidence of this in Colorado and Wyoming can be found in several historical observations. Roosevelt (1925) wrote:

> In northwestern Colorado, in the White River country, cougars fairly abounded in the early nineties, while up to that time, the big gray wolves were almost or entirely unknown. Then they began to come in, and increased steadily in numbers, so that by the winter of 1902-3 they much outnumbered the big cats...in one winter in the neighborhood of the Keystone ranch he (a trapper) trapped forty-two big gray wolves....

Emerson Carney writing to *Field and Stream* in 1902 made this comment which collaborates Roosevelt's statement:

> ...Now these conditions exist today in the cattle country of northern Colorado and southern Wyoming, which locality was familiar to me some years ago. From 1888 to 1894 I lived in and traveled much through these wild and sparsely settled

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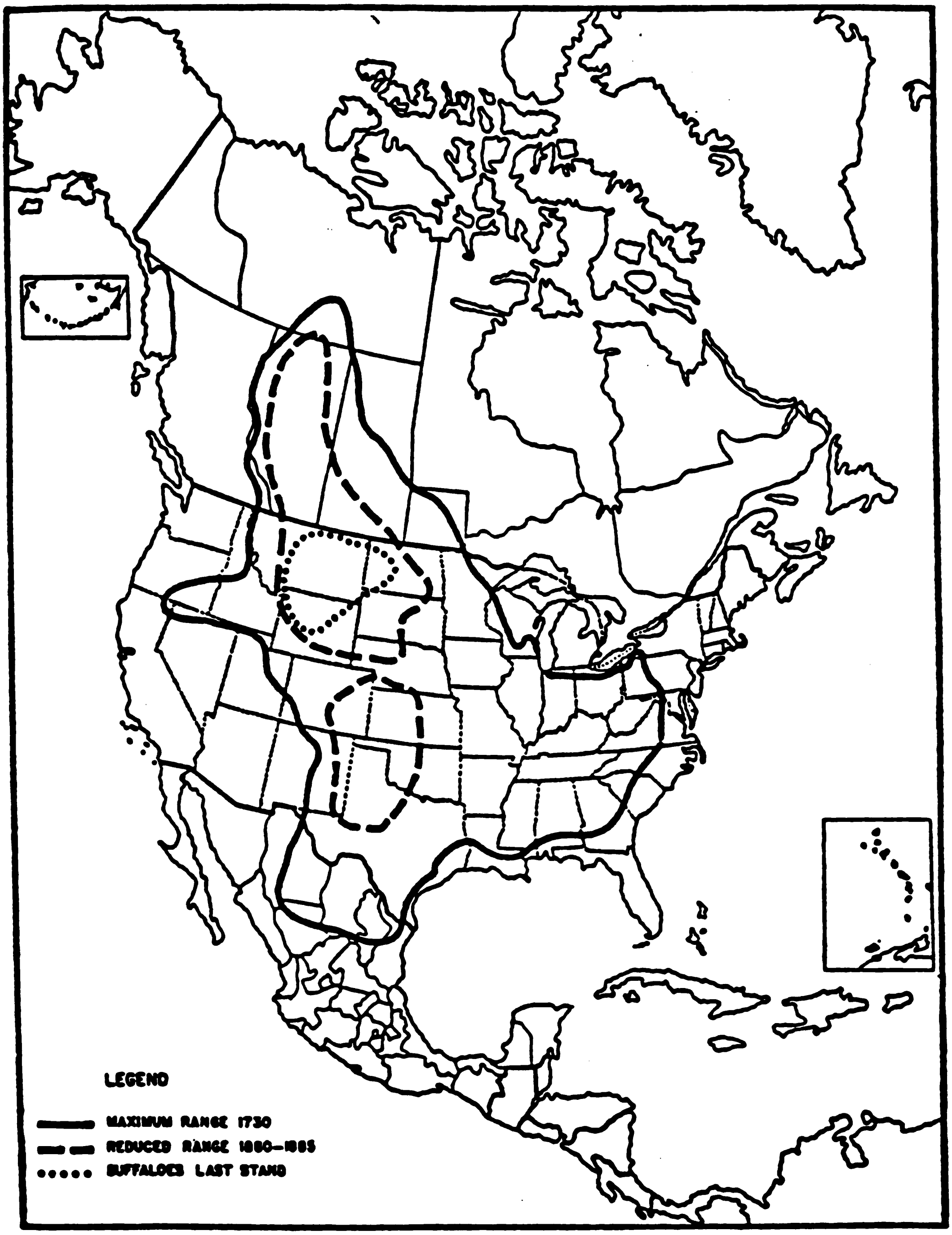

Figure 29. Maximum buffalo range in North America according to the literature (Source: Young 1944).

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regions, both in the open cattle country and in the mountain districts, and never in all that time did I see or track a gray wolf, and never even heard a report of their being seen in that section of country.

It is only, then, in the last few years they have appeared in that locality; and reports show them to be rapidly increasing from year to year. This in the face of the fact that strenuous efforts have been made and are made for their extermination. In some places in Wyoming the stockmen have paid as high as twenty dollars bounty for their scalps aside from the regular bounty for the wolf....

To the northeast of this general area the final extermination of the northern herd pushed the wolf into the more rugged regions of Montana and northern Wyoming (see Fig. 30). Senator Kendrick of Wyoming noted (in: Young 1944):

The gray wolf appeared in largest numbers on the northwestern ranges about 1893...Our fight on the ranges where I had supervision and management at the time began in the fall of 1893. The campaign was conducted through the work of two men on horseback with guns, poison, and traps, and within the short period of two or three months they had a record of 150 gray wolves that they had destroyed.

...all told on this one cattle ranch, covering a territory of 30 to 35 miles square, we had a record of when I left the ranch, and lost track of it, of about 500 gray wolves that we had killed. And the coyotes we threw in for good measure; they numbered hundreds, but we had no disposition to either count them or keep track of them.

Roosevelt (1925) observed:

With the disappearance of the buffalo the wolves diminished in number so that they seemed to disappear. Then in the late eighties or early nineties the wolves began again to increase in numbers until they were once again as numerous as ever and infinitely more wary and difficult to kill; though as they were nocturnal in their habits and were not often seen. Along the Little Missouri and in many part of Montana and Wyoming this increase was very noticeable during the last decade of the nineteenth century...I never knew the wolves to be so numerous or so daring in their assaults upon stock in the Little Missouri country as in the years 1894 to 1896 inclusive....

The increase in wolf numbers in northeastern Wyoming was very evident and resulted in this

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petition being sent to the Governor of Wyoming:

> The following petition, signed by all the stockgrowers in Johnson County, has been forwarded to the legislature of the State of Wyoming under date of Jan. 15, 1893. We the undersigned, being breeders of livestock in Wyoming, hereby petition your honorable body to enact as a law the bill presented herewith, increasing the bounty on gray and timber wolves to ten dollars per head. Wolves have increased so rapidly on the range that the loss of horses, cattle, and sheep has reached a point where energetic action must be inaugurated. The present loss is quite sufficient to deprive the breeders of horses and cattle of a large part, if not all, of the possible profit of such breeding.
>
> From a comparison of the experience of different breeders we believe that from one-sixth to one-fifth of all the colts and calves dropped in the state are devoured by wolves....

An indication of wolf numbers to the east of Johnson County is recorded by the Thorn brothers of Sundance (Wyoming-Crook County), who killed 79 wolves in one week in May, 1897. The two men were employed as wolfers for the Standard Cattle Company and earned $4.00 per pelt in bounties (Roberts et al. 1990).

The winter of 1886-87 has been referred to as the death knell of the open range cattle industry that existed in Wyoming, Montana, Colorado, western Nebraska, and western Kansas. Mitchell and Hart (1987) describes the sequence of the winter storms:

> Those writing about the winter of 1886-87 have differed on the timing of the individual storms, but all agree that they were very numerous and ferocious. On November 16-18, an arctic storm covered the entire High Plains. Central Montana suffered the brunt of the storm, where six inches of snow quickly drifted before the sub-zero winds. After this storm came several days of drizzle, which partially melted the snow. This slush then froze into an impermeable crust, making it impossible for the cattle to feed.
>
> A second blizzard came out of Canada in mid-December. The Missouri River had completely frozen over by Christmas, and the temperature dropped to -37° at Fort Assiniboine near the present town of Havre, Montana. The cold

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> temperatures were unabated during January, 1887, except for a brief chinook early in the month which again crusted the melted snow to a hard sheet of ice. Fort Keough (by Miles City) recorded a temperature of -60° on January 14th. The *Laramie Daily Boomerang* of February 10, 1887, reported, "The snow on the Lost Soldier division of the Lander and Rawlins stage route is four feet deep, and frozen so hard that the stages drive over it like a turnpike."

Frison (1970) describes one of these many blizzards as it hit the Big Horn Basin area of northern Wyoming:

> Early in the afternoon (January 19, 1887) a brisk wind came sweeping in from the northwest, and by nightfall it started snowing. for six days and nights it never stopped. On the morning of the seventh day the sun came out and tried its best to pierce the canopy of blue-gray skies. A hard, cold wind started blowing from the north, blowing and drifting the fresh-fallen snow in clouds that made visibility impossible...swirling snow and shrieking winds leveled the gulches and built huge drifts every place conceivable that could hold the snow...cattle by the thousands drifted with the blinding blizzard...above the shrieking wind at various intervals could be heard that deep, blood-curdling voice of the gray wolves that prowled the wind-swept ridges. As this carnage of nature was spewing its venom of fury, thousands upon thousands of confused cattle were smothering under huge drifts of snow in the gulches, under rimrocks, and the length of every water course that offered the remotest chance of feed and shelter.

The storms that occurred in the winter of 1886-87 did not spare the northern cattle ranges any more than the southern ranges which were hard hit in the winter of 1885-86. Dyer (1934) recorded the effects of one of the blizzards in southcentral Kansas:

> A great many of the oldest pioneers have passed on to other climes. One of these was August Hegwer, who met an untimely death in a great blizzard of January 1886, southwest of Kiowa on Mule Creek[8]. He and his step-son, Dave Freemyer, had been down on the Cherokee Outlet on a hunting expedition, and incidently to poison some lobo wolves that infested that region and were a great menace to the cattlemen....(Author's note: August died in the blizzard; Dave (14 years old) lived through the storm but had to have one foot amputated because of severe frostbite).

---

[8]Kiowa is the author's hometown and is located in southcentral Kansas about one mile north of the Oklahoma border. Kiowa was the starting point for the Cherokee Strip land rush in 1893.

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The winter of 1886-87 took a heavy toll on wildlife as well as cattle, sheep, horses, and hogs. Byers (1856: quoted in Young, 1944) commented that, "Antelopes, and even wolves, drifted with the cattle and piled up with them" in death's struggle by freezing. By the spring of 1887, the grim results of the devastating blizzards became evident. I speculate that the wolves fared better than other wildlife as they scavenged on untold numbers of dead cattle and big game animals.

This natural event aided in setting the wolf up for future conflict with the livestock operators. The great reduction of wildlife, at least for several years after the great winter storms, forced the wolf to prey almost exclusively upon domestic livestock. Ranchers tried every means available to kill the wolves but it was a losing battle. In a desperate position, the ranching industry turned to the Federal Government for help. During this same period of time, the government and various states finally recognized the precarious situation that was facing wildlife. Their approach to the problem was probably an overreaction as game managers and the government placed the major burden of blame on predators in general; the big cats, bears, and wolves in particular.

The events that followed saw the gradual reduction of predatory animals throughout the West, but a few legends were created in the process. I have selected a few of the better known outlaw wolves to describe from an unknown number. Colorado is rich in wolf lore as will be seen in the next section.

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FAMOUS WESTERN RENEGADE WOLVES

Roosevelt (1925) remarked, "all coyotes, like big wolves, die silently and fight to the last." The gray wolves that did survive and fight to the bitter end became known as "outlaw" or "renegade" wolves. Stanley Young, who was Head of the Biological Survey Regional Office in Denver, during the final days stated:

> ...It is probable that never did more intelligent wolves exist than some of these loners, nor were there more dramatic hunts for man or beast planned or carried out, nor greater ingenuity employed, than the efforts put forth by the hunters that trailed them and finally killed them. These wolves had, in the main, become wise beyond all other wolves in the constant avoidance of the various devices employed to capture them by various wolf hunters. At times they seemed to be possessed of most uncanny intelligence in avoiding steel traps, knew poison, and nearly all the methods that man used in attempting to give the drug to them. They likewise seemed to know when man was armed with a gun or was weaponless. With every hand turned against them, they nevertheless received the profound respect of the many stockmen upon whose cattle they preyed, as well as the wolf trappers who finally eliminated them a cost of much time, money, and unlimited patience.

The following is a brief record of several of these "outlaws" that terrorized Arizona, Colorado, Kansas, New Mexico, South Dakota, and Wyoming. Figure 31 shows the approximate areas where the Colorado wolves were said to range (see Young [1970], or Carhart [1929] for a descriptive account).

COLORADO

"Old Lefty" of Burns Hole ranged the Castle Peaks region of Eagle County. He tore off most of his left foot in a trap in 1913 and was noted for his distinguishing gait. He is said to be responsible for killing 384 head of livestock in his career.

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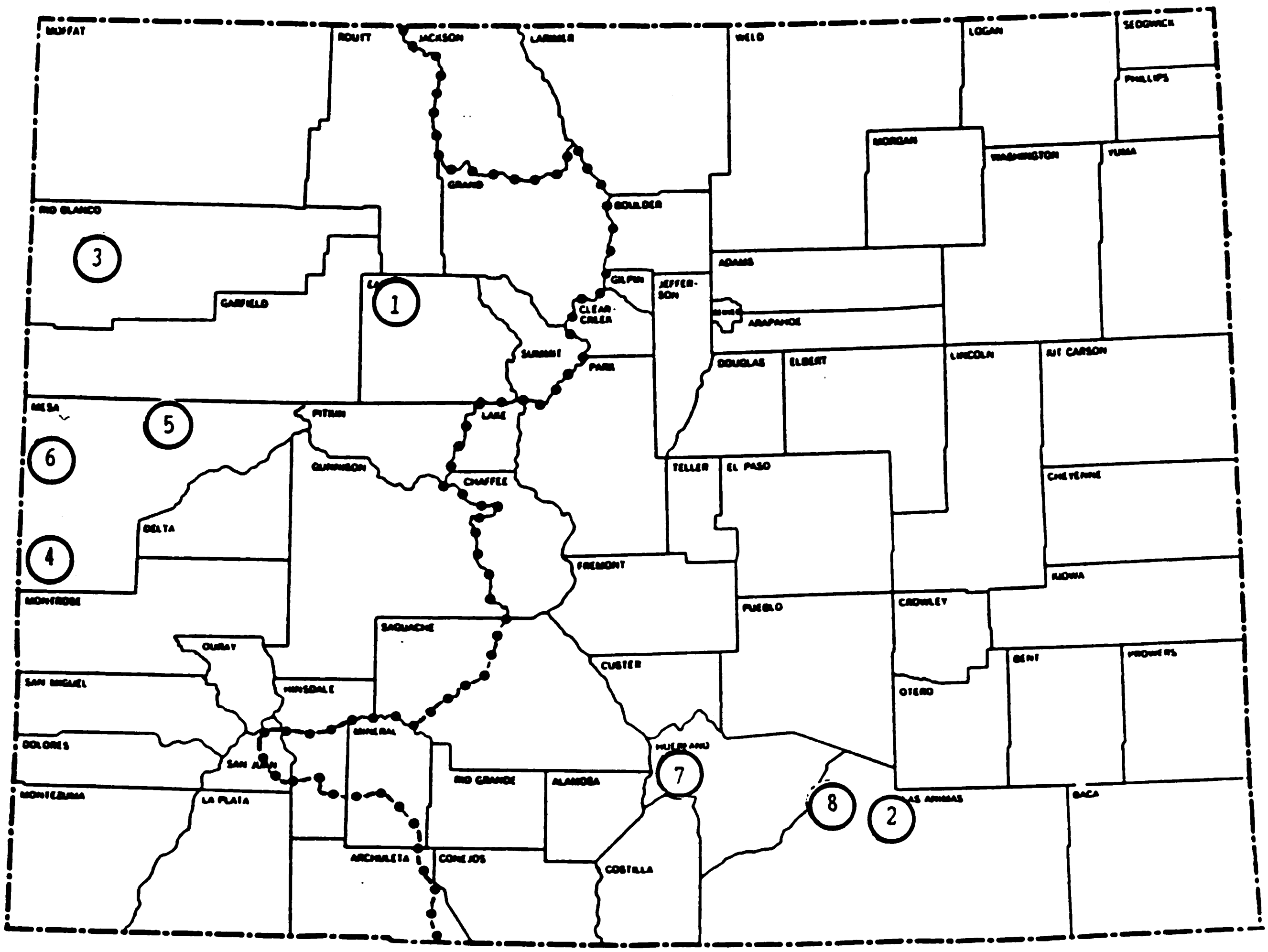

Figure 30. Location Map of Famous Colorado Renegade Wolves.

KEY: (1) Old Lefty; (2) Old Whitey; (3) Rags the Digger; (4) Unaweep Wolf; (5) Big Foot; (6) Phantom Wolf of Big Salt Wash; (7) Greenhorn Wolf; (8) Three-Toes of Aphisapa.

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"Old Whitey" of Bear Springs ranged about 40 miles east of Trinidad, Colorado. He was distinguished by his white pelt and for bobtailing calves. He was reputed to bobtail calves just for the sport of it.

"Rags the Digger" ranged the region around Cathedral Bluffs southwest of Meeker, Colorado. He was so named because of his ability to locate and dig up steel traps set for him and his shaggy coat. Stockmen in this region claimed this wolf caused an economic loss of about $10,000.

The **"Unaweep Wolf"** ranged in the vicinity of the Unaweep Canyon near Whitewater, Colorado and the Uncompahgre Plateau. This female wolf had a unique track due to an old trap injury and was responsible for killing a large number of livestock. Her skull is in the Colorado Museum of Natural History in Denver.

The **"Phantom Wolf"** ranged near the Big Salt Wash near Fruita, Colorado.

The **"Greenhorn Wolf"** ranged in the Butler Pasture area in the Huerfano Valley near Pueblo, Colorado.

"Three-Toes of Aphidasa" was the mate of Old Whitey and both ranged the Bear Springs Mesa region of southcentral Colorado.

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"Big Foot", or sometimes referred to as he **"Terror of Lane Country"** ranged near DeBerque, Colorado. It was reported that his distinctive footprint would, "barely fit inside a number 2 horseshoe. Figure 32 shows a No. 2 horseshoe (courtesy of Mr. John Hunter, Loveland, Colorado) reproduced in actual size in relation to a wolf footprint.

"Two-Toes" of North Park, Colorado.

WYOMING AND MONTANA

> A great number of notorious wolves have been taken by Federal and State hunters in Wyoming. Notable among these are: Scar-Face, Five-Toes, Cushion-Foot, Two-Toes, Three-Toes (or the notorious "Split Rock" wolf), Big Food, Red-Flash, and a pair of Sheridan wolves. Stockmen will well remember them. Some were very remarkable animals. Red-flash, for instance, was an unusually large wolf with a gorgeous coat of glossy red-tipped fur, and was taken in his prime by a Government hunter, Orin Robinson, who, mounted on skies, gave chase, ran down this wolf and shot him. Another off-colored wolf was a blue one taken by Hunter Ed Sterns. Four of a pack of fifteen wolves eliminated by Biological Survey Hunters H.P. Williams and Del Derth near Big Piney were black and bobtailed (Day 1928).

The **Custer Wolf** is usually associated with South Dakota, but the following account by Day (1928) reveals the wolf spent much of his time in Wyoming.

> The Custer Wolf (Fig. 33) was probably the most notorious of Wyoming's stock killers. This old king of the outlaws ranged over northeastern Wyoming and western South Dakota for nine years, and during his reign of destruction killed cattle valued at $25,000. He grew to be the prize catch of any hunter, and soaring bounties for his capture finally reached $500. These failed, for he constantly eluded pursuers and avoided the most cunning and poison sets, even after his mate was killed. He ranged four years after her death without taking another mate, his loss only accentuating his lust for blood, and his killings increased. He had a bodyguard of two coyotes which ran near, but never with him, feeding on his kills after he had eaten his fill. In March, 1920, H. P.

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Figure 31. Full-size Outline of a Number 2 Horseshoe in Relation to a Wolf Footprint (Note: footprint of a three-year-old Alaskan timber wolf, actual size (Lopez 1978, p 20).

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Figure 32. The notorious Custer Wolf, taken after many heart-breaking discouragements by Hunter H. P. Williams, of the Biological Survey. Ranging over a territory 40 by 60 miles in Wyoming and South Dakota, this marauder had killed cattle valued at $25,000, besides uncounted head of big game. (Source: Day [1928], p. 6).

Williams, now Assistant Leader of Predatory Animal Control, was put on his trail with instructions to stay until he killed him. For six months he followed the Custer Wolf through Wyoming and South Dakota. In this time he killed the coyote bodyguards, and on several occasions seemed to have the wolf within gunshot, when something or someone would invariably interfere to give the wolf warning. Finally the old renegade stepped into a trap that Mr. Williams had carefully set, baited with passion scent and provided with a long chain and drag hook. The wolf ran 150 yards when the hook fastened on a tree and the swivel snapped. With only the heavy trap fastened to his foot he ran three miles further before Williams overtook and killed him.

Scent material from a notorious female wolf taken by Williams near Sheridan was what finally lured the Custer Wolf to his destruction.

Day (1929) goes on to describe The **"Split Rock Wolf"** that ranged the Sweetwater River area near Split Rock, Wyoming, a famous historical landmark on the Oregon Trail. of The

Only slightly less notorious than the famous Custer Wolf was old female

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Three-Toes known also as the **$10,000 Split Rock Wolf** (Fig. 34).
This killer had exacted a tribute of at least 50 head of cattle annually before being trapped by C. J. Bayer of the Biological Survey. Old Three-Toes got her name from her track, which was always recognized wherever she did her killing from the fact that one toe had been taken off nearly a year previously in a trap set by Hunter Evans of the Biological Survey. In the interval between her two trappings she had killed nearly 200 head of cattle and probably had gotten her share of also of the antelope and deer in whose country her depredations were conducted. Her last stand was in a trap seven miles northwest of Split Rock, the wolf drag attached to the trap having caught in the rocks. It is such wolves as this that are given up by bounty hunters, and are caught by salaried predatory animal men of the Biological Survey and its cooperators, even though, as in this case, two or more men stick to the trail until the marauder is captured.


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Figure 33. Old "Three-Toes," notorious $10,000 Split Rock Wolf, trapped in 1920 by a Biological Survey Hunter (Source: Day [1928], p. 7).

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The **White Wolf of Cheyenne.**

The last recorded wild wolf killed in Wyoming that I have been able to document was an old white male killed by a "coyote getter" in Fremont County on Thanksgiving Day, 1949, by Government Hunter Charles A. Wilson. This particular wolf had been killing sheep, only to eat their livers. Wilson (1985) states:

> That wolf was as old as the hills and had only five snags left in his jaws! He was fat and had beautiful, shiny, almost white fur. The skin stretched almost seven feet from the tip of his nose to the tip of his tail! (Author's note: the interesting story of this wolf and his capture is detailed in Wilson [1985]).

The **"Ghost Wolf of the Littlebelts"** or **"Old Snowslide"** ranged in the Judith Basin in central Montana. He was reported to have reached an age of about 18 years before being killed. He is mounted and on display in the county courthouse in Stanford, Montana (see King 1965 and Eric Thane in the Empire Section of the Denver Post, April 12, 1953).

"Killer" was notorious wolf that got his name by his habit of killing Shepherd dogs (15 in two years) brought in wipe out predators near Big Timber, Montana. Funderburk (1961) goes on to say:

> With the dog population reduced, the lone wolf turned to coyotes for pastime. Killer tormented the helpless (caught in a trap) animals for hours, taking pleasure in cutting the coyotes to ribbons.

"Old Cripple Foot", a she-wolf, ranged the Little Belt area of central Montana (King 1965).

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The **"Highwood Wolf"**, a Montana wolf that was trailed by Government Hunter Barney Brannin and finally poisoned after a 10 month chase (King 1965).

"Old Crazy Mountain Wallis" ranged the Crazy Mountain region of Montana and had the uncanny ability to split a dog pack by running between the dog pack and the pursued wolves, and then howling which confused the dogs. Pictures of this wolf and his capture are in King (1965).

"Leftie of Fort McGinney" (Montana) was trapped by Barney Brannin in the spring of the year after an all winter chase (King 1965).

The **"Yellow Hammer Wolf"** ranged in the area of Gillette, Wyoming and was reported to be the last wolf known to inhabit this area (1925). After killing 35 head of sheep in one night, he was reported to have been hunted so hard that he left the country and was never seen or heard of again (King 1965).

The **"Bob Drew Wolf"** ranged the Gillette, Wyoming area and was reported to have cost the stockmen of the area an estimated $100,000 before his capture in 1924 (King 1965).

The **"Middle Creek Club Foot Wolf"** of northern Wyoming; taken by Bud Dalrymple, one of the more famous Government Hunters (King 1965). A picture of Mr. Dalrymple and his pet wolf can be found in King (1965, p. 137).

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The **Pryor Creek Wolf** ranged the Pryor Mountains of southern Montana where it had run for at least six years. The wolf was known for its destruction of calves and Shetland ponies, its deeds of cunning, and its skill in eluding traps (Annual Report, Biological Survey, 1922).

SOUTH DAKOTA

See **Custer Wolf** (Wyoming description).

Three Toes of Harding County:

> ... was captured in one of fourteen trap settings placed out of its runway, near which had been placed natural wolf-scent bait. This capture occurred approximately 20 miles northwest of Buffalo, between Gallup and Dry House creeks. Fully 150 men had attempted to take this wolf during the thirteen years he had been known as a killer in Harding County....(Young 1970)

ARIZONA

The **Aquila Wolf**.

> ...a male which ranged the mountainous desert country west of Wickenburg, Arizona, between the years 1916 and 1924. During the eight years of its occurrence on these ranges, stock interests reported that it killed on the average of a calf about every fourth night. On one occasion this wolf was known to have killed 65 sheep in one night and 40 at another time. The range of the Aquila Wolf was in the favorite spring range for Arizona sheep and cattle producers. In the study of the range of this wolf, it was found to be one of the most unusual. It occurred in the low, hot desert section of Arizona at an altitude of not more than 3,000 feet above sea level and in the desert overgrown with typical desert vegetation, such as palo-verdes, mesquites and cacti (Young 1970).

NEW MEXICO

> The wolf known as **Lobo - The King of the Currumpaw**, made famous by the minute description given it by Ernest Thompson Seton, was a 150-pound male wolf captured in northern New Mexico by Seton. It ranged the so-called Currumpaw region for the period 1889-1894 and became in this time a costly

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predator of cattle and sheep (Young 1970).

KANSAS

Yost (1970) relates the account of a renegade wolf that ranged in the country where I was raised in southcentral Kansas:

> The story of ranching in Barber County is not complete without the tale of old **Two Toes**, the big grey wolf that "single-handed" set cattlemen in the region back a good many thousand dollars in the few years he ranged on their pastures...Two Toes...ranged in the Gyp Hills north of that little town (Hardtner) in the southern part of Barber County, near the Oklahoma border.
>
> Some fence riding cowboys came upon a freshly killed yearly steer one morning. A hind quarter had been torn from the still warm body and the cowboys knew it was the work of a lobo wolf. they followed the trail three miles before they came to the den, in which there was five pups. While the wolf raged and howled on a mound half a mile away, trying to draw the men away from the den, one of the boys crawled in and managed to snare a pup. the boys then rode over to the mound and saw that it was regularly used as a lookout from which the wolf kept watch on the family den.
>
> The cowboys set a string of twenty-four traps in the dust around the mound, covering them well and driving the stakes deep into the ground. The next morning, when they came in sight of the mound, they saw the wolf in one of the traps, but when they reached the spot he was gone. Two of his toes remained behind in one of the traps. He had been gnawing at his trapped foot when the men came in sight, but had then jerked free, leaving the toes.
>
> Livestock losses dropped off sharply the rest of that summer, while the wolf's badly injured foot healed. Meanwhile the cowboys had captured three more of the pups, and kept one alive to use as bait to catch the mother. Tieing up the pup at night, they set traps around him. Each morning the tracks of the mother and of the one little wolf that had escaped their raid were plain around the tied pup, but neither was caught for quite awhile. The boys saw signs of a wolf trail, or runway, along a fence, so they set the traps there, and one morning found the freshly killed young wolf in a trap. The signs showed how desperately the mother had tried to free the pup, attempting to dig up the stake that held the trap, and even to gnaw through the steel chain itself. When she knew she could not free him before the men arrived, she had killed him herself. A week later they caught the mother, too.

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The next spring old Two Toes returned to his range with a new mate, and the battle of wits began all over again. The mate was caught in the den that summer, but Two Toes still ranged widely. The men then brought dogs into the battle, and one dog often met up with the wolf. The dog always came home badly chewed up and Two Toes went on killing cattle.

Two Toes showed up with still another mate that third spring, and again the she wolf and pups were caught, but the big grey killer remained at large, killing so many cattle that the cattlemen's association upped the reward for his capture considerably. Affairs on the range became critical when old Two Toes suddenly moved to a new location, nine or ten miles west of Aetna in the southwest part of the county, and brought three females with him. The loss of mules and cattle on that range soon became so serious that all the cowboys of the region held a "drive." More than twenty dogs were brought in from Medicine lodge and Coldwater, but the only results of the drive were some badly chewed up dogs.

The dread of Two Toes was now so great that two Kiowa men, Jack Middleton and Pearl Bunton, took to the hills for the express purpose of killing the big wolf. They took with them eight dogs, one the old veteran that had already battled the wolf so often. The men stayed all night at Aetna, then began the hunt the next morning. They had not gone far when they saw the wolf on the far side of the Salt Fork, carrying something so heavy that he often had to stop and rest. Besides the crippled foot, the old wolf was now hampered by a broken shoulder, acquired some months before in a fight with a buck deer. The combination of injuries slowed him up considerably. The hunters tracked him to his den, where they discovered he had carried, or dragged, the front quarter of a full-grown mule all that distance. On hearing the dogs, Two Toes had dropped the meat at the mouth of the den, then dashed along a ridge trail and jumped to the gyp rock some eight feet below. There he ran into some brush and lay down. When the dogs found his trail again he ran out of the brush into full view and headed for a canyon. Although the men shot at him several times, he escaped. Again the old dog sniffed him out and the two fought again, a wild, snarling battle that left both exhausted, but gave the men time to come up with them. One of the hunters then drew a bead on the played-out old killer and shot him squarely between the eyes.

Whether or not the hunter took the wolf, or even the mutilated foot, to town to prove they had put an end to the famous old killer is not recorded. But the tale ends with the statement that the $1,000 reward offered by a Texas cattlemen's association and some of the local ranchers was never paid, partly because "there was dissention about the identity of the wolf," and partly because the hunters made no particular effort to collect it.

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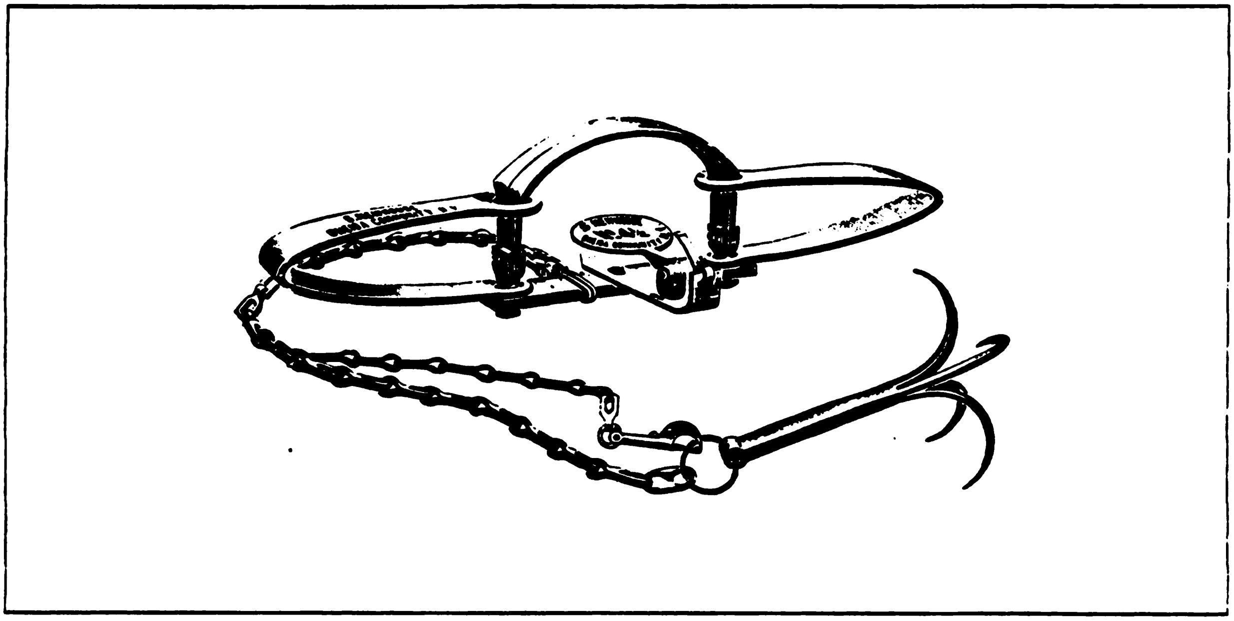
The remainder of this Appendix is a chronological history of wolf-related events to the present, beginning in the mid-1890s.

1895

The manufacture and sale of the famed Newhouse No. 4 1/2 "wolf trap" began this year. Gerstell (1985) states:

> Its market launching was accompanied by publication of a promotional booklet titled How to catch wolves with Newhouse traps and by the production of a special, cast metal wench to use in setting, adjusting, and repairing the trap. The booklet was written and the wrench designed by the well-known naturalist, Ernest Thompson Seaton.

The following illustrations and trap descriptions are from Andersch Brother's (1907).



NO. 4 1/2 NEWHOUSE WOLF TRAP

Spread of jaws, eight inches, other parts in proportion; it is provided with a pronged "drag," a heavy snap, extra heavy steel swivel and chain five feet long. The latter is warranted to hold two thousand pounds. As above shown the trap weighs eight pounds. It will hold the mountain lion.

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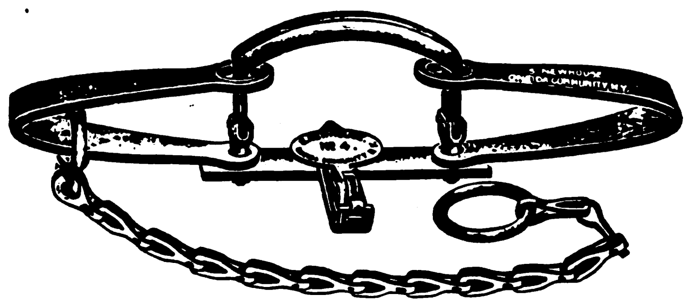
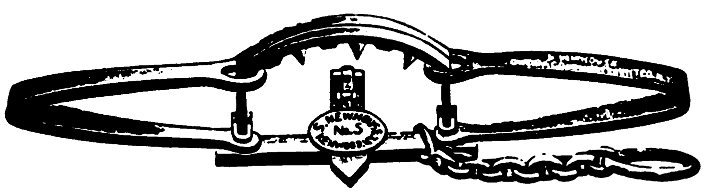
The No. 4 Newhouse trap was also used extensively by professional trappers because of its lighter weight (Young and Goldman 1944).



NO. 4 NEWHOUSE STEEL TRAP

Spread of jaws, 6 1/2 inches. This trap is expressly built for beaver and prairie wolf, but will hold most any animal, from the timber wolf down. Trappers use this size for the Canadian lynx, also for the brush wolf.

Two other popular traps of this era were the Newhouse No. 5 and No. 6 used for bear. Because of their great stength, a clamp was recommended to set the traps.



NO. 5 NEWHOUSE STEEL TRAP

This trap has jaws speading 11 3/4 inches apart, and with a short chain weighs nineteen pounds. It is expressly made for the black and brown bear. The trap is furnished with a short swivel link, and large ring, all sufficiently strong to detain the monster, especially when its sharp steel teeth.are impregnated in the skin or bone if his foot or leg.

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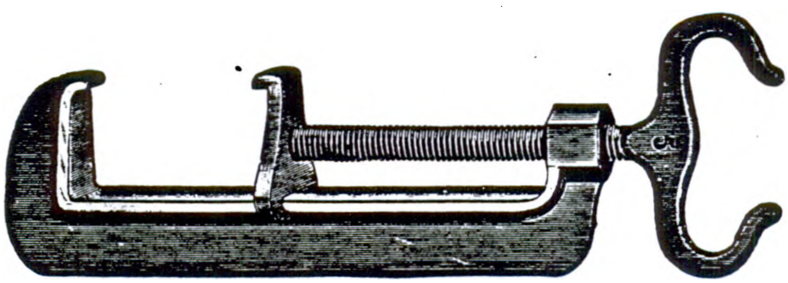
NO. 6 NEWHOUSE STEEL BEAR TRAP

This monster bear-trap is designed for the grizzly or polar bear, also shipped from this country to Africa, presumably to hold the lion. One of these traps was on exhibition at the Minnesota State Fair in connection with our (Andersch Bros.) fur exhibit in 1902, and thousands of trappers viewed this monster trap, all feeling assured of its holding the grizzly bear. The jaws have a spread of sixteen inches, and the entire trap as illustrated weighs forty-two pounds.



NEWHOUSE CLAMPS FOR SETTING STEEL TRAPS

These clamps are made to overcome the difficulty and danger of setting steel traps, especially the larger size. They are made in three sizes.

No. 4. Clamp for traps up to No. 4.
No. 5. Clamp for all larger sizes including No. 6.
No. 6. Clamp a still stronger clamp than No. 5, for the same size traps.

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(Author's note): The traps shown are highly sought after by collectors; current (1993) prices range from $150 for the Newhouse 4 1/2 to $600 for the No. 6.

1896

The following column was printed in the Saratoga Sun newspaper (Wyoming), dated December 10, 1896:

> George Allen was in from Pass Creek Friday. He reports severe depredations by wolves in his vicinity. There is a large band of a dozen in that country, of which three are black and the rest gray. They are killing calves, colts, and young stock all along the creek...some of the stockmen are offering $5 and $10 reward for the scalps of these marauders, and there is talk of combining all the stockmen on the creek and each paying, say a sum of one dollar, as bounty...The black wolves are a rarity for this part of the country, none of that color being seen until the last few months. They have undoubtedly found their way down from British Columbia. They are very large, coal black in color, and are very daring. The extermination of these pests is a serious question for the stockmen to deal with, and some concerted action will have to be determined upon before they gain a permanent foothold. Wyoming Wildlife, Vol 4, No. 9, Sept., 1939).

T.S. Palmer of the U.S. Biological Survey publishes a critical article concerning the bounty system being advocated at the time. The following is a summary of his article that appeared in the 1896 Yearbook of the United States Department of Agriculture Yearbook:

> (1) Bounty legislation has existed in the United States for more than two centuries and a half, and has been thoroughly tested in most of the States and Territories.
> (2) Rewards have been paid (a) on large animals, such as wolves, coyotes, bears, and panthers; (b) on small mammals, particularly gophers, ground squirrels, and rabbits; (c) on a few birds, such as crows, English sparrows, hawks, and owls.
> (3) This legislation has probably involved an expenditure of over $3,000,000 in the last quarter of a century, and the expense seems to be increasing instead of decreasing. Single laws have caused an outlay of nearly $200,000 in less than two years, and it is safe to say that any act which carries a sufficiently high reward to insure its operation will cost from $5,000 to $20,000 per annum.
> (4) Objections to the bounty system may be grouped under four main heads: (a) Expense, which is usually out of proportion to the benefit gained, and may be greater than the county or the State can afford; (b) impossibility of maintaining bounties in all parts of an animal's range for any length of time; (c) impossibility of maintaining equal rates in all the States; (d) impossibility of preventing payments for animals imported from other States, for counterfeit scalps, or for animals raised especially for bounty. These objections have never been satisfactory overcome, and most laws have failed through one or another of these causes.
> (5) Bounties have not resulted in the extermination of a single species in the United States, and have failed even in the island of Bermuda, which has an area of less than 20 square miles.
> (6) Rewards for wolves, coyotes, and panthers are now so generally paid as to check the increase of these species to some extent, but premiums on ground squirrels, gophers, and other small mammals have accomplished little or nothing, and bounties on birds may do great harm by encouraging the killing of useful species through ignorance.
> (7) Extermination of noxious animals is usually slow and can be accomplished more effectively and economically through the efforts of individual landowners than by the lavish expenditure of public funds.

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1897

The Thorn brothers of Sundance (Wyoming) killed 79 wolves in one week in May, 1897. Employed as wolfers by the Standard Cattle Company, the two men earned $4 per pelt in bounties. In the two year period 1897-1898, the state paid bounties on 4,281 wolf pelts. In the 11 years to 1908, an additional 10,819 bounties were paid.

The Organic Administration Act of 1897 (16 USC sect. 475) is signed into law by President McKinley on June 4, 1897. This Act is referred to as the "Organic Act" of the U.S. Forest Service. For 63 years, the 1897 Organic Act provided the basic framework for managing the Federal forest reserve, until supplemented in 1969 by the Multiple-use Sustained-Yield Act.

> As late as 1897, a small herd of wild buffalo, numbering between twenty and thirty animals, ranged in Lost Park near Bison Peak, Park County, Colorado. They had been protected by ranch and cattlemen, but occasionally some unprincipled person would kill one, and the increase was less than the loss. Through the work of these vandals, the herd dwindled until there were but four left: two bulls, one cow and one calf. These are believed to be the last wild buffalo killed in the United States (Garretson 1938).

1898

The following table (Corbin 1900) was meant to show the seriousness of wolf predation on the livestock industry in an effort to increase bounty payments.

NUMBER OF CATTLE SHEEP AND WOLVES IN EIGHT STATES OF THE UNION

	Cows	Other Cattle	Sheep	Wolves
Nebraska	628,750	1,395,825	296,779	275,000
South Dakota	372,321	449,362	363,697	275,000
North Dakota	175,073	252,640	359,721	343,000
Montana	43,994	952,598	3,377,547	300,000
Wyoming	18,140	694,973	2,328,025	340,000
Colorado	91,666	973,259	1,655,557	200,000
New Mexico	19,317	701,967	3,128,692	350,000
Arizona	18,404	381,812	1,014,287	175,000

The livestock numbers are fairly accurate, but the wolf numbers are inflated. I believe his line of reasoning was based upon the assumption that 1/2 the estimated wolf population was female and each had a litter of 5 pups with no mortality. The actual estimated number of wolves would be about 1/5 of the numbers shown. The legislature voted against an increased wolf bounty.

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1899

First national forest grazing permits issued in Colorado. Fees were twenty cents per head for the summer and thirty-five cents for the year (Peake 1937).

Wolf skin production in the United States and Canada for the 1899-1900 trapping season was 75,000 raw pelts (Andersch Bros. 1906).

First car in Denver

1900

Wolf skin production in the United States and Canada for the 1900-1901 trapping season was 72,500 raw pelts (Andersch Bros. 1906).

Population of Colorado 539,700

1901

Wolf skin production in the United States and Canada for the 1901-1902 trapping season was 90,000 raw pelts (Andersch Bros. 1906).

1902

Wolf skin production in the United States and Canada for the 1902-1903 trapping season was 110,500 raw pelts (Andersch Bros. 1906).

"Old Clubfoot" (a grizzly bear) was killed near Delta on October 24 (Murray 1987).

Rollinson describing the presence of wolves in the Goshen Hole area of southeastern Wyoming:

> Game and coyote sign were plentiful, and we soon began to hang up a bunch of good pelts...We ranged rather far from our stone house camp and reached the homes of other folks living on small streams, some ten or twelve miles distant. These were all bachelors who had small bunches of cattle and winter range in the Goshen Hole country. Occasionally these men would stop at our camp when they were riding in that direction. From more than one we heard of the wolves which each winter made most unwelcome visits to that part of the range. They did not remain long, but were accused of killing many cattle during their predatory visits. Some of our new neighbors declared there was a large pack of wolves; some said five or six; a few of the more conservative men said three or four. It was thought these savage creatures came from the Black Hills country. Trappers had, in former years, failed to have any success in taking or poisoning them, and the wolf pack was said to be uncanny and smart. (Rolliston. 1941. Pony Trails in Wyoming.)(Authors note: the pack was discovered to consist of three wolves, of which, one was shot).

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A $50.00 wolf bounty was paid by stockmen in North Park, Colorado (Peake 1937).

1903

> In northwestern Colorado, in the White River country, cougars fairly abounded in the early nineties, while up to that time, the big gray wolves were almost or entirely unknown. Then they began to come in, and increased steadily in numbers, while the cougars diminished, so that by the winter of 1902-3 they much outnumbered the big cats...In one winter in the neighborhood of the Keystone Ranch he (a trapper) trapped forty-two big gray wolves; they still outnumber the cougars, which in that neighborhood have been nearly killed out, but they are no longer abundant (Roosevelt 1925).

"Old Four Toes" (a grizzly bear) killed near Montrose (Murray 1987).

First Colorado hunting licenses issued. Cost was $1.00 for residents and $20.00 for non-residents (Tech. Pub. 16).

Wolf skin production in the United States and Canada for the 1903-1904 trapping season was 100,000 raw pelts (Andersch Bros. 1906).

1904

The total population of antelope in Wyoming at this time was estimated to be about 5,000 animals (Allred 1943).

Wolf skin production in the United States and Canada for the 1904-1905 trapping season was 125,000 raw pelts. Total wolf skin production in the United States and Canada from 1899 to 1905 was 498,000 raw furs valued at $672,300 (Andersch Bros. 1906).

"Old Mose", perhaps the most famous of the legendary grizzly bears, killed on Black Mountain, in Park County on 30 April (Murray 1987).

1905

> The loss of cattle in Wyoming and southern New Mexico during recent years from wolves has caused much alarm. It was thought by many that the wolves were breeding in the reserves, and that protection of game increased their number. In response to an appeal from stockmen, the Forest Service in cooperation with the Biological Survey, is studying the habits of wolves and coyotes, the location of their dens, and the most practical method for their extermination. It has already been found that the breeding grounds are not within the reserves, but in the foothills outside, and that they simply follow the cattle into the mountains during the summer. A large number of dens were located and steps were taken to kill both the old and young wolves. It is confidently believed that the result of this investigation will be of great benefit to live stock interests (source).

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First licensed sage grouse season in Colorado from September 1 to October 20, with a daily bag limit of 25 and a possession limit of 50 birds (Colorado Game, Fish and Parks Department, Tech. Pub. No. 16, date?).

In Wyoming, the cost of a resident license increased to $2.00. This license entitled the resident to kill 2 antelope, 2 deer, 2 elk and one mountain sheep (Wyoming Game and Fish Commission 1957).

Rollinson (1945) describing wolves in the Sunlight Basin area of northern Wyoming in the early 1900s:

> Along in January, while the cattle were down on the winter range, wolves made their appearance. Al Beam first observed where they had killed a couple of young heifers...we poisoned the freshly killed carcasses, but got only three coyotes, a lot of magpies, a couple of jays, and an owl...About ten o'clock every night a wolf on a distant peak would let loose his long-drawn, deep-throated howl, and presently an answering call would be heard from another point; then others would take it up. Then would follow silence for perhaps an hour. Then would come the sounds of a chase as if the pack were running deer or elk, and though they could not catch them on level land, they knew if they could run a deer or elk into the deep-crusted snow along the edge of the timber, or on the ice of the creek, they could easily make a kill-and they did, every night.
>
> Our dogs were not the kind to follow a track, and the wolves outsmarted every trap we set for them, so our night watch was kept up for seven weeks. We were all disgusted, as the Yellowstone National Park was the breeding ground, or at least the refuge, for these predatory beasts (Rollinson 1945).

1906

> A preliminary study of the present status of the wolf problem in the Western States, with a view to the discovery of methods of destroying the big gray or timber wolf, has been completed, except that certain work during the fall months is necessary to develop the best methods of trapping at that season. A report on the subject, prepared by the Biological Survey, will be published by the Forest Service (Report of the Chief of Biological Survey. 1906. United States Department of Agriculture, Washington, DC).

Various names are used throughout the early literature to denote the wolf. The following is quoted from the 1906 publication of Andersch Bros., Hunters and Trappers Guide, which may help explain the terminology used during this period:

> The timber wolf - He is found in northern, western and northwestern states, also in Canada. He must not be confused with the smaller order elsewhere described under brush or buffalo, neither with the still smaller variety of prairie or coyote. It is also known under the name of giant wolf or grey wolf...Recently there was shipped to us from Canada what was considered by the shipper and his friends to be a good specimen of a large timber wolf. The animal was killed by a Mr. Johnson in the vicinity of Calgary and shipped in a frozen state, reaching us in a well-preserved condition. The dimensions are judged to be as follows when the animal was alive:
> Length from root of tail to extremity of nose.................63 1/2 inches
> Tail, root to tip..18 inches
> Height from floor to top of shoulders.........................29 1/2 inches

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Circumference of body estimated...............................34 inches

The brush wolf - This is also a northern species, somewhat smaller than the timber or grey wolf...In size he is about one-half between that of the small prairie and the big timber species. The male is about one-fifth to one-fourth larger than the female. The former attains a weight of 60 to 80 pounds. One fair-sized specimen that came to my notice, and which was killed in northern Wisconsin by being poisoned, weighed 71 pounds... The skin of the animal during the winter time, if not otherwise damaged, is suitable for for various purposes, and of late years the manufacturer has purchased the better grade of such skins, which are converted into the spurious tails so extensively used by the furrier in the making of ladies' neckwear, boas, etc.

The black wolf - This dusky brute is now sparingly found on this hemisphere. Audubon and Bachman and other prominent naturalists claim that the black wolf, 40 to 60 years ago, was numerous in the southern states and in fact all over the the United states. The black wolf is by no means extinct in this hemisphere, but is exceedingly scarce, and probably extinct in most states. During the last 15 years, no less than 100,000 wolf skins of the various species came to my notice, and out of this number no more than twelve or fifteen were of the black variety...A certain trapper and Indian trader informed me some years ago that this black brute is shunned by the white man as well as the Indian, that all believe that the fortunes of the individuals are affected by the killing of a black wolf.

The white wolf - In former years the white wolf was found to be quite numerous in Montana, Idaho, Washington. Wyoming and Oregon, but of recent years has become almost extinct, at least such are the reports from that section, which are confirmed by the exceedingly small number of white wolf skins received in this and other principle markests of the United States. They are still quite numerous in Alaska and British North America...Certain tribes of Indians were opposed to killing the white wolf, believing as they did that by doing so they would incur the ill-will of their gods, etc.

The prairie wolf or coyote - This brute is known the world over and resembles the European more than any of the other species....

1907

As stated last year, the problem of ridding the National forests and cattle ranges of gray wolves was taken up by the Biological Survey at the request of and in cooperation with the Forest Service. As the result of investigations by one of the assistants of the Survey, a preliminary bulletin was issued, followed later by a circular setting forth practical methods of reducing the number of wolves. Both these publications were widely distributed to forest rangers, ranchmen, hunters and trappers in the wolf-infested regions.

The depredations of wolves are not limited to the western stock ranges. So numerous have timber wolves become in the upper peninsula of Michigan and upper Wisconsin and Minnesota as to threaten extinction of the deer. At the request of owners of large tracts of forest land and of sportsmen, an assistant of the Survey visited the region for the purpose of studying the problem on the ground and of devising methods to abate the evil. As a result, practical suggestions for destroying wolves were set forth in a circular which has been widely distributed in the above-named States.

Following the adoption of the methods recommended, especially that of destroying the pups

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in the breeding dens, so many wolves have been killed that the savings of stock this year amounts to at least a million dollars, and it is believed that persistent efforts will result in a permanent reduction of the numbers of these destructive animals, if not their practical extermination in the cattle country. Their absolute and final extermination will probably not be practicable so long as extensive tracts of wild land remain to afford them harborage (Report of the Forester. 1907).

Circular No. 55 issued by the Bureau of Biological Survey to:

...present briefly the best methods of hunting, trapping, and poisoning wolves and coyotes, of finding their dens and destroying the young, and of fencing to protect stock" (Bailey, V. 1907).

Circular No. 72 issued by the U.S. Forest Service to:

..put in the hands of every hunter, trapper, forest ranger, and ranchman directions for trapping, poisoning, and hunting wolves and finding the dens of young (Bailey, V. 1907).

The number of wolves and coyotes killed in and near national forests in 1907 was:

Forest	Wolves	Coyotes	Remarks
		Colorado	
Medicine Bow	13	950	of the wolves, 7 were pups
San Juan	1	365	
Holy Cross	--	294	
Pikes Peak	--	346	
Wet Mountain & San Isabel	--	142	
Montezuma	6	55	
White River	45	596	
Gunnison	--	254	
		Wyoming	
Yellowstone	79	218	old wolves 8; pups 71
Bear Lodge	925	1,165	
Medicine Bow & Sierra Madre	5	600	

(Source: Bailey, V. 1908. Destruction of Wolves and Coyotes, Bureau of Biological Survey, Circ. No. 63, p. 6).

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"Old Clubfoot" (a grizzly bear) killed in Moffat Co. (Warren 1942)

Wolves were reported as common and destructive to stock near Lamar in 1892 and as common about Olney, Arlington, Chivington, and Burington in 1894, all on the plains of the eastern part of the State. In 1894 they were common also in Estes Park. In 1905 they were common and destructive to stock in North Park, in the Bear and White River valleys, and on the Iron Springs Divide of the Goldovia Ridge; and in 1906 they were killing stock on the Laramie Mountains in North Park. Middle Park, in the Rangely region, in Lily Park, Browns Park, and the Snake River Valley, and on the Iron Springs Divide (Bailey, V. 1907).

1908

As the result of much experimental field work, the destruction of wolves and coyotes by locating the breeding dens and killing the young and by approved methods of poisoning and trapping have been earnestly advocated as the most practicable means of checking the increase of these formidable carnivores. Circulars describing these methods have been widely distributed to stockmen and others throughout the wolf country, with the result that during the past year more wolves and coyotes were destroyed than ever before, the total number of wolves known to have been killed being over 1,800 and the number of coyotes about 24,000. The saving of stock by this means is estimated at not less than $2,000,000.
It is earnestly pointed out that the safety of stock over the great cattle and sheep ranges of the West depends upon the persistence with which repressive methods are followerd up. So long as wild lands exists in vast tracts, so long will wolves find safe harborage and breeding grounds therein. By persistent effort, however, and at comparitively small cost, the number can be so reduced as to limit the damage done by them to a minimum (Yearbook of the United States Department of Agriculture. 1909. U.S. Government Printing Office:Washington, DC).

Passing from the general consideration of poisons to their practical use by the farmer and stockman for the protection of his property against pests, it may be stated that strychnine is the most effective poison known for wolves. The strycnia sulphate is to be preferred on account of its quicker action. The proper dose for a wolf is 4 grains; for a coyote, 2 grains. The common 3-grain gelatin capsules of the drug stores, if well filled, will hold 4 grains of strychnine. The 2-grain capsule should be used for coyotes. Fill, cap, and carefully wipe each capsule to remove every trace of the drug from the outside. Insert it into a piece of beef suet the size of a walnut and close the cavity. The baits should be carried in a can or pail and not handled except with gloved hands or forceps. They should be dropped from horseback along trails followed regularly by wolves or by an artificial trail made by dragging an old bone or piece of hide well saturated with the fetid scent described in Circular 63 of the Biological Survey, which should be consulted for more detailed directions for destroying wolves. These baits are very effective when placed around or partly under a carcass on which wolves or coyotes are feeding (Ibid).

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BOUNTIES FOR 1909-1910 (Wyoming)

Appropriations	$60,000.00
Bounty on Coyotes	1.25
Bounty on Wolves	5.00
Bounty on Mountain Lions	5.00

Entire skin must be presented in order to collect bounty. Must have naturally attached the four paws, the skin of the head, with both ears, upper and lower lips, and upper jawbone or head. Affidavit may be made before the County Clerk or a Notary Public designated for the purpose, and must be sworn to by the applicant, who must be identified by one resident taxpayer.

Private bounty associations which have complied with the law may also take affidavits, and may advance the amount of the state bounty, which will be refunded to them by the State Auditor on presentation of the proper papers (Sheep Laws of Wyoming. 1909. S.A. Bristol Co., Printers and Binders, Cheyenne, Wyoming).

The following animals were destroyed within and immediately adjacent to the National Forests by 51 Forest rangers and guards, detailed to work for an average period of one hundred and seven days (Colorado statistics shown):

Bears	--
Lions	3
Wolves	1
Wolf pups	--
Coyotes	73
Wild-cats	11
Lynxes	1

The value of the stock which these animals would have destroyed in one year, as estimated by the Biological Survey and by experienced stockmen, is at the lowest figures not much less than the total amount paid for grazing privileges during the year. It was impossible to meet the demand by hunters.

Prairie dogs were practically exterminated on large areas of Forest in Colorado, New Mexico, and Arizona, and it is anticipated that the land will shortly become productive of forage grasses and plants. Most of the Forests in the infested regions now have at least one man upon them who is versed in the work and can be assigned to it during the periods when it is most effectual. A widespread interest and readiness to assist has developed among stockmen.

An interesting encounter with wolves in the wild is narrated by Enos Mills (Mills 1909):

On that autumn afternoon I was walking along slowly, reflectively in a deep forest. Not a breath of air moved, and even the aspen's golden leaves stood still in the sunlight. All

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was calm and peaceful around and within me, when I came to a little sunny frost-tanned grass-plot surrounded by tall crowding pines. I felt drawn to its warmth and repose and stepped joyfully into it. Suddenly two gray wolves sprang from almost beneath my feet and faced me defiantly. At a few feet distance they made an impressive show of ferocity, standing ready apparently to hurl themselves upon me.

Now the gray wolf is a powerful, savage beast, and directing his strong jaws, tireless muscles, keen scent, and all-seeing eyes are exceedingly nimble wits. He is well equipped to make the severe struggle for existence which his present environment compels. In many western localities, despite the high price offered for his scalp, he has managed not only to live, but to increase and multiply. I had seen gray wolves pull down big game. On one occasion I had seen a vigorous long-horned steer fall after a desperate struggle with two of these fearfully fanged animals. Many times I had come across scattered bones which told of their triumph; and altogether I was so impressed with their deadliness that a glimpse of one of them usually gave me over to a temporary dread.

The two wolves facing me seemed to have been asleep in the sun when I disturbed them. I realized the danger and was alarmed, of course, but my faculties were under control, were stimulated, indeed, to unusual alertness, and I kept a bold front and faced them without flinching. Their expression was one of mingled surprise and anger, together with the apparent determination to sell their lives as dearly as possible. I gave them all the attention which their appearance and their reputation demanded. Not once did I take my eyes off of them. I held them at bay with my eyes. I still have a vivid picture of terribly gleaming teeth, brisling backs, and bulging muscles in savage readiness.

They made no move to attack. I was afraid to attack and I dared not to run away. I remembered that some trees I could almost reach behind me had limbs that stretched out toward me, yet I felt that to wheel, spring for a limb, and swing up beyond their reach could not be done quickly enough to escape those fierce jaws.

Both sides were of the same mind, ready to fight, but not all eager to do so. Under these conditions our nearness was embarrassing, and we faced each other for what seemed, to me at least, a long time. My mind working like lightning, I thought of several possible ways of escaping. I considered each at length, found it faulty, and dismissed it. Meanwhile, not a sound had been made. I had not moved, but something had to done. Slowly I worked the small folding axe from its sheath, and with the slowest of movements placed it in my right coat-pocket with the handle up, ready for instant use. I did this with studied deliberation, lest a sudden movement should release the springs that held the wolves back. I kept on staring. Statues, almost, we must have appeared to the "camp-bird" whose call from a near-by limb told me we were observed, and whose nearness gave me courage. The, looking the nearer of the two wolves squarely in the eye, I said to him, "Well, why don't you move?" as though we were playing checkers instead of the game of life. He made no reply, but the spell was broken. I believe that both sides had been bluffing. In attempting to use my kodak while continuing the bluff, I brought matters to a focus. "What a picture you fellows will make," I said aloud, as my right hand slowly worked the Kodak out of the case which hung under my left arm. Still keeping up a steady fire of looks, I brought the kodak in front of me ready to focus, and then touched the spring that released the folding front. When the Kodak mysteriously, suddenly opened before the wolves, they fled for their lives. In an instant they had cleared the grassy space and vanished into the woods. I did not get the picture.

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With a gun, The wolf encounter could not have happened more happily. At any rate, I have not for a moment cared for a gun since I returned enthusiastic from my first delightful trip to the wilds without one. Out in the wilds with nature is one of the safest and most sanitary of places. Bears are not seeking to devour, and the death-list from lions, wolves, snakes, and all other bug-bears combined does not equal the death-list from fire, automobiles, street-cars, or banquets. Being afraid of nature or a rainstorm is like being afraid of the dark.

Another experience with wolves in Wyoming is narrated by Mills in Adventures of a Nature Guide.

> A tumbleweed in a Wyoming windstorm furnished the plaything in an exciting game for a pack of Wolves. I watched the play from the shelter of a ravine. Flying before the wind, the tumbleweed bounded a ridge with a huge wolf leaping after it. Closely pressing him came a pursuing pack of twenty. A lull in the wind and the tumbleweed, colliding with the leading Wolf's head, bounded off to one side. Other wolves sprang in the air after it, but the wind carried the tumbleweed along and the entire pack rushed in pursuit.
>
> This big, much-branched, ball-shaped weed was two feet in diameter. When it touched the earth the gale swept it, bounding forward and rolling over and over, across the brown wide plains. After it came the closely massed Wolves. Just as those in the lead were nearing this animated plaything it was caught by a whirlwind and pulled high in the air. Two Wolves leaped and tried to sieze it. Several sat down and stared after it as though it was gone forever. The tumbleweed commenced to descend, but bouyed by the air as it came down slowly. The pack surged this way and that, as the weed surged in descending, to be beneath it; and while it was still several feet above them a high-leaping fellow struck it head-on and sent it flying to one side. It disappeared in a hollow and the Wolves vanished after it. Puffs of dust and occasionally the high-bounding weed itself told me that the game was on as vigorously as ever.
>
> The next act opened with the re-appearance of one of the Wolves running up a slope and looking back over its shoulder. Up in the wind, a little behind him and off to one side, came the tumbleweed. The Wolf turned, leaped at the weed, struck it with his breast, and knocked it vaulting away. The pack, rushing into view, swerved as one to seize or strike it. Each player was intense and all were as serious as football players. A sweeping gale carried the whirling weed forward again. It came into contact with a rock outcrop and rolled to one side. The whole team rushed at the weed and tumbled pellmell around it....

Antelope are still found in 14 Western States though the total number is approximately only 17,000. Not withstanding the fact that the antelope is protected throughout the year in practically all the States in which it now occurs, special efforts are necessary to save this fine game animal from extinction. In the decade from 1898 to 1908 the antelope of Colorado, according to estimates of the state game warden, decreased from 25,000 to 2,000. (Yearbook of the United States Department of Agriculture. 1909. Washington, Government Printing Office.)

A standing reward of $100.00 for any female wolf killed in the Tensleep (Wyoming) area was in effect during

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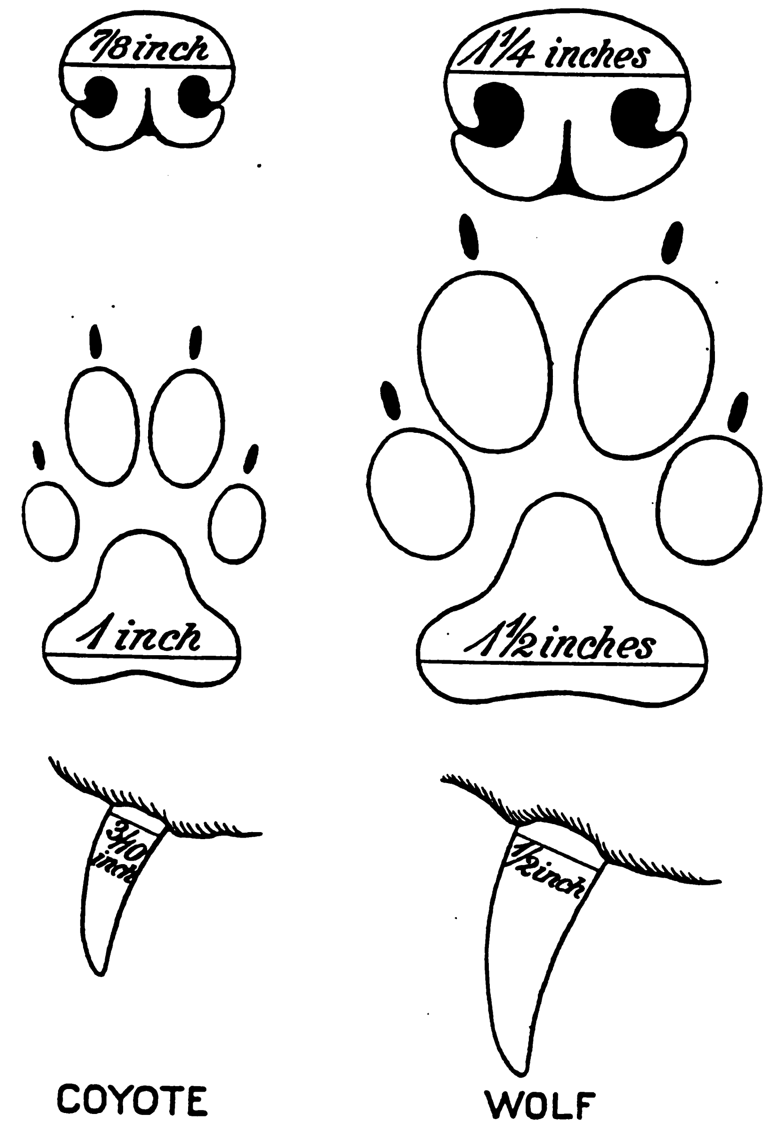
this time period (Frison 1970).

In an effort to prevent widespread fraud in the then current bounty system, Circular No. 69 issued by the Bureau of Biological Survey as an aid to county and State officers in identifying scalps, skins, and skulls of wolves and coyotes, the pups of wolves, coyotes, red, gray, and kit foxes, and young bobcats, coons, and badgers. The following diagram is from this Circular (Bailey, V. 1909).

DIAGRAM SHOWING RELATIVE SIZE OF NOSE PADS, HEEL PADS OF FRONT FEET, AND DIAMETER AT BASE OF UPPER CANINE TEETH OF WOLVES AND COYOTES.



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1910

Wolves seem to be found all over Colorado, though from what Bailey says about their habits in Wyoming, they may move down from the higher elevations at the approach of winter. But wherever I have been in the State I have heard of the presence of wolves, in greater or less abundance, and I doubt if there is any county in the State, with the possible exception of Denver, which has not a few wolves within its limits, and Denver has some in confinement in the City Park (Warren 1910).

Mr. A. C. Rowell, in a letter written to the State Game Warden of Wyoming (D. C. Nowlin):

If we need any game laws at all, we need a stringent law against the use of poison on the public domain. I can say that I know positively that poison of any kind is not a success for destroying wolves and coyotes, nor for taking any kind of animal where it is desirable to recover the carcass or pelt.

I found that in using poison, even in moderation and with judgement, I killed all sorts of harmless birds, some dogs and many other things I didn't desire to kill. And I find in this country [Dubois] that poison has about exterminated carnivorous fur-bearers, without doing anyone any good; fox, martin, mink, skunk and all kinds of cats will take poison readily.

As a general thing the stockmen use poison in utter ignorance of how it should be used, and they generally use it when fur-bearers are raising young and are unprime; by killing the females they destroy the young. Even with those animals which take poison, it is impossible to recover half those that are killed. (Annual Report of the State Game Warden of Wyoming. 1910. The S. A. Bristol Co., Printers and Binders, Cheyenne, WY.

Total elk poulation in Colorado reduced to 500-1000 individuals (Swift 1947).

Forest officers killed the following animals harmful to livestock and to game animals and birds in Colorado:

Bears.......... 12
Lions.......... 3
Wolves......... 6
Wolf pups...... 11
Coyotes........613
Wild-cats...... 88
Lynxes......... 3

This is an increase of 109 per cent over the number of animals destroyed last year. The number of bears killed increased 151 per cent, of wolf pups 139 per cent, and of coyotes 107 per cent. Wolves and coyotes are particularly destructive animals. The benefits of

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this work are cumulative, for the animals killed off cease to breed as well as to levy toll upon the stock and game on which they feed. Good progress was made in clearing parts of the range of prairie dogs. Many of the Forest officers have become proficient in the methods found to be most successful. The work was carried on as widely as possible with the funds available. Stockmen displayed an active interest in the work, and in a number of instances cooperated with the local Forest officers (U.S. Department of Agriculture 1910)

1911

Forest officers in Colorado killed the following animals harmful to livestock and to game animals (Report of the Forester 1911):

Bears............	11
Mountain lions....	-
Wolves............	8
Wolf pups.........	31
Coyotes..........	1,008
Wild cats.........	70
Lynxes............	2

The following account of Colorado mammals is quoted from: Cary, M. 1911. North American Fauna No. 33 - A biological survey of Colorado. U.S. Government Printing Office, Washington, DC.

Elk - The elk is now exterminated over much of its former range in Colorado, and the few bands which remain in the wildest part of the western plateaus and mountains are small and widely scattered...

Mule deer - The mule deer...is found in every county west of the Continental Divide, being probably more abundant in Routt and Rio Blanco Counties...Mr. Edward A. Preble reported a few mule deer in the Estes Park region in 1895, but I heard of none in the foothills of Boulder and Larimer Counties in 1906. Apparently none remain on the plains east of the mountains, where they were common in the early times.

Antelope - Antelope are now comparatively scarce even in the thinly settled parts of the eastern plains region, and few remain on the sage plains of North Park and Routt County, where formerly there were thousands...in 1898 the state game warden placed the number at 25,000, while in 1908 the game commissioner estimated not over 2,000. A conservative estimate based on data collected by the Biological Survey would not be over 1,200 in 1909.

Bison - The buffalo was formerly present over much of the state, even ranging in summer to timberline in certain sections of the mountains, as is proved by the bleached and weathered skulls occasionally found at that elevation. While most numerous on the plains east of the mountains, they nevertheless must have been common in the higher mountain parks, especially on the sage plains of North Park, where the bleached skulls, now rapidly disintegrating after more than twenty years' exposure may still be seen in considerable numbers. A favorite range of the buffalo was the extensive region of sage plains in western Routt County, where in sections least frequented by range cattle the deeply worn trails can still be distinguished...

Mountain sheep - A few bands of mountain sheep live on nearly all the high mountains ranges

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of Colorado. On the main ranges they are usually seen at or near timberline and seldom below the Canadian Zone. On the plateaus and in rough country of western and southwestern Colorado, however, they occur at much lower elevations...Although they have been protected by law in Colorado since 1885, the marked increase at the present time is the result both of a more efficient game-warden service and of local protection afforded by an aroused public sentiment. A danger which threatens mountain sheep in Colorado, as well as other Western States, is the introduction of scab introduced by domestic sheep allowed to graze on the higher mountain slopes.

Gray wolf - Gray wolves were formerly abundant over practically the entire state, except possibly the highest mountains, and were especially numerous on the eastern plains, where large bands preyed upon the buffalo. From this habit of hanging on the flanks of the large herds, they were generally known as buffalo wolves. The mountain animals are said to average much darker than those of the plains, Unfortunately there are no specimens available from the mountains to settle this point, but it is unlikely that two forms occur in the State. Wolves are still found in considerable numbers in North Park and in Routt and Rio Blanco Counties, where they kill a great many range cattle. A few are probably found throughout the mountains west of the main ranges, and small numbers are still present over the more unsettled parts of the eastern plains region, particularly in Baca and eastern Las Animas Counties, in the extreme southeast, where, in 1907 and in 1910, they were said to be common and to kill a great many sheep.
In 1906 wolves were common over most of Routt County, notwithstanding the bounty of $15 authorized by the local stock association, the additional $10 offered by the county, and the efforts of several professional wolf trappers employed by the association. The heaviest losses of stock were at that time incurred on the Iron Springs Divide and south of the Elk Head Mountains, although wolves were reported as unusually abundant in Browns Park on Green River. In the latter region the stock association hired three or four trappers to reduce their numbers, and about fifty were killed during the winter of 1905-6, the majority being trapped. Mr. John Criss, a trapper of many years' experience in the Snake River country, informed me that the wolves have been so persistently hunted, trapped, and poisoned that they will now rarely come to a scent of any description and seldom to a baited trap, while poisoning is unsuccessful....
An impression prevails among stockmen in northwestern Colorado that wolves retire to the mountains to whelp, but I find no evidence to support this theory (Note: see Bailey. 1907. Wolves in relation to stock, game, and the National Forest Reserves, p.XX, Section 2).
In the Lily Park region, on the lower Bear River, Mr. F.C. Barnes states that wolves were numerous until 1902, but during the two years following a trapper named Snyder killed 61....In 1905 wolves were reported in considerable numbers in the White River country, particularly in the valley of the Piceance, but were scarce near Rangely in 1906. During. the winter of 1904-5, 7 were killed out of a band of nearly 25 which was ranging in North Park, but in 1906 wolves were reported as scarce in that region. I often saw wolf tracks in the trail that we traveled through the parks on the divide east of the Laramie River, in August, 1906, and the animals were said to be very troublesome in that section. Tracks were observed as high as 10,000 feet. Wolves are a rare occurrence in Middle Park, but two are said to have been seen on the stage road near Coulter during the winter of 1903-4, and another near Grand Lake the following winter. One of a band of three which ranged on the head of Willow Creek, in the northern part of middle Park, was killed early in the summer of 1906. In Egeria Park and on the Gore Range wolves are reported as of rare occurrence. They were uncommon over most of southern Colorado in 1907, particularly in the San Luis Valley, the Pagosa Springs region, and in Montezuma County, where they are considered very rare. According to Mr. Steve Elkins, of Mancos, none have been reported in that region

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since the winter of 1904-5, when four or five were seen between Cortez and Mancos. In the region contiguous to the upper waters of the Vallecito and Los Pinos, in northeastern La Plata County, they are said to be increasing during the past few years, but no serious damage is reported. Forest Supervisor E.W. Shaw, of Durango, states that a band of 12 was seen near Vallecito in the winter of 1906-7. A few wolves were reported from the western part of San Miguel and Montrose Counties, a large male having been killed in the Dry Creek Basin in the winter of 1906-7, and a female with four whelps was said to be ranging the same region in the summer of 1907. According to Mr. Warren, wolves were reported in the fall of 1906 to be increasing on the Black Mesa, south of the West Elk mountains. Dr. A.K. Fisher reported wolves as common near Las Animas in 1892 and in the Estes Park region in 1894, and according to Streator, numbers were to be found the same year on the Republican River, north of Burlington, and in the vicinity of Olney. Prof. Lantz reports that a band of three was often seen in the vicinity of Hugo during the winter of 1904-5. The rough canyon country of Las Animas, Baca, and southern Otero and Bent Counties was in the early days resorted to by large numbers of wolves for breeding purposes, and many still breed in that region.

Ranchmen living in northwestern Logan and northeastern Weld Counties stated in the summer of 1909 that wolves were very scarce in that section, only one being known to inhabit the Horsetail Basin south of the Chimney Cliffs. This said to be a female, and is supposed to be the mother of eight whelps which were dug out of a den in the rough country on the head of Deadman Creek, 20 miles northeast of Avalo, in the spring of 1909. In the spring of 1908 a litter of six or seven was dug out of a den in the same canyon, two of which were taken alive to Nebraska, and another was kept on a ranch north of Sterling until it became vicious, when it was killed. In 1908 a cowboy named Frank Jordan is stated to have roped an old male wolf on the open plains in the same vicinity Allen states that _Canis lupus_ was comparatively scarce in Park County in 1871, although formerly abundant there. As _Cani occidentalis_ Trippe records the wolf as an early inhabitant of Clear Creek County.

1912

A prairie dog research and demonstration experiment was performed by Professor David Lantz in the Pike and Cocketopa Forest of Colorado (Cadieux 1983).

Elk numbers in Routt and Moffat Counties reduced to 120 individuals, and fewer than a dozen were known to remain on the Roosevelt National Forest (Swift 1947).

1913

Middle Park Elk herd reduced to 50 head (Swift 1947).

Predatory animals destroyed in Colorado, fiscal year 1913 (Report of the Forester. 1913. In: Annual Reports of Department of Agriculture, U.S. Government Printing Office:Washington, DC).

Bears.................	21
Coyotes...............	483
Mountain lions........	--
Lynxes................	7
Wildcats..............	41

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Wolves................ 1
Wolf pups............. 24

1914

Predatory animals destroyed, fiscal year 1914 (Colorado):

Bears................. 14
Coyotes...............373
Mountain lions........ 2
Lynxes................ 7
Wildcats.............. 33
Wolves................ --
Wolf pups............. --

> The employment of special men to hunt and trap predatory animals has largely been discontinued. The larg majority of the animals killed by Forest officers in connection eith other work and at practically no cost to the Government. The trapping and hunting of animals by settlers and other private parties was aided by loans of traps and, in some instances, by furnishing poison. Thus an additional large number of animals were destroyed. The wolf and the coyote, the two species that do by far the greatest amount of damage to game and domestic stock, are transient visitors ehich frequent the Forests only during the months when fame and domesticlivestock are most abundant. They are bred, born, and spend the major portion of their life cycle in the foothills and flats outside of the Forests. Under these conditions the animals killed on the Forests are replaced by others from the outside ranges, and this will continue to be the case until the Government initiates a general movement to destroy the animals throughout the length and breadth of the public domain....(Report of the Forester. 1914. In: Annual Report of Department of Agriculture. U.S. Government Printing Office:Washington, DC.

1915

> On November 2, 1915, a large male of the Cascade timber wolf (Canis gigas) was shot by Mr. H. W. Fisk in Logan Valley, Grant County, Oregon. The skin, which was of the tawny type, was presented to the State Game Commission during December, 1915, where it was examined by the writer. Logan Valley is a small mountain valley at about 5,000 feet altitude in the Blue Mountains, and is surrounded by heavy forests of almost a clear stand of yellow pine. As this is the only known appearance of this wolf east of the Cascade Mountains in Oregon I thought it well to place it on record. Canis gigas at present ranges from Indian Creek in Jackson County, Oregon, north to the Clackamas River in the county of the same name, as so far as is known only along the west slope of the Cascade Mountains. There are probably not over one hundred of these animals in the state today (Jewett 1923).

The distribution of the gray wolf in Utah this year was reported to be:

> In 1915, bounty was paid on 72 wolves in Utah in the following counties: Carbon 3, Duchesne 2, Grand 17, Kane 1, Rich 15, San Juan 3, Summit 2, Unitah 9, Wasatch 19, and Weber 1. In 1916 bounty was paid on 79 wolves as follows: Carbon County 13, Duchesne 5, Emery 2, Grand

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8, Juab 1, Rich 5, San Juan 26, Sevier 4, Unitah 12, Wayne 1. The gray wolf is almost extinct in the St. George district though one was recently taken near Leny's ranch about twelve miles from Enterprise...It is estimated by A. W. Jensen that there are 30 wolves in the Uinta forest.

A gray wolf was killed in the limits of Salt Lake City in July, 1918. According to William M. Anderson of Vernal the gray wolf is very scarce in that country. Occasionally one is taken by a trapper, but wolves do not remain long in that vicinity. C. A. Mattsson of Salina says: "A few years ago there were a number of gray wolves on the East Desert and on the Thousand Lake Mountain...The large bounties offered by stockmen induced two trappers to spend part of two winters in the desert. They killed two large wolves and eleven pups. there are a few remaining in that vicinity."

S. B. Locke says that wolves occur on the east side of La Sal mountains, in Dry Valley and both north and south of Blue Mountains.... (Barnes 1922)

Demonstrations and experiments were carried on in Colorado, Nevada, Texas, Idaho, Oregon, and other of the Western States with a view to the control of wolves and coyotes....Future work contemplates much extended activity and the division of the area inhabited by wolves and coyotes into districts, each in charge of a competent inspector, who will supervise closely the operations of trappers and hunter (Henshaw, H.W. Report of Bureau of Biological Survey. 1915. U.S. Department of Agriculture, U.S. Government Printing Office, Washington, DC).

The work of destruction of predatory animals is now in the hands of the Bureau of Biological Survey, the agricultural appropriation act for 1916 having made special provision for its conduct by that bureau...In the work of destroying prairie dogs, ground squirrels, and other range-destroying rodents the Bureau of Biological Survey treated some 751,000 acres with excellent results. It is estimated that there still remains 3,000,000 acres infested with prairie dogs, ground squirrels, and gophers within the National Forests, which, if the appropriations are continued, should be completely cleaned up in a few years (Report of the Forester. 1915. In: Annual Report of Department of Agriculture, U.S. Government Printing Office:Washington, DC).

1916

On July 1, 1915, an appropriation of $125,000 became available for use on national forests and the public domain for destroying wolves, coyotes, and other predatory animals. Immediate steps were taken to organize the work on a permanent basis and eight districts were established: (1) Arizona and New Mexico; (2) California and Nevada; (3) Oregon and Washington; (4) Colorado; (5) Idaho; (6) Montana; (7) Utah; and (8) Wyoming. An inspector was placed in charge of each district and an inspector at large has supervised all the field work. Hunters were employed who devote their entire time to the work. They are not permitted to receive bounties from any source, and the skins of all fur-bearing animals taken by them become the property of the Government....during the year 424 wolves, 9 mountain lions, 11,890 coyotes, 1,564 bobcats, and 2,086 miscellaneous wild animals were destroyed. This includes those destroyed under the project for the suppression of rabies among wild animals, an appropriation for which became available March 4, 1916. It does not, however, take into consideration animals poisoned unless the bodies were recovered

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(Report of Chief of Bureau of Biological Survey. 1916).

Predatory animals - The annual losses of livestock in the United States, mainly upon the public domain, from the depredations of such animals as wolves, coyotes, mountain lions, and bears, exceeds $12,000,000. Wolves and coyotes are subject to epidemics of rabies and, therefore, are peculiarly a menace to domestic animals and human beings. there was a serious outbreak of this disease among coyotes during the past year. It was prevalent in several States in the Northwest and was especially disturbing in Nevada. Congress appropriated $200,000 for the destruction of predatory wild animals during the past year. The sum of $250,000 is available for this purpose during the fiscal year 1917. A force of hunters and trappers has been organized in the infested States, and 543 wolves, 19,170 coyotes, and many other predatory animals have been destroyed (Yearbook of the United States Department of Agriculture. 1916).

It is of the opinion of men who are in the know, and I fully agree with them, that more game is killed each year by predatory animals than by hunters. The work of destroying predatory animals is now going on and must be kept up. Appropriations must be large enough for this work, as it is the only way possible to keep the predatory animals thinned out. During the past year our department employed from two to five trappers constantly, good results being reported in each case. We hope to be able to employ at least five or six trappers steadily during the next year, who will give attention to game violations as well as destroying predatory animals. The Biological Survey has been very active in this work under the management of Mr. Chas. J. Bayer, Predatory Animal Inspector, who is very familiar with his work, accomplishing good results. Mr. Bayer reports the following animals destroyed during the past year (Report of the State Game Warden of Wyoming. 1916):

Wolves	95
Coyotes	1,602
Bobcats	200
Bears	3
	1,900

Reports received from the state trappers show the following predatory animals destroyed during the past year:

Wolves	33
Coyotes	574
Bobcats	20
	627

1917

World War 1 (1917-18). The increased demand for meat during World War I resulted in increased congressional appropriations for wildlife damage control (Cain et al. 1972).

Predatory animal research laboratory established in Albuquerque, NM. It was called the "Eradication Methods

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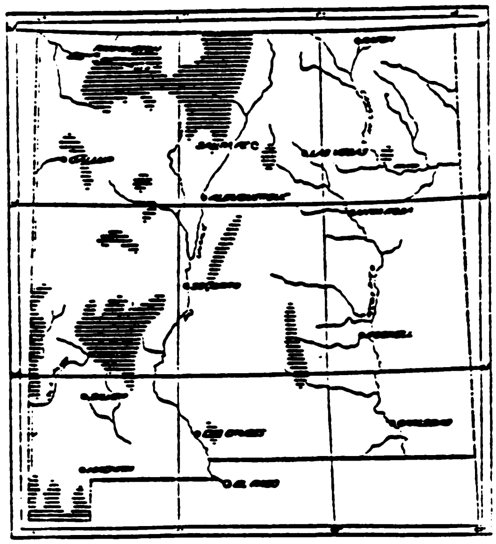
Laboratory."

The work (destruction of predatory animals), which is conducted by the Bureau of Biological Survey in cooperation with the Forest Service, has been continued by the officers of that bureau with gratifying success, and the depredations of predatory animals upon the flocks and herds of the local stockmen has been appreciably decreased. The biological Survey, besides employing hunters of its own, furnishes traps, ammunition, and poison to forest officers, who devote such time to this work as their other duties will permit. The predatory animals killed by forest officers totaled 3,027, as against 4,455 the previous year (Report of the Forester. 1917).



Shaded area showing approximate distribution of the wolves in New Mexico in 1917. From map prepared by J.S. Ligon (Source: Bailey, V. 1931).

1918

During the year, the bureau had available about $304,000 to be used in the destruction of wolves, coyotes, mountain lions, and other predatory stock-killing animals and for the suppression of rabies in wild animals...Predatory animals are killed by a force of about 250 to 350 hunters under the direction of district supervisors...Predatory animals are destroyed by a force of from 250 to 350 hunters under the direction of district supervisors....Predatory animals are destroyed by trapping, shooting, den hunting during the breeding season, and poisoning. Poisoning campaigns were conducted on a larger scale than ever before and the results have been so satisfactory that they have received the strong support of cattle and sheep owners...The largest poisoning operation in the West was carried on in the great sheep-growing region of southwestern Wyoming, where it covered about one-sixth of the state. Another large area in southern Colorado was systematically poisoned with excellent effect...The following predatory animals were taken by hunters under the direction of the bureau, during the present year: 849 wolves, 26,241 coyotes, 85 mountain lions, 3,432 bobcats, 30 lynxes, and 41 bears...Since the bureau began its operations against predatory animals the skins of 70,732 have been taken and a vast number in addition have been killed by poison. Reports from various sections of the country where poisoning operations have been conducted show the finding of thousands of dead coyotes.

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The well-known fact that the great majority of poisoned animals are never found, coupled with the scarcity of coyotes in the poisoned areas, indicates the effectiveness of the work (Report of Chief of Bureau of Biological Survey. 1918).

1919

Of the total funds available for the campaign against injurious animals, about $375,000 was provided for use in destroying wolves, coyotes, mountain lions, bobcats, and other stock-killing animals and for the suppression of wild animals affected with rabies....During the past year....During the year a force of from 400 to 500 skilled hunters has been employed under the direction of the various inspectors....The number of skins or scalps of predatory animals taken by official hunters during the year is as follows: Wolves, 584; coyotes,27,100; mountain lions, 149; bobcats, 4,123; Canada lynxes, 43; bears, 81. In addition, as a result of poisonous operations, so many dead coyotes are reported by stock growers to have been found on the ranges where poisoning operations were conducted that it is safe to estimate the number destroyed in this way as more than equalling the approximately 32,000 predatory animals of which the skins and scalps were taken.

From much expert study and experimentation, great improvements in methods of poisoning predatory animals have resulted....Extended poisoning operations were conducted in the great sheep-growing sections of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming (Report of Chief of Bureau of Biological Survey. 1919. United States Department of Agriculture, U.S. Government Printing Office, Washington, DC).

1920

A force of skilled hunters and trappers, varying from 300 to 400 in number, were employed under bureau supervision during the year to destroy predatory animals...for this purpose $272,000 was expended by cooperators in Arizona, Colorado, Montana, North Dakota, Nevada, California, New Mexico, Oregon, Washington, Texas, Utah, and Wyoming....The numbers and kinds of skins taken by these hunters during the year are as follows:

Wolves..............	523
Coyotes.............	21,558
Mountain lions.......	189
Bobcats.............	2,987
Canada lynxes........	10
Bears................	94

Not all predatory animals are equally as destructive of live stock. Some individuals become strongly marked among their fellows because of their depredations. This is particularly the case with mountain lions, wolves, and coyotes (Report of Chief of Bureau of Biological Survey. 1920).

The last grizzly bear in northern Colorado reported near Rocky Mountain National Park by Enos Mills (Murray 1987).

1921

Predatory Animal Research Laboratory moved to Denver and the name changed to Control Methods Laboratory:

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The establishment during October, 1921, of a well-equipped laboratory at Denver, Colorado, for investigating poisons and their preparation and use will be an important factor in increasing the effectiveness of campaigns for the destruction of predatory animals and harmful rodents. Necessary machinery has been installed in the laboratory to process and otherwise prepare all the poison needed by field parties of the bureau and cooperators throughout the country. During the year, the processed strychnine prepared amounted to more than 10,000 ounces....(Author's note: one ounce = 437.5 grains; at the recommended rate of 2 gr./coyote and 4 gr./wolf, this quantity would be sufficient to kill 2,187,500 coyotes or 1,093,750 wolves, respectively.

When in 1916, the bureau first began organized operations to reduce the depredations on livestock by wolves, coyotes, and other predatory animals, the losses from this source were estimated at more than $20,000,000 annually. These operations include carefully planned trapping, shooting, den hunting, and poisoning campaigns covering the grazing States of the West and extending eastward to western Missouri and northern Michigan. The work is done in cooperation with State departments of agriculture, State live-stock commissions, stockmen associations, and individuals, so that concerted effort action may be taken to clear large units of Federal, State, and private land of these pests. The Forest Service of the Department of Agriculture and the Office of Indian Affairs and the National Park Service of the Department of Interior also cooperate on lands controlled by them.

The skins or scalps turned in by hunters as evidence of animals taken show a total destruction of 27,611 stock-destroying animals. These consisted of 694 timber or gray wolves, 24,234 coyotes, 2,466 bobcats and Canada lynxes, 129 mountain lions, and 88 bears. Exact returns of animals killed in poisoning campaigns are not obtainable, but judging from the number of dead carcasses found and the marked reduction in the number of coyotes over large areas following poisoning operations, it may be conservatively estimated that from 25,000 to 30,000 coyotes were killed by this means in addition to the number whose skins or scalps were actually taken, making a total of more than 50,000 predatory animals during the year.

The "Custer" wolf mentioned in last year's report as having ranged for six or seven years in the vicinity of Custer, South Dakota, and during that period to have killed $25,000 worth of cattle, had escaped all efforts of sportsmen and stockmen to effect its capture, despite a bounty of $500 placed on its head. Early this year he succumbed to the skill and marksmanship of a bureau hunter (see Appendix B). In the vicinity of Split Rock, Wyo., a pack of nine wolves, that were killing about $10,000 worth of cattle each year, was trapped and poisoned. All of a pack of five wolves that had ranged in the vicinity of Pueblo, Colo., for several years were taken. The last one to fall victim to the skillfully placed traps was an old renegade that had been known for at least twelve years and is reported to have killed $6,000 worth of cattle on a single ranch, besides making heavy inroads upon others, and during the last six weeks of his life to have destroyed nine yearling cattle (see Appendix B)(Report of Chief of Biological Survey. 1921. U.S. Department of Agriculture, U.S. Government Printing Office, Washington, DC).

1922

Moffat Tunnel Improvement District is created by legislature for construction of 6.4 mile bore under Continental Divide to provide better rail connections between eastern and western slopes.

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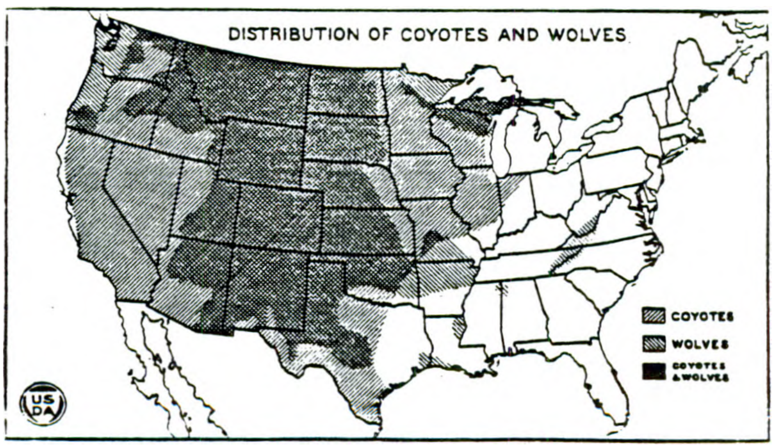
The continuous campaign against injurious animals are gradually eliminating large gray wolves over most of their former range and will gradually wear down the numbers of all predatory species until losses from them will become comparatively small.... p. 2.)

During the year an average force of 266 hunters, trappers, and poisoners was employed under bureau supervision, and many thousands of stockmen participated in the distribution of poisoned baits during the organized drives. Part of the men employed were paid by the Federal Government and part by the States and other cooperating agencies, which contribute $196,405 to the work. Hunters are required to turn in as evidence the skins or scalps of animals killed when found in condition for the purpose. Such positive evidence was obtained for the year in the case of 30,986 predatory animals, of which 687 were large gray wolves, 27,185 coyotes, 2,827 bobcats and Canada lynxes, 173 mountain lions, and 114 bears. In addition to the dead animals secured, it is estimated that not less than 50,000 coyotes were killed in connection with the extended poisoning operations, but their carcasses were not found. Many wolves, bobcats, and some mountain lions were also poisoned.

In a period of five weeks two Utah hunters put out a poison line approximately 300 miles long in a great loop and around their first two stations on their return found about 40 dead coyotes. A stockman wrote that these two men did good work, for, as he put it, they left a string of dead coyotes wherever they went....Another important catch was the "Pryor Creek Wolf," which had run for at least six years on the cattle ranges of Montana, where it was noted for its destruction of calves and Shetland ponies, its deeds of cunning, and its skill in eluding traps...Three wolves were killed in September south of Meeker, Colo., the old male having taken a serious toll from stockmen and terrorized this section for the past 15 years. Another male wolf, taken with his entire family near De Berque, Colo., had caused losses to stockmen in that vicinity amounting to many thousands of dollars, and was responsible during the last few months of its life for taking about 100 calves on one ranch, or two-third's of the season's calf crop (see Appendix B)(Report of Chief of Bureau of Biological Survey. 1922).

1923



Distribution of coyotes and wolves in 1923 (Source: The sheep industry. 1923. In: Annual Report of the United States Department of Agriculture. 1923. U.S. Government Printing Office:Washington, DC., p.265).

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The western livestock owners suffer heavy losses from depredations of predatory animals, these losses formerly estimated to amount to from $20,000,000 to $30,000,000 annually. Wolves, coyotes and bobcats are the greatest offenders, and in many localities inflict such heavy and continuous losses as to make sheep raising an unprofitable enterprise. In the earlier days the individual stockmen endeavored to combat these predatory animals on his own range by employing hunters to trap, shoot, and to poison them. The payment of bounties for animals taken was also resorted to. These individual efforts were not satisfactory and demonstrated the necessity for organized effort in order to secure adequate results. The coordination of the efforts of all those directly interested in the problem was then undertaken. As the Department of Agriculture had charge of the control and eradication of predatory animals in the national forests and on the public domain, and as it had already developed methods of eradication which had proved eminently successful, the work is now largely conducted under its general supervision.

The national forests and other great areas of public land in the Western States are the main breeding places of wolves, coyotes, mountain lions, and other stock killing animals **(Author's note: 1907), and of prairie dogs, ground squirrels, pocket gophers, and many other forage and crop destroying rodents...Through the campaigns against them prairie dogs have been exterminated on considerable areas, and the large wolves, of which 4,900 have been killed, are being so reduced in numbers that over most, if not all of the West their end is in sight.

The best evidence of the growing appreciation of the practical value of campaigns against animal pests in the West was given in the winter of 1923 by the legislatures of 13 States, which made total appropriations of about $647,000 for cooperation in the work during the following biennium.

Clearing the ranges of coyotes is proving a boon to the cattleman as well as the sheepman, for with the practical elimination of the gray or timber wolf over much of the range country of the Western States, *cattlemen have discovered that heavy losses of calves, heretofore attributed to wolves, have evidently been due to coyotes.

During the year an average force of 250 hunters, trappers, and poisoners were employed under bureau supervision, in addition to the thousands of stockmen who personally took part in the work...during the year hunters took the skins or scalps of more than 29,300 predatory animals, of which 599 were wolves, 447 of these being the large gray wolves; 25,622 coyotes; 2,822 bobcats and Canada lynxes; 158 mountain lions; and 101 bears.

In view of the substitution of poisoning campaigns for other methods of field operations in most of the districts during six to nine months of the year, the number of skins and scalps is no longer a satisfactory gauge of the number of animals being killed. Men spend practically their entire time in establishing poison stations and distributing baits, and relatively little time in searching for animals killed, as the value of the skin commonly does not pay for the time lost. One man in the Lemhi National Forest, Idaho, by use of an automobile maintained a poison line over 700 miles in extent, which served to cover an area of about 5,000 square miles...

In response to a telegram from stockmen ranging cattle near Thatcher, Colo., a hunter was detailed to take a wolf believed to be the leader of a pack depredating in the locality. Work against the wolves there had been in progress at intervals during the past five years,

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and inquiry established the fact that during the course of six weeks 20 head of cattle were killed and the tails were bitten off a number of small calves. The hunter succeeded in trapping an old male wolf, with the result that depredations were entirely stopped in the vicinity and evidence showed that only a lone she wolf remained in the area. This female mated with a collie dog, and in efforts to get her, the collie was killed by poison and later she was taken in a trap. The stockman, on whose ranch the wolf was killed, writes as follows:

"Old Three-Toes as this particular wolf was called, was caught in one the Government traps especially constructed for wolves, and the hunter has caught two of her pups. With her capture ends the pack of which she was the leader. Thousands of dollars worth of calves and sheep have been killed by this wolf and her pack. Just a few days prior to her capture, Old Three-Toes killed six calves here on our ranch, 11 miles west of Thatcher. We hold a private grudge against this old gray wolf, as she mated with our pet collie dog, even going so far as to dig him out of a pen. He heard the "call of the wild" and answered it, going off for days at a time, sometimes coming home for a few days. At last he went away for weeks and was finally poisoned by one of your men. This was a good thing, as a collie, hearing the "call of the wild" kills for his young too. We extend our thanks for staying on the job and getting Old Tree-Toes and her pack. Other stockmen join us in our praise of you and your men, as the loss from predatory animals has been reduced to almost nothing."

At present, the department is cooperating with many States, county officials, and livestock associations in well-organized campaigns for the destruction of these pests. Congress has appropriated $274,000 for fighting these animals during the fiscal year 1924, while 13 States, mostly western, have appropriate $285,000 for cooperation during this period. Additional funds have also been provided by stockmen's associations. A well-organized force of hunters, who are supervised by capable and experienced men, and who have been thoroughly trained in the most up-to-date and efficient methods of trapping, poisoning, and den hunting, are employed. Substantial headway has already been made and stockmen report greatly improved conditions, with losses entirely eliminated in some instances and greatly reduced in others. Approximately 500,000 predatory animals have been destroyed since 1915

1924

The general range of most of these animal pests (wolves, coyotes, Mountain lions, and bobcats) has been determined. The fierce destructiveness of large wolves and mountain lions, both to domestic animals and game, is so great that it becomes a necessity to eliminate them from certain areas. This, however, does not mean the actual destruction of these species, since they range over such a vast area in both North and South America that the possibility of their actual extermination undoubtedly lies many centuries in the future.

The big wolves have been reduced a relatively small number over much of the West. Since 1915 more than 5,400 of them are known to have been killed, in addition to many which have been poisoned and not found.

In addition to the thousands of cooperating stockmen a force of 406 trappers and poisoners was employed under bureau supervision during the year. Part of the men employed were paid from Federal funds and part by the States and other cooperating agencies. Skins or scalps

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of 38,591 predatory animals were taken, of which 562 were wolves, 34,092 coyotes, 3,507 bobcats and Canada lynxes, 237 mountain lions, and 193 bears. In addition to these animals, it is estimated that about 100,000 coyotes were killed in the extended poisoning operations, of which neither skins or scalps were taken...State game departments and sportsmen's associations in many States have cooperated heartily in the predatory animal work on account of its very evident favorable influence on the game supply.

Notable kills during the year include an old white wolf in Arizona, known for the past eight years in the Aquila range and reported by stockmen to have killed about $25,000 worth of cattle and sheep in that time.

A wolf locally known by forest rangers and stockmen as the "butchering wolf" was trapped in Eagle County, Colo., during July 1923. In addition to its record of animals killed outright it had the unusual reputation for biting off the ears and tails or otherwise mutilating young calves and even full-grown cattle.

A notorious she wolf was taken in December south of Pueblo, Colo., which had been known for a long time in that section and responsible for the killing of many cattle (see Appendix During the year more than 3,567,00 especially prepared poisoned baits (coyotes) were methodically put out in accordance with definite plans, and these poisoning operations covered an area of about 284,400 square miles (Report of Chief of Bureau of Biological Survey. 1924).

The estimated number of big game animals on national forests in Colorado as of December 31, 1924 was (Report of the Forester. 1924):

Antelope.................	63
Black or brown bears.....	2,720
Grizzly bears............	27
Deer.....................	22,673
Elk......................	6,404
Moose....................	--
Mountain sheep...........	4,860

"Big-foot Mary" (a grizzly bear) killed south of Grand Junction in October (Murray 1987).

1925

Good progress has been made in the cooperative campaign of the department in the Western States for the reduction of losses, mainly on the public domain, from which such destructive predatory animals as timber wolves, coyotes, and mountain lions. Since the campaign began in 1915 more than 5,830 wolves, hundreds of thousands of coyotes, and more than 1,469 mountain lions have been destroyed. In some States where timber wolves existed by hundreds and were excessively destructive their numbers have been brought down to less than a dozen. During this year the cooperating States contributed $394,374, with the active participation in the field of great numbers of stockmen. The department expended $270,967 (Yearbook of Agriculture. 1925. United States Department of Agriculture, Washington, DC, p 81).

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On June 26, 1925, I was close witness to an incident of unusual interest which occurred at the extreme northern end of the Snowy Range in the Medicine Bow Mountains, at a point about forty miles northwest of Laramie, Wyoming (Section 35, T. 17N, R. 79W). At eleven o'clock in the morning while following timberline (altitude here about 10,700 feet) toward a low divide in the range, I was startled by a rush and a crash sounding from a point about a hundred yards up the slope to my right. In quick succession their followed a number of peculiar, deep-throated sounds such as I could not recall ever hearing before. My first thought was that I had stumbled upon a litter of wolf or coyote whelps tussling about in their den. Quickly I took five or six steps forward so as to see around the low timberline trees that at first obscured my view. A single glimpse convinced me that this was far from being a matter of mere animal horseplay. About a hundred yards up the slope was a whiling mass of greyish fur, twisting and rolling with such rapidity that I could not possibly determine what animals constituted the struggling group. From time to time there came the same low-pitched sound, a strained monotone which could only come, I was sure, from the throat of a chocking animal. It was not pleasant to hear. In its rapid gyrations the fur mass edged toward the brink of an incline five or six feet high. Over this it finally toppled, falling with a crash upon a mat of flat-topped timberline trees below and sinking into it out of sight. By means of the noise of the smashing boughs I followed the course of the combat. The sounds from the chocking animal became fewer and more labored, little more than occasional forced wheezes. Suddenly all sounds ceased. There came a sound of a spasmodic shake; a second; a third. then out of the foliage leaped a timber wolf (Canis nubilus) holding in its jaws, as a tabby would hold a kitten, the limp body of a dead marmot (probably Marmota flavenensis). With indescribable ease the wolf leaped to a rock point and there, beautifully poised, looked calmly down on me. I had no firearm with which to disturb its somewhat exasperating nonchalance. After a few moments it relaxed, and, entirely disregarding me, laid down the marmot in order to take a firmer grip on its neck. Then it started up the slope with long, effortless leaps. When it reached the top, it again turned, still holding the marmot in its jaws, to survey me. Minute after minute passed without change; whereupon, in the faint hope that the wolf might drop its victim, I yelled at it and threw a pebble up the slope in its direction. It then turned and loped over the ridge out of sight. Probably it carried the marmot off to a waiting litter of hungry young. Later I carefully searched the snowfields on the other side of the ridge for tracks, but found no clues to indicate which direction the animal had taken (Fryxell, F. M. 1925).

Barnes (1923) states that the 1925 estimate of the number of gray wolves in the Ashley National Forest (Utah) was 5. No other recent reports were obtainable (Svihla, R. D. 1931. Mammals of the Uinta Mountain Region, Journal Mamm., Vol. 12, No. 3, p. 260).

The estimated number of big game animals and beaver on national forests in Colorado as of 31 December was (Report of the Forester. 1925):

Antelope	70
Black or brown bears	2,783
Grizzly bears	25
Deer	23,390
Elk	7,358
Mountain sheep	4,318
Beaver	47,314

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1926

Eradication programs were carried out in all States from Montana to Texas and westward, and in South Dakota and Illinois. During the fiscal year 47 big gray wolves, 154 red wolves, 37,887 coyotes, 246 mountain lions, 3,677 bobcats, 41 Canada lynxes, and 186 predatory bears were reported as killed, but coyotes were actually destroyed in larger numbers, 53,000 additional being the estimated number that were killed by poison but not found.

During the past three years charges have been made by private trappers and fur interests that predatory-animal control through poison campaigns is responsible for the depletion of fur bearer. An investigation of the situation was suggested by the Association of the Fur Industry, to which the department agreed. (see 1910 letter to Wyoming Chief Game Warden)

Rodent-control was carried on under Biological Survey leadership in all States west of the Great Plains...altogether 1,312 tons of poisoned grain were used, besides 405,191 pounds of carbon disulfide and 146,035 pounds of other fumigants, mainly powdered calcium cyanide, in completing the kill of prairie dogs and ground squirrels where poison had failed in first and second treatments. More than 127,000 ounces of strychnine were used for poisoned baits for both predatory animals and rodents in Federal and cooperative control campaigns during the year (Report of Chief of Bureau of Biological Survey. 1926).

The estimated number of big game animals and beaver on national forests in Colorado as of 31 December 1926 was (Report of the Forester. 1926).

Antelope.................	164
Black or brown bears.....	2,704
Grizzly bears............	18
Deer.....................	26,115
Elk......................	8,295
Mountain sheep...........	3,888
Beaver...................	45,275

1927

...all bears, whether black, brown, or grizzly, have had the reputation of being stock killers. This public attitude toward bears persists to the present, and is apparent in widespread and often unjust accusations against these interesting forms of wildlife.
A case in point, similar to many others coming to the attention of the department, was the death recently of 35 head of livestock on one allotment of the Uncomphagre National Forest, Colo. At the same time that the owner discovered this loss, he noticed an abundance of bear tracks surrounding many of the carcasses. A request was immediately dispatched, through the forest supervisor to the district field office of the Bureau of Biological Survey, for a predatory-animal hunter to trap out the bears, as being undoubtedly the cause of this great loss. The hunter was detailed to the locality and made a careful preliminary investigation, which proved that the bears thought responsible for the destruction were only scavenging the carcasses of cattle that had died from larkspur-plant poisoning. As that particular season was a dry one, with a small wild-berry crop, the bears had gathered about the carcasses of the poisoned cattle in unusually large numbers (Young 1927).

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The estimated number of big game animals and beaver on national forests in Colorado as of 31 December 1927 was (Report of the Forester, 1927):

Antelope.................	114
Black or brown bears.....	2,641
Grizzly bears............	19
Deer.....................	27,757
Elk......................	8,519
Mountain sheep...........	3,835
Beaver...................	43,905

1928

Greatly extended operations are essential in the range States, if the problems on predatory-animal control are to be solved. That the stock interests in these States look to the Federal Government for more adequate and equalized expenditure is evident from the annual resolutions of State livestock associations as well correspondence received from hundreds of private stockmen. The Federal Government should provide more adequate financial support whenever practicable, particularly since there still exists in large numbers on the Federal Domain a heavy infestation of predatory animals, which eventually invade private and State lands and are taking a $20,000,000 annual toll from the producers of livestock and poultry.

The gray wolf is under control in all States west of the one-hundredth meridian. The small red wolf of eastern Texas, however, is still the cause of severe depredations on livestock, but marked progress toward its control has been made during the year.

The total number of coyotes destroyed during the year, for which skins or scalps were actually obtained was 35,709; gray wolves, 11; and red wolves, 716. In addition, it is estimated that 48,000 coyotes were destroyed by the use of poisons but not recovered (Report of Chief of Bureau of Biological Survey. 1928).

Wolves in the early days ranged the length and breadth of Wyoming, killing the buffalo, elk, deer, and other big game at will. With the advent of the early settlers, the passing of the buffalo, and the thinning of the other game herds, the beasts of prey turned to cattle and hordes. Fifty years ago the wolf menace was one of the worst problems of the cattle industry. In the year 1896 the State paid bounties of $3.00 each on 3,458 wolves. From 1895 to 1927, 36,161 wolves have been taken in Wyoming by regular, Federal, State and bounty Hunters. In the early stages of wolf control, bounties reduced them greatly, but it was left to the expert State and Federal Government hunters to thin the ranks of the last few, and if possible, exterminate them entirely. In 1915, when the Biological Survey first started work in Wyoming, there were over 1,000 adult wolves in the State, doing damage to livestock and game estimated to exceed $1,000,000 annually. At the present time (1928), excepting those in Yellowstone Park, there are probably no more than five adult wolves left ranging in Wyoming. Two of these are known to be in the Jackson Hole region, where they are doing little damage to domestic stock, but largely on the elk abounding in that section (Day and Nelson 1928).

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The estimated number of big game animals and beaver on national forests in Colorado as of 31 December 1928 was (Report of the Forester. 1928):

Antelope.................	115
Black or brown bears.....	2,598
Grizzly bears............	16
Deer.....................	30,958
Elk......................	8,976
Mountain goat............	10
Mountain sheep...........	3,721

1929

Great Depression begins.

Stapleton Airport opens.

> *The gray wolf is no longer a livestock menace in States west of the one-hundredth meridian, although control work must be continued on the southern border of Arizona and New Mexico to prevent ingress of individual wolves from Mexico. The small red wolf of southern Texas and adjacent territory, however, still commits serious depredations on livestock.
>
> The total number of coyotes destroyed during the year, of which skins or scalps were actually obtained was 40,254; the number of gray wolves, 71; and the number of red wolves, 1,339. In addition, it is estimated that 54,000 coyotes not recovered were destroyed by the use of poisons.
>
> It became necessary in the course of the year to destroy 280 bears that had acquired the habit of preying upon livestock (Report of the Chief of the Biological Survey. 1929. In: U.S. Department of Agriculture Annual Report, U.S. Government Printing Office, Washington, DC).

The estimated number of big game animals and beaver on national forests in Colorado as of 31 December 1929 was (Report of the Forester. 1929):

Antelope.................	110
Black or brown bears.....	2,641
Grizzly bears............	13
Deer.....................	33,315
Elk......................	10,286
Mountain goat............	12
Mountain sheep...........	3,374
Beaver...................	40,123

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1930

This is the first year that concern was voiced about the use of poison to control predatory animals. This concern can be seen in the tone of the Annual Report by the Biological Survey:

> Recent opposition by a group of naturalists to the control operations of the bureau has been based on the assumption that insufficient preliminary research has been undertaken and that inadequate safeguards were being thrown about the use of poison for predatory animals in localities where fur animals might be endangered. Augmentation of the research program should have the effect of giving a full and satisfactory answer to such criticisms.
>
> As in previous years control operations in general included trapping, poisoning, and den hunting, with occasional hunting with trained dogs. In many States where control work was undertaken no poison was used. In fact the only States in which poisoning operations were conducted were in the Rocky Mountain and Great Basin regions...
>
> In the control operations conducted by the Biological Survey, a year-long average of only 505 Federal, State, and cooperative hunters were employed, and many of these used no poison. These men engaged in work over the whole area of the States in which predatory-animal control was carried on, a very limited region compared with the total range of the predators over western stock country and on the public domain, including national forests and parks. Furthermore, information gathered throughout the West indicates that there are at least 8,000 men not connected in any with the Government, a large number of whom are professional trappers, engaged in poisoning predatory animals. Compared with the total number thus working with poisons, the representation of the Biological Survey is limited, indeed. Moreover, it is highly significant that the government employees are responsible men, working under competent direction, and that all possible safeguards are thrown about their operations for the protection of harmless and valuable species of wildlife.
>
> The bureau has a definitely established policy regarding safeguards in the use of poisons...

The use of animal poisons was addressed in the Resolutions of the Western Association of State Game and Fish Commissioners:

> WHEREAS, reliable scientific data on the effects of predatory animal poisoning in different parts of the West is meager and conflicting; now, therefore, BE IT HEREBY RESOLVED, that the Western Association of State Game and Fish Commissioners, in regular session assembled in Santa Fe, New Mexico, this 16th day of September, 1930, does hereby favor the appointment of a commission of scientists with open minds on the question at issue, to investigate, (1) the diet of the coyote in all parts of the country and at all times of the year; (2) the numbers and kinds of fur-bearing animals, game animals, and game and non-game birds destroyed in different parts of the country by poison; and (3) that further expansion of predatory animal poisoning be postponed pending the outcome of this investigation.... (Sponsored and introduced by Clinton W. Rowley (Washington) and unanimously adopted).

The United States National Park Service also became involved in the debate and responded:

> ...Of late there has been much discussion by the American Society of Mammalogists and other scientific organizations relative to predatory animals and their control. The inroads of

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the fur trapper and widespread campaigns of destruction have caused the great destruction of some and the near disappearance of several American carnivores. The question naturally arises as to whether there is any place where they may expected to survive and be available for scientific study in the future. The National Parks Service believes that predatory animals have a real place in nature, and that all animal life should be kept inviolate within the parks. As a consequence, the general policies relative to predatory animals are as follows:

1. Predatory animals are to be considered an integral part of the wild life protected within national parks, and no widespread campaigns of destruction are to be countenanced. The only control practiced is that of shooting coyotes or other predators when they are actually found making serious inroads upon herds of game or other animals needing special protection.
2. No permits for trapping within the borders of a park are allowed. A resolution opposing the use of steel traps within a park was passed several years ago by the superintendents at their annual meeting, and they are used now only in emergencies.
3. Poison is believed to be a non-selective form of control and is banned from the national parks except where used by Park Service officials in warfare against rodents in settled portions of a park, or in case of an emergency. Though provision is made for the handling of special problems that may arise, it is the intention of the Service to hold definitely to these general policies. It can be seen, therefore, that within the national park system definite attention is given to that group of animals which elsewhere are not tolerated. It is the duty of the National Park Service to maintain examples of the various interesting North American mammals under natural conditions for the pleasure and education of the visitors and for the purpose of scientific study, and to this task it pledges itself.--Horace M. Albright. (Journ. Mamm.)

1931

The 13th Annual Meeting of the Society of American Mammalogists was held at the Academy of Natural Science of Philadelphia from May 12 to 15, 1931. The conclusions of the predator control committee were:

1. the problem of the control of predatory mammals is so complex that much time will be needed to discover and assemble the facts necessary to a satisfactory analysis of all factors involved, but ample data are at hand to justify the assumption that a crisis confronts our native mammals.

2. the gathering of these facts should be the duty of the Biological Survey not only because its policy in the field has precipitated this crisis through premature action but because it has some funds and personnel for such studies. The committee believes the Survey needs more men and money to work along these lines.

3. The Survey should curtail the destruction of wild life wherever possible until such facts are assembled.

4. The theory of control as formulated by the Survey in Washington is often quite distinct from the facts of control as practiced in the field.

5. A major activity of the survey is along the lines of destruction of wild life and, the committee believes, not in the best interests of conservation.

6. The Survey is deliberately educating the public to seek the destruction of certain species of

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mammals and is actively disseminating propaganda which tends to create a demand where none existed formerly. In a word, the Survey is not a passive agent destruction but is seeking to expand along the lines of its present-day policy.

7. A majority of the people in the United States who are informed on the subject are not in favor of the present Survey Policy of predatory mammal control. Even in the West, the studies of the committee show great numbers of citizens who are opposed to it. The vociferous supporters of this policy are a small but active minority who are interested only in securing the maximum return from their investment in livestock.

8. There is a rising tide of protest throughout the entire country against the destructive activities of the Survey, and institution after institution is going on record against the continuation of such practice.

9. Claims for destruction of game and livestock by predatory mammals are based too much upon hearsay evidence from prejudiced sources. Incontestible facts upon this subject should be made known to the public.

10. Very frequently destruction of livestock can be traced to individual predators and when that individual is destroyed the destruction ceases. This fact is brought out time and time again and admitted by the survey leaders, but they continue to condemn the innocent with the guilty and to carry control measures beyond the point justified by the circumstances.

11. Shiftlessness of herders results in losses which could easily be avoided and strays are marked up to the coyotes. Efficiency in herding would materially cut down losses and weaken the indictment against predators.

12. It has been demonstrated by the testimony of many competent witnesses, numbers of them in the Survey employ, that more coyotes can be taken by traps than by poison, although perhaps at greater expense. Trapping can be made more selective, by use of splints under the pan, than poison.

13. there is little trustworthy data upon the full numbers of mammals killed by poison baits. Many Survey poisoners visit stations so infrequently, often not at all, that Survey statistics on this point are valueless.

14. Considerable poisoning is being done by private parties in some cases with, and in some cases without, the connivance of Survey leaders. The argument advanced by the survey that the well-being of our fauna is better served by keeping control of poisoning in the hands of the Survey can be effectively answered as follows:

A. Such an argument is an admission that poison is a menace in some instances, and the administration of the Survey policy in the field has not demonstrated that the Survey can or ever will be able to remove that menace.

B. The issue of poison, through Survey leaders, as a special privilege, to certain favored individuals, is a commentary as to how far this argument is effective with those who advance it.

15. The use of poison in the field should be discouraged regardless of who employs it.

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The fur trade has assured your chairman, through one of its spokesmen, that it will attempt to make it unpopular with their trappers, but the Survey must set a good example.

16. Cooperation between the Survey and the Society, as attempted during the past year, will produce no tangible result as long as the Survey manifests such an interest in intensifying its present policy of predator control.

17. Far from indicating a desire to cut down on poisoning until in possession of sufficient facts to meet all criticism, the Survey has shown by advocation of the Ten-Year Plan, and by other indications of satisfaction with the present policy of predatory mammal control, that in the future the use of poison is to be increased.

18. The fur trade, from trapper to dealer, is unamiously against this policy of the Biological Survey and believes the very existence of the domestic fur trade is threatened. The dollar value of mammals destroyed by poison may equal or even exceed the sums saved to special interests.

19. the executive officers of the Survey have brought about the crisis confronting our wild life and are more directly responsible for it than any other agency. The burden of proof rests upon the Survey and the issue at stake is not for us to prove that the Survey is wrong, but for the Survey to prove that it is right. The Society need feel no necessity for digging out those facts which the Survey should seek for itself, but by every dictum of logic and common sense it can call upon the Survey to show full and adequate cause for becoming the most destructive organized agency which has ever menaced so many species of our native fauna (Proceedings of the Thirteenth Annual Meeting. 1931. In: Journ. of Mamm., Vol 12)

The most extensive study of the coyote's diet ever completed was begun in 1931, when the Biological Survey established a research laboratory in Denver to analyze stomach contents and list them both qualitatively and quantitatively (Cadieux 1983).

Animal Damage Control Act of March 2, 1931 authorized (46 Stat. 1468; 7 U.S.C 426-426c). This Act is the primary statutory authority for the ADC program.

The estimated number of big game on national forests in Colorado as of 31 December 1931 was (Report of the Forester. 1931):

Antelope.................	112
Black or brown bear......	2,678
Grizzly bear.............	17
Deer.....................	41,160
Elk......................	12,215
Mountain goat............	--
Mountain sheep...........	3,511

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1932

Six wolves reported in Gunnison National Forest (Warren 1942).

> After working more than 15 years in the control of predatory animals and injurious rodents on the public domain and elsewhere in cooperative undertakings, the Bureau of Biological Control has been authorized by Congress to conduct work on a 10-year program. the new act, approved on March 2, 1931, will permit the bureau, when funds are provided, to do more effective work along lines already organized rather than stimulate new lines of control...[T]he 10-year program contemplates control of predators on public domain to an extent that will reduce to the minimum the infestation on adjacent livestock-grazing areas (Young 1932).

The estimated number of big game animals on national forests in Colorado as of 31 December 1932 was (Report of the Forester. 1932):

Antelope.................	112
Black or brown bear......	2,860
Grizzly bear............	3
Deer.....................	47,780
Elk......................	13,610
Mountain goat...........	--
Mountain sheep...........	3,341

A formal resolution opposing the poisoning of predatory mammals and rodents was adopted by a written ballot of 34 to 26 at the fourteenth annual meeting of the American Society of Mammalogists. The resolution reads as follows:

> WHEREAS: It has come to the attention of the American Society of Mammalogists through various channels, such as "the Condor" and "Science" that Federal and State authorities continue extensively to employ thallium and other poisons which have been demonstrated to be wasteful to many species of wild life, and,
>
> WHEREAS: The constant additions to the list of species selected for drastic control because of alleged damage to certain vested interests arouses the fears of the Society for all forms of wild life, therefore,
>
> BE IT RESOLVED: That the American Society of Mammalogists reiterates its opposition to the present control methods and policies practices against predatory mammals and rodents, and again urges the United States Biological Survey to cease the widespread use of poison and the active dissemination of propaganda calculated to create a demand for control (Jour. of Mamm., Vol 13, No. 1).

1933

Winter food habits of coyotes initiated by Denver Food Lab.

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The estimated number of big game animals on national forests in Colorado as of 31 December 1933 was (Report of the Forester. 1933):

Antelope................. 97
Black or brown bear...... 3,012
Grizzly bear............. 6
Deer.....................48,840
Elk......................13,775
Moose.................... 1
Mountain sheep........... 3,189

1934

The Taylor Grazing Act (43 USC SS 315-315r) was signed into law on 28 June 1934, by President Franklin D. Roosevelt. The Act was formulated by representative Edward T. Taylor (CO) and was the first Law passed specifically to regulate livestock grazing on the public lands and initiated the trend of increasing federal involvement in rangeland management. The Taylor Grazing Act is still the major legal basis for regulating grazing on public lands (Ross 1984).

Protracted drought curtailed the production of palatable forage on national forests throughout the west, increasing the amount of bare ground and poisonous plants. The livestock losses in Region 2 for 1934 were (Report of the Forester. 1934):

Cattle and horses
From poisonous plants..........2,779
From predatory animals......... 107
From disease................... 943
From other causes..............1,621
Total
5,450

Sheep and goats
From poisonous plants..........12,009
From predatory animals.........14,294
From disease................... 3,368
From other causes..............14,040
Total
43,711

The estimated number of big game on national forests in Colorado as of 31 December 1934 was (Report of the Forester. 1934):

Antelope................. 224
Black or brown bear...... 3,362
Grizzly.................. 3
Deer.....................59,570
Elk......................15,276
Mountain sheep........... 3,002

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1935

The estimated number of big game on national forests in Colorado as of 31 December 1935 was (Report of the Forester. 1936):

Antelope................. 212
Black or brown bear...... 3,665
Grizzly bear............. 5
Deer......................55,540
Elk.......................15,250
Mountain sheep........... 2,750

1936

Eight wolves reported in the National Forests in Colorado.

1937

From 1937 to 1970, the known number of animals removed by the Bureau of Sport Fisheries and Wildlife and its predecessors in order to suppress damage were (Cain Report 1971):

Year	*Bears*	*Bobcats*	*Coyotes*	*Red Wolves*	*Lobo Wolves*	*Lions*
1937	299	7,472	80,299	980	27	212
1938	392	7.189	84,844	1.343	17	255
1939	495	9.033	93,039	1.188	26	241
1940	608	10.566	104.072	1.246	9	214
1941	528	10,347	110.495	1.362	5	204
1942	636	10.957	111.076	781	10	204
1943	618	9.527	103.971	1.004	10	147
1944	592	8.900	108.050	1.161	9	167
1945	619	7,325	102.979	1.354	11	163
1946	730	6.487	108.311	1.551	6	113
1947	919	6,508	103.982	1.450	10	127
1948	744	7.223	90.270	1.053	14	148
1949	652	8.231	75.448	1.032	4	131
1950	719	10.874	66.281	1.051	108	236
1951	733	13.343	60.455	1.244	134	229
1952	714	13.476	50.661	1.451	182	197
1953	729	18.905	55.000	1.797	65	184
1954	860	19.559	52.636	1.589	93	232
1955	874	19.249	55.204	2.487	171	195
1956	977	19.495	55.402	1.940	96	285
1957	1,039	22.198	62.585	2.681	109	267
1938	1,023	23.453	62.765	2.615	172	331
1959	978	25,079	78.714	3.393	161	292
1960	1,023	25.808	94.769	3.830	2	290
1961	1,039	25.177	100.363	2.532	1	276
1962	815	21.228	104.787	2.780	2	254
1963	842	20.780	89.653	2.771	8	294
1964	711	20.918	97.096	2.617	24	323
1965	605	17.294	90.236	–	15	280
1966	549	13.365	77.258	–	5	212
1967	499	11.031	75.892	–	9	143
1968	440	9.351	69.390	–	34	152
1969	399	8.443	74.070	–	14	145
1970	403	8.403	73.093	–	11	121

1938

2 wolves reported in the National Forests in Colorado. The Forest Service estimated a total wolf population of 2,178 within the ten national forest regions (FS 1947).

> Expenditures in cooperative predator and rodent control involved $609.022 for regular departmental appropriations supplemented by $818,598 from cooperating counties, livestock associations, and others, and about $512,877 from emergency funds on work under Biological Survey supervision. The year's catch of predators taken through this cooperation aggregated 94,040, exceeding last year's record by 4,751, and consisted of 84,844 coyotes, 1,360 wolves, 7,189 bobcats and lynxes, 393 bears, and 252 mountain lions.
>
> A number of valuable predatory-animal specimens were collected by the field force for addition to the Survey's mammal collection in the National Museum. Among these is a coyote taken in Wyoming in November which weighed 74 3/4 pounds and measured 63 inches in length (Report of the Chief of the Biological Survey. 1938):

1939

Report of the Chief of the Biological Survey, 1939, United States Department of Agriculture, Washington, DC., p. 1.

> Cooperative predator and rodent-control operations during the year entailed expenditures of $644,774 from regular departmental appropriations, supplemented by $424,973 from cooperating States, $967,993 from cooperating counties, livestock associations, and others, and about $735,199 from emergency funds for control work conducted under Bureau supervision.

1940

Population of Colorado 1,1123,296.

> Residents of Foxton. Colorado, have reported to U.S. Biological Survey officials that timber wolves or bigger-than-average coyotes have moved southward into their region from Wyoming and are killing deer "at a fast pace." Ranchers in the area have declared war on the marauders, but have had little success thus far (Anon. 1940. Wyoming wildlife, Vol. V, No. 2. p. 9).

> Many reports have been received of the presence of one or more of these animals [gray wolf] in the north and northwestern part of Wyoming. Many if not all of these, however, proved to be the large mountain coyote. The last wolf killed in Wyoming was shot by Deputy Game Warden H. B. Sanderson of Greybull, in January 1940, near Copman's tomb on the north rim of Shell Canyon. The wolf measured 64 inches from nose to tip of tail (Anon. 1940. Wyoming Wildlife, Vol. V, No. 9, p. 6). (see Wilson 1985).

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1941

Five wolves reported in the national forests of Colorado.

1943

Elk population in Colorado estimated at 24,000 head (Swift 1947).

1945

Last known wild wolf in Colorado killed in Conejos County by state hunter (Robinson 1993).

1949

Thinking like a mountain (Leopold 1949) published. One of the most recited quotations ever written about the wolf is:

> A deep chesty bawl echoes from rimrock to rimrock, rolls down the mountain, and fades into the far blackness of the night. It is an outburst of wild defiant sorrow, and of contempt for all the adversities of the world.
>
> Every living thing (and perhaps many a dead one as well) pays heed to that call. To the deer it is a reminder of the way of all flesh, to a pine a forecast of midnight scuffles and of blood upon the snow, to the coyote a promise of gleanings to come, to a cowman a threat of red ink at the bank, to the hunter a challenge of fang against bullet. Only the mountain has lived long enough to listen objectively to the bawl of a wolf.
>
> In those days we never heard of passing up a chance to kill a wolf. In a second we were pumping lead into the pack, but with more excitement than accuracy: how to aim a steep downhill shot is always confusing. When our rifles were empty, the old wolf was down, and a pup was dragging a leg into impassible slide-rocks.
>
> We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new in those eyes--something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean a hunter's paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.

A large white wolf was killed by a cyanide gun in Fremont County, Wyoming on Thanksgiving Day, 1949, by Charles A. Wilson. The wolf was, "as old as the hills and had only five snags left in his jaws! He was fat and had beautiful, shiny, almost white fur. The skin stretched almost seven feet from the tip of his nose to the tip of his tail" (Wilson 1985). An interesting account of this wolf (with photograph) is in Wilson (1985).

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1951

On 5 September a two-or three-year-old male grizzly is trapped in Starvation Gulch, near the headwaters of the Rio Grande River in the San Juan Mountains (Murray 1987).

1952

In September, the last confirmed killing of a grizzly (until 1979) occurs near the headwaters of the Los Pinos River in the San Juan National Forest (Murray 1987).

1954

Rio-Grande-San Juan Grizzly Bear Management Act authorized. This Act was intended to preserve the last few grizzlies in Colorado and made it illegal to kill them throughout the state (Murray 1987).

1971

Wolf killed in Boise National Forest (Idaho).
Wolf photographed in Clearwater National Forest (Idaho).

1972*

Wolf research by Wolf Ecology Project, University of Montana, began by evaluating wolf reports and sightings. They found no evidence of wolves in Montana.

1973

The ESA was enacted; wolves become protected in the U.S.

Wolves became protected by Montana State Law.

1974

An Interdisciplinary Wolf Recovery Team was appointed and led by a Montana Fish and Game representative. Introduction was considered in selected areas.

1977

Wolves become protected by Idaho State Law.

* Most of the observations from 1972 to the present are from: USFW. 1993. Yellowstone and central Idaho DEIS.

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1978

A lone wolf was photographed and another killed in central Idaho.

1978

The Wolves of Yellowstone report indicated no wolf packs in the Yellowstone area; viable populations ended in 1925.

1979

The last known grizzly bear in Colorado is killed 23 September 1979 in the region of Platoro Reservoir in the south San Juans (Murray 1987).

A lone wolf was monitored adjacent to Glacier National Park.

1980

A lone wolf depredated on livestock near Big Sandy, Montana, and was killed by FWS. This was the first documented depredation in over 50 years.

The Northern Rocky Mountain Wolf Recovery Plan was reviewed by the public and approved by the FWS.

1981

The Wolf Recovery Team leader appointed new members, and revision of recovery plan began.

1986

The first wolf den in the western U.S. in over fifty years was documented in Glacier National Park.

1987

The revised Northern Rocky Mountain Wolf Recovery Plan was reviewed by the public and approved by FWS.

National Park Service director Mott suggested beginning EIS for reintroduction to Yellowstone. Park Service began wolf information program.

A wolf pack near Browning, Montana, depredated on livestock and was removed by the FWS. Representative Owens (Utah) introduced a bill to require the NPS to reintroduce wolves to Yellowstone National Park (H.R. 3378 Sept. 30, 1987).

1988

The Interim Wolf Control Plan was approved by FWS. The Wolf Recovery Program in Montana was staffed and funded.

Congress directed NPS and FWS to conduct "Wolves for Yellowstone?" studies and mandated appointment of Wolf Recovery Coordinator.

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1989

Depredating wolves from Marion, Montana were relocated, leading to the establishment of the Ninemile wolf pack near Missoula, Montana. Representative Owens (Utah) introduced bill to Congress requiring initiation of EIS for wolf reintroduction to Yellowstone (H.R. 2786 June, 1989). It was not passed.

1990

Senator McClure (Idaho) introduced a bill "to provide for the reestablishment of the gray wolf in Yellowstone National Park and central Idaho Wilderness (5.2674 May 1990). It did not pass.

The National Park Service and FWS released the first "Wolves for Yellowstone?" report, Volumes I and II.

Congress established the Wolf Management Committee. No Congressional or agency action was taken on the Committee's May 1991 recommendation.

At least 4 litters of pups (minimum of 21 pups) were produced in Montana in 1990.

1991

Congress directed the FWS, in consultation with the Park Service and the Forest Service, to prepare a DEIS on wolf recovery in central Idaho and Yellowstone National Park.

Congress funded the FWS to support the Animal Damage Control Wolf Management Specialist position in the West.

A black wolf was illegally poisoned on a livestock allotment in a central Idaho Wilderness area.

Two separate radio-collared wolves moved into Idaho. One stayed, the other went back to Canada.

A minimum of 2 litters with about 10 pups were born in Montana in 1991.

Presence of at least two wolves confirmed at elk kill site inside Idaho in March, 1991.

At least two wolves discovered in Boise National Forest in 1991. A female was found disabled in the Bear Valley area on July 31; she died in captivity despite intensive treatment. The wolf was first thought injured by a prey animal, but later was determined to have been poisoned with the pesticide furadan.

Wolf activity again documented in the North Cascades in spring and summer of 1991 and 1992 and numerous sightings suggest the possible presence of wolves in the southern portion of the Cascades.

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Cattle and calf losses in Colorado for 1991 were (Wyoming Agricultural Statistics. 1992. U.S. Department of Agriculture, National Agricultural Statistics Service):

Predators....................	3,100 (2.7% of total)
Calving problems.............	11,300
Digestive problems...........	17,800
Respiratory problems.........	47,500 (41% of total)
Weather......................	6,100
Poison.......................	6,000
Theft........................	800
Other........................	22,400
Total losses.................	115,000

1992

The National Park Service and the FWS released a second "Wolves for Yellowstone?" report, Volumes III and IV.

An estimated 40 wolves in 4 packs occupied northwestern Montana. All packs except the Ninemile Pack, which resulted from the relocation of a problem wolf in 1989, and Murphy Lake Pack were still in the Glacier National Park area. Lone wolves continued to be reported throughout Montana, Idaho, and Wyoming but no wolf reproduction was documented in Idaho or Wyoming.

A possible wild wolf was photographed in Yellowstone. A wolf was shot just south of Yellowstone. No other wolves located despite increased monitoring.

Congress directed the FWS to complete EIS by January 1994 and that it expected the proposed alternative to conform to existing law.

Reports of wolves provided to the U.S. Fish and Wildlife Service during 1989, 1990, and 1991 totalled 162, 265, and 303, respectively. Forty-five have been received to date in 1992.

Polls indicate that about 2 out of 3 Montanans support natural recovery of wolves in the state, if hunting and recreational activities are not impacted.

Public attitudes about wolf recovery (in Idaho) are most favorable of the 3 Northern Rocky Mountain states. A 1992 survey indicated that 72% of Idahoans favor having wolves in the wilderness and roadless ares of central Idaho.

Occasional unconfirmed reports come from the Yellowstone area, including reports from the Dubois, Wyoming, area in 1991. Ten reports have been received from northwestern Wyoming in 1992.

Surveys indicate that most residents in Wyoming, Idaho, and Montana, and most park visitors support restoration of wolves to Yellowstone Park.

> On February 1, an animal believed to be a wild wolf was darted and radio collared by Washington Department of Wildlife personnel in the Mt. Baker area. Monitoring led experts to conclude that the animal was a wolf x dog hybrid. It was captured and transported to Wolf Haven, where it is being used as an example to discourage public ownership of hybrids. Over the past 10 years, at least 9 wolves have been killed in the Dakotas after being mistaken for coyotes or dogs. Other reports there have been made. These animals evidently

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are dispersers from Minnesota, Manitoba, or Saskatchewan. Appearances of wolves in the Dakotas will likely continue and possibly increase, creating a management dilemma for the Service. Although the species is fully protected, few sizable blocks of public land exist in North and South Dakota, livestock is abundant, and a recovery program is untenable (Fritts 1993).

A minimum of 4 litters (16 pups) were born in Montana in 1992; 2 packs just north of the Canadian border produced 6 pups each.

Estimated number of selected big game animals in Colorado in 1992 was (Colorado Division of Wildlife. 1992. Big game hunting statistics. 1992. Denver, CO):

Antelope................. 53,412
Deer.....................585,410
Elk......................194,715

1993

An estimated 45 wolves in 5 packs occupy northwestern Montana. Monitoring efforts increased in Idaho and Wyoming but no wolf packs have been located.

1994

"Colorado Gray Wolf Recovery: A Biological Assessment" report completed 31 March.

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APPENDIX C

Federally Listed Species and Their Status in Colorado

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U. S. Fish and Wildlife Service
Colorado State Office

(Effective December 13, 1993)

FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	ADAMS	ALAMOSA	ARAPAHOE	ARCHULETA	BACA	BENT	BOULDER	CHAFFEE	CHEYENNE	CLEAR CREEK	CONEJOS	COSTILLA	CROWLEY	CUSTER	DELTA	DENVER
American peregrine falcon, *Falco peregrinus*, Listed Endangered				●			●	●			●			●		●
Bald eagle, *Haliaeetus leucocephalus*, Listed Endangered	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Whooping crane, *Grus americana*, Listed Endangered	●	●		●	●		●							●		●
Least tern (interior population), *Sterna antillarum*, Listed Endangered					o	o										
Piping plover, *Charadrius melodus*, Listed Threatened					●	●										
Eskimo curlew, *Numenius borealis*, Listed Endangered	o				o		o							o		
White-faced ibis, *Plegadis chihi*, Category 2	●	●	●	●	●	●	●	●	●	●	●					
Mountain plover, *Charadrius montanus*, Category 1	o	o	o		o	o	o		o				o			
Ferruginous hawk, *Buteo regalis*, Category 2					●	●							●			
Southwestern willow flycatcher, *Empidonax traillii extimus*, Proposed End.				o							o	o				
Northern goshawk, *Accipiter gentilis*, Category 2				●			●			●				●	●	
Black tern, *Chlidonias niger*, Category 2	o	o	o	o	o	o	o	o	o		o	o	o	o	o	o
Mexican spotted owl, *Strix occidentalis lucida*, Listed Threatened	●	●	●	●			●	●		●	●	●		●		●
Columbian sharptailed grouse, *Tympanuchus phasianellus columbianus*, Category 2															o	
Western snowy plover, *Charadrius alexandrinus nivosus*, Category 2		●				●					●					
Baird's sparrow, *Ammodramus bairdii*, Category 2	o		o		o	o			o				o			
Loggerhead shrike, *Lanius ludovicianus*, Category 2			●			●	●							●	●	
Boreal western toad, *Bufo boreas boreas*, Category 2							o	o		o	o				o	

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Colorado State Office

(Effective December 13, 1993)

FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	ADAMS	ALAMOSA	ARAPAHOE	ARCHULETA	BACA	BENT	BOULDER	CHAFFEE	CHEYENNE	CLEAR CREEK	CONEJOS	COSTILLA	CROWLEY	CUSTER	DELTA	DENVER
Colorado hog-nosed skunk, *Conepatus mesoleucus figginsi*, Category 2					●	●								●		
Black-footed ferret, *Mustela nigripes*, Listed Endangered	o	o	o	o	o	o	o		o		o	o	o		o	
Preble's meadow jumping mouse, *Zapus hudsonius preblei*, Category 2	●		●				●									●
Fringed-tailed myotis, *Myotis thysanodes pahasapensis*, Category 2					o	o	o									
North American wolverine, *Gulo gulo luscus*, Category 2				●			●	●		●				●	●	
North American lynx, *Felis lynx canadensis*, Category 2				o						o	o			o		
Swift fox, *Vulpes velox*, Category 2	●		●		●	●	●		●				●			
Razorback sucker, *Xyrauchen texanus*, Listed Endangered															o	
Bonytail chub, *Gila elegans*, (presumed-historical) Listed Endangered															●	
Greenback cutthroat trout, *Oncorhynchus clarki stomias*, List. Threat.							o			o				o		
Arkansas darter, *Etheostoma cragini*, Category 1					●	●			●				●			
Speckled chub (Arkansas River Basin population), *Extrarius aestivalis tetranemus*, Category 2	o				o	o					o	o				
Flannelmouth sucker, *Catostomus latipinnis*, Category 2				●											●	
Plains topminnow, *Fundulus sciadicus*, Category 2	o		o				o									o
Colorado River cutthroat trout, *Oncorhynchus clarki pleuriticus*, Cat. 2				●											●	
Colorado squawfish, *Ptychocheilus lucius*, Listed Endangered															o	
Round tail chub, *Gila robusta*, Category 2				●											●	
Rocky Mountain capshell, *Acroloxus coloradensis*, Category 2							o									

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Colorado State Office

(Effective December 13, 1993)

FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	ADAMS	ALAMOSA	ARAPAHOE	ARCHULETA	BACA	BENT	BOULDER	CHAFFEE	CHEYENNE	CLEAR CREEK	CONEJOS	COSTILLA	CROWLEY	CUSTER	DELTA	DENVER
Texas horned lizard, *Phrynosoma cornutum*, Category 2					●	●							●			
Regal fritillary butterfly, *Speyeria idalia*, Category 2	o		o				o									
Lost ethmiid moth, *Ethmia monachella*, Category 2							●									
Great Basin silverspot butterfly, *Speyeria nokomis nokomis*, Category 2															o	
Uncompahgre fritillary butterfly, *Boloria acrocnema*, Listed Endangered														●		
Bell's twinpod, *Physaria bellii*, Category 2							o									
Larimer aletes, *Aletes humilis*, Category 2							●									
Pagosa bladderpod, *Lesquerella pruinosa*, Category 2				o												
Clay-loving wild buckwheat, *Eriogonum pelinophilum*, Listed Endangered															●	
Spineless hedgehog cactus, *Echinocereus triglochidiatus* var. *inermis*, Listed Endangered															o	
Uinta Basin hookless cactus, *Sclerocactus glaucus*, Listed Threatened															●	
Smith whitlow-grass, *Draba smithii*, Category 2														o		
Grand Mesa penstemon, *Penstemon mensarum*, Category 2															●	
Ripley milkvetch, *Astragalus ripleyi*, Category 2											o					
Ute ladies'-tresses orchid, *Spiranthes diluvialis*, Listed Threatened	●		●				●									●
Adobe beardtongue, *Penstemon retrorsus*, Category 1															o	

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(Effective December 13, 1993)

FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	ADAMS	ALAMOSA	ARAPAHOE	ARCHULETA	BACA	BENT	BOULDER	CHAFFEE	CHEYENNE	CLEAR CREEK	CONEJOS	COSTILLA	CROWLEY	CUSTER	DELTA	DENVER
Brandegee wild buckwheat, *Eriogonum brandegei*, Category 1								●								
Colorado watercress, *Rorippa coloradensis*, Category 2		o														
Arkansas River feverfew, *Parthenium tetraneuris*, Category 2								●								
Colorado green gentian, *Frasera coloradensis*, Category 2					o	o										
Colorado butterflyweed, *Gaura neomexicana* ssp. *coloradensis*, Category 1	o		o	o			o									o
Colorado (Adobe) desert parsley, *Lomatium concinnum*, Category 2															●	
Slender spiderflower, *Cleome multicaulis*, Category 2		o										o				
Pagosa gilia (skyrockets), *Ipomopsis polyantha* var. *polyantha*, Category 2				●												
Dwarf milkweed, *Asclepias uncialis*, Category 2	o				o	o			o							o
Showy prairie gentian, *Eustoma grandiflorum*, Category 2	●		●				●									●
Aztec milkvetch, *Astragalus proximus*, Category 2				o												
Pale moonwort, *Botrichium pallidum*, Category 2							●									
Purple lady's slipper orchid, *Cypripedium fasciculatum*, Category 2							o									
Brandegee milkvetch, *Astragalus brandegei*, Category 2									●							

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(Effective December 13, 1993)

FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	DOLORES	DOUGLAS	EAGLE	ELBERT	EL PASO	FREMONT	GARFIELD	GILPIN	GRAND	GUNNISON	HINSDALE	HUERFANO	JACKSON	JEFFERSON	KIOWA	KIT CARSON
American peregrine falcon, *Falco peregrinus*, Listed Endangered		●			●	●	●		●	●	●	●	●	●		
Bald eagle, *Haliaeetus leucocephalus*, Listed Endangered	o	o	o	o	o	o	o		o	o	o	o	o	o	o	o
Whooping crane, *Grus americana*, Listed Endangered				●								●				
Least tern (interior population), *Sterna antillarum*, Listed Endangered															o	o
Piping plover, *Charadrius melodus*, Listed Threatened															●	●
Eskimo curlew, *Numenius borealis*, Listed Endangered				o			o							o	o	o
Mountain plover, *Charadrius montanus*, Category 1		●		●	●							●	●		●	●
Ferruginous hawk, *Buteo regalis*, Category 2							o								o	
Southwestern willow flycatcher, *Empidonax traillii extimus*, Proposed Endangered	●						●									
Northern goshawk, *Accipiter gentilis*, Category 2	o		o				o	o	o	o	o	o	o			
Black tern, *Chlidonias niger*, Category 2	●	●	●	●	●	●	●	●	●	●		●	●			●
Mexican spotted owl, *Strix occidentalis lucida*, Listed Threatened	o	o			o	o		o	o			o	o	o		
Columbian sharptailed grouse, *Tympanuchus phasianellus columbianus*, Category 2	●						●									
Western snowy plover, *Charadrius alexandrinus nivosus*, Category 2					o					o					o	
Loggerhead shrike, *Lanius ludovicianus*, Category 2					●	●				●		●				
Baird's sparrow, *Ammodramus bairdii*, Category 2		o		o	o							o			o	o
Harlequin duck, *Histrionicus histrionicus*, Category 2					●								●			
Black-footed ferret, *Mustela nigripes*, Listed Endangered	o	o	o	o	o	o			o	o	o		o		o	o

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓

COUNTIES →	DOLORES	DOUGLAS	EAGLE	ELBERT	EL PASO	FREMONT	GARFIELD	GILPIN	GRAND	GUNNISON	HINSDALE	HUERFANO	JACKSON	JEFFERSON	KIOWA	KIT CARSON
Swift fox, *Vulpes velox*, Category 2		o		o	o	o						o	o		o	o
Colorado hog-nosed skunk, *Conepatus mesoleucus figginsi*, Category 2					•	•				•						
Fringed-tailed myotis, *Myotis thysanodes pahasapensis*, Category 2					o							o	o			
North American wolverine, *Gulo gulo luscus*, Category 2	•		•				•	•	•	•	•	•	•	•		
North American lynx, *Felis lynx canadensis*, Category 2			o				o		o	o			o			
Preble's meadow jumping mouse, *Zapus hudsonius preblei*, Category 2		•		•	•									•		
Plains topminnow, *Fundulus sciadicus*, Category 2		o		o										o		
Colorado River cutthroat trout, *Oncorhynchus clarki pleuriticus*, Category 2	•		•				•		•	•	•					
Round tail chub, *Gila robusta*, Category 2	o						o			o						
Greenback cutthroat trout, *Oncorhynchus clarki stomias*, Listed Threatened		•			•							•				
Razorback sucker, *Xyrauchen texanus*, Listed Endangered							o									
Bonytail chub, *Gila elegans*, (presumed-historical) Listed Endangered							•									
Speckled chub (Arkansas River Basin population), *Extrarius aestivalis tetranemus*, Category 2					o	o						o				
Arkansas darter, *Etheostoma cragini*, Category 1				•	•	•						•			•	
Flannelmouth sucker, *Catostomus latipinnis*, Category 2	o						o									
Regal fritillary butterfly, *Speyeria idalia*, Category 2		•		•	•									•		•
Pawnee montane skipper, *Hesperia leonardus montana*, Listed Threatened		o												o		

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	DOLORES	DOUGLAS	EAGLE	ELBERT	EL PASO	FREMONT	GARFIELD	GILPIN	GRAND	GUNNISON	HINSDALE	HUERFANO	JACKSON	JEFFERSON	KIOWA	KIT CARSON
Uncompahgre fritillary butterfly, *Boloria acrocnema*, Listed Endangered											○					
Boreal western toad, *Bufo boreas boreas*, Category 2			●				●	●	●	●			●			
Brandegee wild buckwheat, *Eriogonum brandegei*, Category 1					○	○										
Roundleaf four-o'clock, *Oxybaphus (Mirabilis) rotundifolius*, Category 2						●										
Rabbit ears gilia, *Ipomopsis aggregata* ssp. *weberi*, Category 2													○			
Colorado butterflyweed, *Gaura neomexicana* ssp. *coloradensis*, Category 1		●			●									●		
Arkansas River feverfew, *Parthenium tetraneuris*, Category 2						○										
Dwarf milkweed, *Asclepias uncialis*, Category 2						●						●				●
Uinta Basin hookless cactus, *Sclerocactus glaucus*, Listed Threatened							○									
Wetherill milkvetch, *Astragalus wetherillii*, Category 2							●									
Grand Mesa Penstemon, *Penstemon mensarum*, Category 2										○						
Parachute beardtongue, *Penstemon debilis*, Category 2							●									
Skiff milkvetch, *Astragalus microcymbus*, Category 2										○						
Osterhout milkvetch, *Astragalus osterhoutii*, Listed Endangered									●							
Contracted Indian ricegrass, *Oryzopsis contracta*, Category 2											○					
Debeque phacelia, *Phacelia submutica*, Category 1							●									
Weber monkey-flower, *Mimulus gemmiparus*, Category 2									○					○		

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	DOLORES	DOUGLAS	EAGLE	ELBERT	EL PASO	FREMONT	GARFIELD	GILPIN	GRAND	GUNNISON	HINSDALE	HUERFANO	JACKSON	JEFFERSON	KIOWA	KIT CARSON
Ute ladies'-tresses orchid, *Spiranthes diluvialis*, Listed Threatened		●			●									●		
North Park phacelia, *Phacelia formosula*, Listed Endangered													○			
Harrington beardtongue, *Penstemon harringtonii*, Category 2			●						●							
Penland beardtongue, *Penstemon penlandii*, Listed Endangered									○							
Streaked ragweed, *Ambrosia linearis*, Category 2				●	●										●	
Bell's twinpod, *Physaria bellii*, Category 2					○									○		
Purple lady's slipper orchid, *Cypripedium fasciculatum*, Category 2			●						●				●			
Pale moonwort, *Botrichium pallidum*, Category 2						○				○						
Showy prairie gentian, *Eustoma grandiflorum*, Category 2						●										
Arapien stickleaf, *Mentzelia argillosa*, Category 2							○							○	○	
Gunnison milkvetch, *Astragalus anisus*, Category 2										●						
Brandegee milkvetch, *Astragalus brandegei*, Category 2										○						
Leadville milkvetch, *Astragalus molybdenus*, Category 2										●						

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	LAKE	LA PLATA	LARIMER	LAS ANIMAS	LINCOLN	LOGAN	MESA	MINERAL	MOFFAT	MONTEZUMA	MONTROSE	MORGAN	OTERO	OURAY	PARK	PHILLIPS
American peregrine falcon, *Falco peregrinus*, Listed Endangered		●	●				●	●	●	●	●			●	●	
Bald eagle, *Haliaeetus leucocephalus*, Listed Endangered	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Whooping crane, *Grus americana*, Listed Endangered			●	●		●						●				
Least tern (interior population), *Sterna antillarum*, Listed Endangered				○								○				
Piping plover, *Charadrius melodus*, Listed Threatened				●								●				
Eskimo curlew, *Numenius borealis*, Listed Endangered		○	○	○		○						○				
Northern goshawk, *Accipiter gentilis*, Category 2	●	●	●				●		●	●	●			●	●	
White-faced ibis, *Plegadis chihi*, Category 2																○
Mountain plover, *Charadrius montanus*, Category 1			●	●	●	●	●		●			●	●		●	●
Black tern, *Chlidonias niger*, Category 2	○	○	○	○	○	○	○		○	○	○	○	○		○	
Southwestern willow flycatcher, *Empidonax traillii extimus*, Prop. End.		●		●			●		●	●						
Ferruginous hawk, *Buteo regalis*, Category 2		○		○		○			○	○		○	○			
Mexican spotted owl, *Strix occidentalis lucida*, Listed Threatened		●	●	●					●	●	●				●	
Columbian sharptailed grouse, *Tympanuchus phasianellus columbianus*, Category 2							○		○	○	○					
Western snowy plover, *Charadrius alexandrinus nivosus*, Category 2		●	●										●		●	
Loggerhead shrike, *Lanius ludovicianus*, Category 2		○					○					○				
Baird's sparrow, *Ammodramus bairdii*, Category 2			●	●	●	●						●	●			●
Harlequin duck, *Histrionicus histrionicus*, Category 2		○													○	
Texas horned lizard, *Phrynosoma cornutum*, Category 2			●	●								●	●			

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Black-footed ferret, *Mustela nigripes*, Listed Endangered		●	●	●	●	●	●		●	●	●	●	●	●	●	
Swift fox, *Vulpes velox*, Category 2			○	○	○	○						○	○			○
Fringed-tailed myotis, *Myotis thysanodes pahasapensis*, Category 2			●	●								●	●			
North American wolverine, *Gulo gulo luscus*, Category 2	○	○	○					○						○	○	
North American lynx, *Felis lynx canadensis*, Category 2	●	●									●				●	
Colorado hog-nosed skunk, *Conepatus mesoleucus figginsi*, Category 2				○	○								○		○	
Spotted bat, *Euderma maculatum*, Category 2									●							
Preble's meadow jumping mouse, *Zapus hudsonius preblei*, Category 2			○									○				
Arkansas darter, *Etheostoma cragini*, Category 1				●	●								●			
Speckled chub (Arkansas River Basin population), *Extrarius aestivalis tetranemus*, Category 2				○									○			
Plains topminnow, *Fundulus sciadicus*, Category 2			●			●						●				
Colorado River cutthroat trout, *Oncorhynchus clarki pleuriticus*, Cat. 2		○						○	○	○	○			○		
Round tail chub, *Gila robusta*, Category 2		●					●		●	●	●					
Colorado squawfish, *Ptychocheilus lucius*, Listed Endangered							○		○		○					
Razorback sucker, *Xyrauchen texanus*, Listed Endangered							●		●							
Bonytail chub, *Gila elegans*, (presumed-historical) Listed Endangered							○		○							
Greenback cutthroat trout, *Oncorhynchus clarki stomias*, List. Threat.	●		●												●	
Flannelmouth sucker, *Catostomus latipinnis*, Category 2		○					○		○	○	○			○		

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	LAKE	LA PLATA	LARIMER	LAS ANIMAS	LINCOLN	LOGAN	MESA	MINERAL	MOFFAT	MONTEZUMA	MONTROSE	MORGAN	OTERO	OURAY	PARK	PHILLIPS
Great Basin silverspot butterfly, *Speyeria nokomis nokomis*, Category 2							●		●		●			●		
Stevens' tortricid moth, *Decodes stevensi*, Category 2			○													
Regal fritillary butterfly, *Speyeria idalia*, Category 2			●		●	●						●				●
Uncompahgre fritillary butterfly, *Boloria acrocnema*, Listed Endangered														○		
Pawnee montane skipper, *Hesperia leonardus montana*, Listed Threatened															●	
Boreal western toad, *Bufo boreas boreas*, Category 2	○		○				○								○	
Payson (Paradox) lupine, *Lupinus crassus*, Category 2											●					
Adobe beardtongue, *Penstemon retrorsus*, Category 1											○					
Clay-loving wild buckwheat, *Eriogonum pelinophilum*, Listed Endangered											●					
Mancos columbine, *Aquilegia micrantha* var. *mancosana*, Category 2										○						
Small-flower beardtongue, *Penstemon parviflorus*, Category 2										●						
Mancos saltbrush, *Proatriplex pleiantha*, Category 2										○						
Schmoll milkvetch, *Astragalus schmolliae*, Category 2										●						
Cronquist milkvetch, *Astragalus cronquistii*, Category 2										○						
Mesa Verde cactus, *Sclerocactus mesae-verdae*, Listed Threatened										●						
Wetherill milkvetch, *Astragalus wetherillii*, Category 2							○		○		○					
Mancos milkvetch, *Astragalus humillimus*, Listed Endangered										●						

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	LAKE	LA PLATA	LARIMER	LAS ANIMAS	LINCOLN	LOGAN	MESA	MINERAL	MOFFAT	MONTEZUMA	MONTROSE	MORGAN	OTERO	OURAY	PARK	PHILLIPS
Uinta Basin hookless cactus, *Sclerocactus glaucus*, Listed Threatened							●				●					
Canyonlands lomatium (Slickrock desert parsley), *Lomatium latilobum*, Category 2							○									
Dolores skeletonplant (desert pink), *Lygodesmia dolorensis*, Category 2							●									
Debeque milkvetch, *Astragalus debequaeus*, Category 2							○									
Grand Junction catseye, *Crypantha aperta*, Category 2							●									
Hamilton milkvetch, *Astragalus hamiltonii*, Category 2									○							
Gibbens beardtongue, *Penstemon gibbensii*, Category 2									●							
Ownbey's thistle, *Cirsium ownbeyi*, Category 2									○							
Debeque phacelia, *Phacelia submutica*, Category 1							●									
Colorado green gentian, *Frasera coloradensis*, Category 2				○												
Penland eutrema, *Eutrema penlandii*, Threatened	●														●	
Knowlton's cactus, *Pediocactus knowltonii*, Listed Endangered		○														
Piceance twinpod, *Physaria obcordata*, Listed Threatened									●							
Ute ladies'-tresses orchid, *Spiranthes diluvialis*, Listed Threatened			○									○				
Leadville milkvetch, *Astragalus molybdenus*, Category 2	●														●	
Aztec milkvetch, *Astragalus proximus*, Category 2		○														
Wilken fleabane, *Erigeron wilkenii*, Category 2									●							
Purple lady's slipper orchid, *Cyprepedium fasciculatum*, Category 2			○													

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	LAKE	LA PLATA	LARIMER	LAS ANIMAS	LINCOLN	LOGAN	MESA	MINERAL	MOFFAT	MONTEZUMA	MONTROSE	MORGAN	OTERO	OURAY	PARK	PHILLIPS
Weber monkey-flower, *Mimulus gemmiparus*, Category 2			●													
Rocky Mountain (Larimer) cinquefoil (Front Range), *Potentilla effusa* var. *rupinicola*, Category 2			○													
Bell's twinpod, *Physaria bellii*, Category 2			●													
Colorado butterflyweed, *Gaura neomexicana* ssp. *coloradensis*, Category 1			○													
Larimer aletes, *Aletes humilis*, Category 2			●													
Streaked ragweed, *Ambrosia linearis*, Category 2					○											
Contracted Indian ricegrass, *Oryzopsis contracta*, Category 2			●				●									
Wolf Creek (Klein's) evening-primrose, *Oenothera kleinii*, Category 2								○								
Spineless hedgehog cactus, *Echinocereus triglochidiatus* var. *inermis*, Listed Endangered														●		
Colorado (Adobe) desert parsley, *Lomatium concinnum*, Category 2											○			○		
Kachina daisy, *Erigeron kachinensis*, Category 2											●					
Mesa Verde stickleaf, *Hackelia gracilenta*, Category 2										○						
Alcove bog orchid, *Habenaria zothecina*, Category 2							●		●							
Park rockcress, *Arabis vivariensis*, Category 2									○							
Pale blue-eyed grass, *Sisyrinchium pallidum*, Category 2			●												●	
Grand Mesa penstemon, *Penstemon mensarum*, Category 2							○				○					
Porter's feathergrass, *Ptilagrostis porteri*, Category 2	●														●	

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	LAKE	LA PLATA	LARIMER	LAS ANIMAS	LINCOLN	LOGAN	MESA	MINERAL	MOFFAT	MONTEZUMA	MONTROSE	MORGAN	OTERO	OURAY	PARK	PHILLIPS
Showy prairie gentian, *Eustoma grandiflorum*, Category 2			●			●						●				
Dwarf milkweed, *Asclepias uncialis*, Category 2			○													
Sandhill goosefoot, *Chenopodium cycloides*, Category 2				●												
Smith whitlow-grass, *Draba smithii*, Category 2				○				○								

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	PITKIN	PROWERS	PUEBLO	RIO BLANCO	RIO GRANDE	ROUTT	SAGUACHE	SAN JUAN	SAN MIGUEL	SEDGWICK	SUMMIT	TELLER	WASHINGTON	WELD	YUMA
American peregrine falcon, *Falco peregrinus*, Listed Endangered					●	●	●	●	●			●			
Bald eagle, *Haliaeetus leucocephalus*, Listed Endangered	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Whooping crane, *Grus americana*, Listed Endangered		●	●				●			●			●	●	
Least tern (interior population), *Sterna antillarum*, Listed Endangered		○								○			○	○	
Piping plover, *Charadrius melodus*, Listed Threatened		●								●			●	●	
Eskimo curlew, *Numenius borealis*, Listed Endangered		○			○					○			○	○	
Northern goshawk, *Accipiter gentilis*, Category 2	●			●		●	●		●		●				
White-faced ibis, *Plegadis chihi*, Category 2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Mountain plover, *Charadrius montanus*, Category 1		●	●		●		●			●			●	●	●
Black tern, *Chlidonias niger*, Category 2		○	○	○	○	○	○			○	○	○	○	○	○
Southwestern willow flycatcher, *Empidonax trailli extimus*, Proposed End.				●				●	●						
Ferruginous hawk, *Buteo regalis*, Category 2		○	○	○						○				○	
Columbian sharptailed grouse, *Tympanuchus phasianellus columbianus*, Category 2				●		●			●						
Western snowy plover, *Charadrius alexandrinus nivosus*, Category 2		○	○												○
Loggerhead shrike, *Lanius ludovicianus*, Category 2			●												
Baird's sparrow, *Ammodramus bairdii*, Category 2		○	○							○			○	○	○
Harlequin duck, *Histrionicus histrionicus*, Category 2											●				
Mexican spotted owl, *Strix occidentalis lucida*, Listed Threatened			○		○		○		○		○	○		○	
Black-footed ferret, *Mustela nigripes*, Listed Endangered	●	●	●	●		●	●	●	●				●	●	●

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	PITKIN	PROWERS	PUEBLO	RIO BLANCO	RIO GRANDE	ROUTT	SAGUACHE	SAN JUAN	SAN MIGUEL	SEDGWICK	SUMMIT	TELLER	WASHINGTON	WELD	YUMA
Preble's meadow jumping mouse, *Zapus hudsonius preblei*, Category 2														○	
North American wolverine, *Gulo gulo luscus*, Category 2				●		●		●	●		●				
Colorado hog-nosed skunk, *Conepatus mesoleucus figginsi*, Category 2		○	○							○		○			
Fringed-tailed myotis, *Myotis thysanodes pahasapensis*, Category 2		●	●											●	
Swift fox, *Vulpes velox*, Category 2		○	○							○			○	○	○
North American lynx, *Felis lynx canadensis*, Category 2	●			●			●	●			●				
Regal fritillary butterfly, *Speyeria idalia*, Category 2										○			○	○	○
Pawnee montane skipper, *Hesperia leonardus montana*, Listed Threatened												●			
Uncompahgre fritillary butterfly, *Boloria acrocnema*, Listed Endangered					○		○	○							
Colorado River cutthroat trout, *Oncorhynchus clarki pleuriticus*, Category 2	●			●		●	●	●	●		●				
Round tail chub, *Gila robusta*, Category 2				○		○			○						
Colorado squawfish, *Ptychocheilus lucius*, Listed Endangered				●											
Flannelmouth sucker, *Catostomus latipinnis*, Category 2				○					○						
Arkansas darter, *Etheostoma cragini*, Category 1		●	●												
Greenback cutthroat trout, *Oncorhynchus clarki stomias*, Listed Threatened			○												
Speckled chub (Arkansas River Basin population), *Extrarius aestivalis tetranemus*, Category 2		●	●												
Plains topminnow, *Fundulus sciadicus*, Category 2			○	○						○			○	○	
Boreal western toad, *Bufo boreas boreas*, Category 2	●			●		●					●				
Texas horned lizard, *Phrynosoma cornutum*, Category 2		○	○												

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	PITKIN	PROWERS	PUEBLO	RIO BLANCO	RIO GRANDE	ROUTT	SAGUACHE	SAN JUAN	SAN MIGUEL	SEDGWICK	SUMMIT	TELLER	WASHINGTON	WELD	YUMA
Colorado butterflyweed, *Gaura neomexicana* spp. *coloradensis*, Category 1			●											●	
Roundleaf four-o'clock, *Oxybaphus (Mirabilis) rotundifolius*, Category 2			o												
Colorado green gentian, *Frasera coloradensis*, Category 2		●													
Porter's feathergrass (needle grass), *Ptilagrostis porteri*, Category 2											o				
Arkansas River feverfew, *Parthenium tetraneuris*, Category 2			●												
Slender spiderflower, *Cleome multicaulis*, Category 2					o		o								
Harrington beardtongue, *Penstemon harringtonii*, Category 2						●									
Graham beardtongue, *Penstemon grahamii*, Category 1				o											
White River penstemon, *Penstemon albifluvis*, Category 1				●											
Dudley Bluffs (Piceance) twinpod, *Physaria obcordata*, Listed Threatened				o											
Dudley Bluffs bladderpod, *Lesquerella congesta*, Listed Threatened				●											
Spineless hedgehog cactus, *Echinocereus triglochidiatus* spp. *inermis*, Listed Endangered									o						
Ute ladies'-tresses orchid, *Spiranthes diluvialis*, Listed Threatened														●	
Leadville milkvetch, *Astragalus molybdenus*, Category 2	o										o				
Showy prairie gentian, *Eustoma grandiflorum*, Category 2		●	●							●				●	●
Dwarf milkweed, *Asclepias uncialis*, Category 2			o											o	
Sandhill goosefoot, *Chenopodium cycloides*, Category 2			●												
Purple lady's slipper orchid, *Cypripedium fasciculatum*, Category 2						o					o				
Rabbit ears gilia, *Ipomopsis aggregata* ssp. *weberi*, Category 2						●									

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FEDERALLY LISTED SPECIES & THEIR STATUS IN COLORADO ↓ / COUNTIES →	PITKIN	PROWERS	PUEBLO	RIO BLANCO	RIO GRANDE	ROUTT	SAGUACHE	SAN JUAN	SAN MIGUEL	SEDGWICK	SUMMIT	TELLER	WASHINGTON	WELD	YUMA
Penland eutrema, *Eutrema penlandii*, Threatened											●				
Pale moonwort, *Botrichium pallidum*, Category 2												○			

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APPENDIX D

Local Names of *Canis lupus*
(Sources: Roe 1970, Ognev 1931, and others)

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LOCAL NAMES OF CANIS LUPUS

NATIVE AMERICANS

Apache (Jicarilla)	
Arapaho	haqihana
Arikara	steerich
Assiniboine	schunk-togitsche
Atsina	kiatissa
*Bannock	
Beaver	chiyune
Blackfoot (Siksika) Makuyi or Mahkwoyi (Vest)	sikkapehs (Maximilian)
	ahpace (Catlin)
Caddo (Kainah)	tasna (clan)
Cherokee	ani' wa' ya (clan)
Cheyenne	hoh-ni
Chinook	leloo
Chipewyan	noon-dee-a
Comanche	
Cree	mahihkun or may-hee-gan
Crow	mahigan
Gros Ventre	
Hidatsa	sahscha (gray)
	sah-tschuppischa(black)
	sahschattachi (white)
Iowa	michirache
Iroquois	toryone
Kadohadacho	tasha (clan)
Kansa	shomakoosa
Kiowa	qui
Kutenai	kachi, kachkin
Mandan	chahrata-psih (black)
	c.chotta (gray)
	harratta (Catlin)
Mandan	
Menominee	moqwaio
Miami	mowhawa or mahwawa
Mohican	mechchaooh or nehjao
Nez Perce'	
Ojibwa	maihngann
(Chippewa)	myeegun or ma-i-ngun
Omaha	schanton
	mikasi (gens)

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Ojibway		my-in-gan or kit-chi my-in-gan
Omaha		
Osage		
Oto		schanton
		me'-je-ra-ja
Pawnee		tskiri
Potawatomi		moah
Pueblos		
(Hopi)		kwewu
(Isleta)		tuim
(Laguna)		kakhan
(Taos)	kah-le-na (Bailey)	kahl
(Tigua)		tuim
Quapaw		shangke
Ute (Northern and *Southern)	*	sinapu
Sarsi		
Shawnee		m'-wa-wa
Sauteaux		my-in-gan
Sioux		
(Yankton)		schuk-toketscha-tanka
(Yankton)		song-toke-cha tung-ka (Seaton)
(Ogallala)		shunk-ah mah-nee-tu
Shoshone, Northern		
Tahltan		cheona
Tonkawa		hatchukuni (a clan)
Tuscarora		tskwarinuh
Winnebago		shungikikara
Yuchi		ta' ia

EUROAMERICAN

	wolf
	gray wolf
	big wolf
	lobo wolf
	cattle killer
	lobo
	loafer
	timber wolf
	big gray
	buffalo wolf
	Mexican wolf

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EASTERN EUROPE AND NORTHERN ASIA

southeastern Russia	Gray, biryuk (from Tartan 'bure')
Russian	beast
Ukainian	vovk
Polish	vilk
Russian Lapland	
paltis, seipeg, stakke, stalpe, ravia(male), zikko (female), skiuwga (young)	
Lettish	wilka
Estonian	hunt
Mordvinian language	virgas, rivas
Cheremissian language	pire, pir'e
Votish language	Kiion, kion
Permian languge	koin
Syryenian languge	kain
Chuvash	kaskar, kashkar
Meshcherian languge	bure
Tartan language	buro, biru, bure
Bashkir	karshan
Kopbals and Siberian Tartars	tyr
Vogul language	tschas, gas, siasa, sohsch
Kirghiz language	kashkir or kaskir
Tartars in the northern Caucasus	boryu
Kalmuck	chono
Kabardinian language	duguzhzh or duguzz
Circassian language	dugush
Ossetic language	birag
Chechan language	borz
Tavli language	bez or bers
Abkhasian language	abgydu
Georgian language	migelli
Azerbaijani	kurd
Kurdish	jakovar
Armenian	gail and guil
Turkoman	gurt
Parsee language	gurg
Romany	ruw
Buriat anf Soyot language	shokhno
Ob Ostyaks	eiur and evur
Ugan Ostyaks	pur
Surgut Ostyaks	jeuri, jaura
Narym Ostyaks	chumbani
Ostyak-Samoyedic dialect	chumbine
Samoyeds on the Pechora and Ob	sarmik, njuleka, ty-chanda,ty-channuta

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Yurak language	techanuda
Tavghi people on Yenisei	njunlera, njuitaeda
Koibal language	tadpe
Yenisei Urianghai people	ioru
Urianghai people on Tesa River	pore
Urianghai people in basin of Irkut	shono
Durbet-Mongolian	chono
Khalkha-Mongolian	chono
the Tunguses on northern Baikal	boijuku, baijuku
Tungus language	ayitka, typkaki
Daurian Tunguses	guzke
Birarian Tunguses, Orochons and Manegre	gusko, guske. guska
Orochon people	gose
Lamut people	galuki, neluki, burbik
Yakut language	bere
Yukagir language	kodiel
Mangun language	nigoia
Chuckchee language	ina, khinga, aine
Gold language	jengur, nenguru, ngolaki, neluki
Kileh in Gorin	ngoia
Kileh on Kura	ngoiaki
Giliaks of the west shore of Sakhakin	liks
Giliak language	attk
Sakhalin Ainus	herokeo
Khodzen language	enggur (adult male) uazang (adult female) khusa
Manchu	niokhe
Kamchadals on the Uk River	kuiriu, kuiichu
Western Kamchadals	kutaiju
Kamchadals on the Tigil River	aigue
Koriak language	ejylungur
Kirghiz language	orgiu
Aleutian language	kahannae, ellachgik
Kanagi language	alechjik

OTHER

Chinese	lang, nin-ha
French Canadian	loup gris, louve grise
Japanese	oinu, okami
French	le loup
German	der Wolf
Mexican	Xoloitzcuintli (Hernandez) or lobo

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APPENDIX E

Scientific Names for Animals Mentioned in this Report

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Scientific Names for Animals Mentioned in this Report.

Common Name	Scientific Name
BIRDS	
Eagle, Bald	*Aix sponsa*
Raven, Common	*Corvus corax*
MAMMALS	
Bear, Black	*Ursus americanus*
Bear, Grizzly	*Ursus arctos*
Beaver	*Castor canadensis*
Bighorn sheep	*Ovis canadensis*
Bighorn sheep, Desert	*Ovis canadaensis nelsoni*
Bison (buffalo)	*Bison bison*
Bobcat	*Felis rufus*
Coyote	*Canis latrans*
Deer, Mule	*Odocoileus hemionus*
Deer, White-tailed	*Odocoileus virginianus*
Elk	*Cervus elaphus*
Goat, Mountain	*Oreamnos americanus*
Hare, Snowshoe	*Lepus americanus*
Lion, Mountain	*Felis concolor*
Lynx, Canada	*Lynx canadensis*
Marmot, Yellow-bellied	*Marmota flaviventris*
Moose, Shiras	*Alces alces*
Pronghorn	*Antilocarpa americana*
Wolf, Gray	*Canis lupus*
Wolf, Great Plains	*Canis lupis nubilus*
Wolf, Mexican	*Canis lupis baileyi*
Wolverine	*Gulo gulo*

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APPENDIX F

State of Colorado Map.

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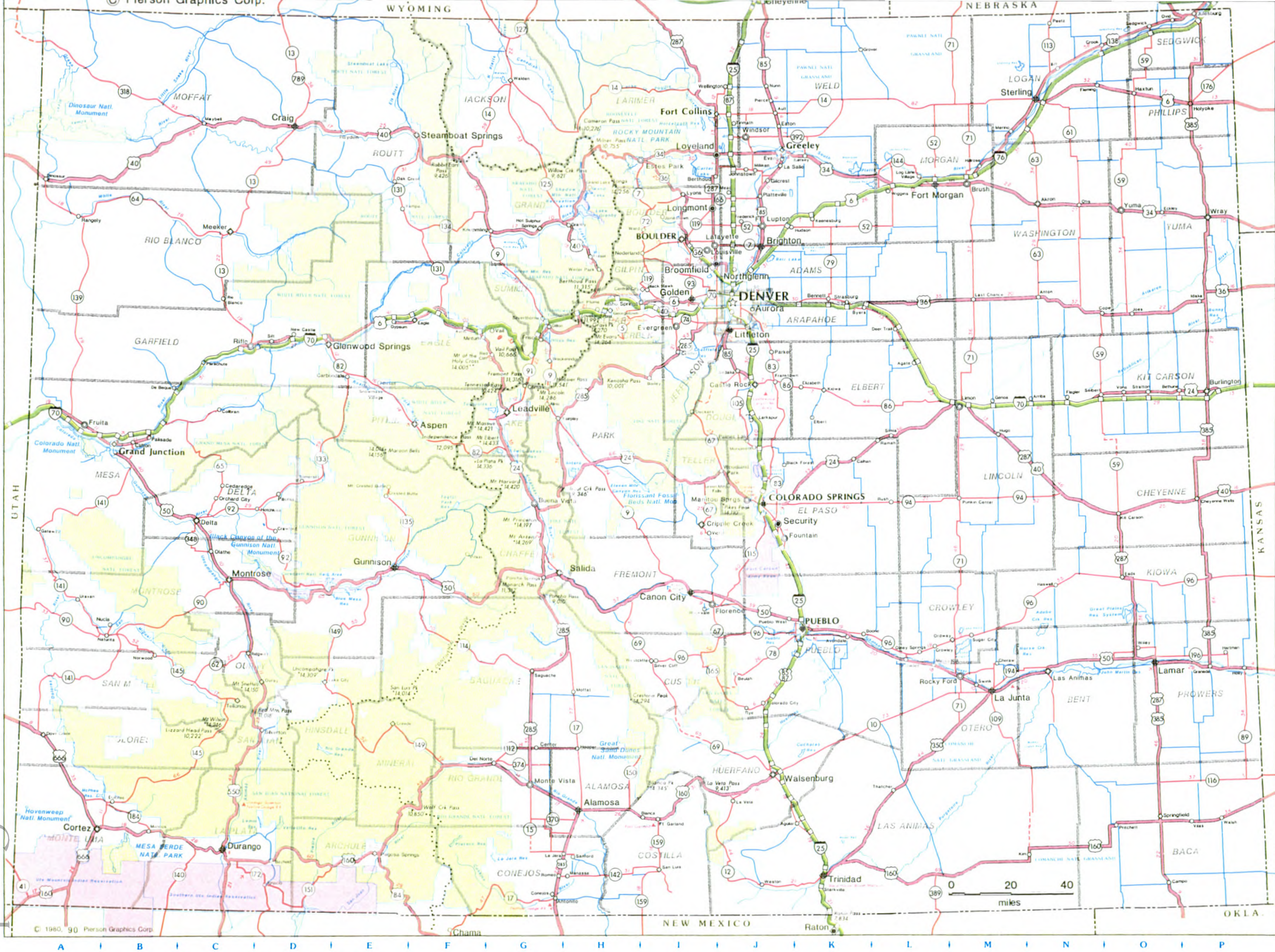

COLORADO

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APPENDIX G

Map of Colorado Big Game Management Units

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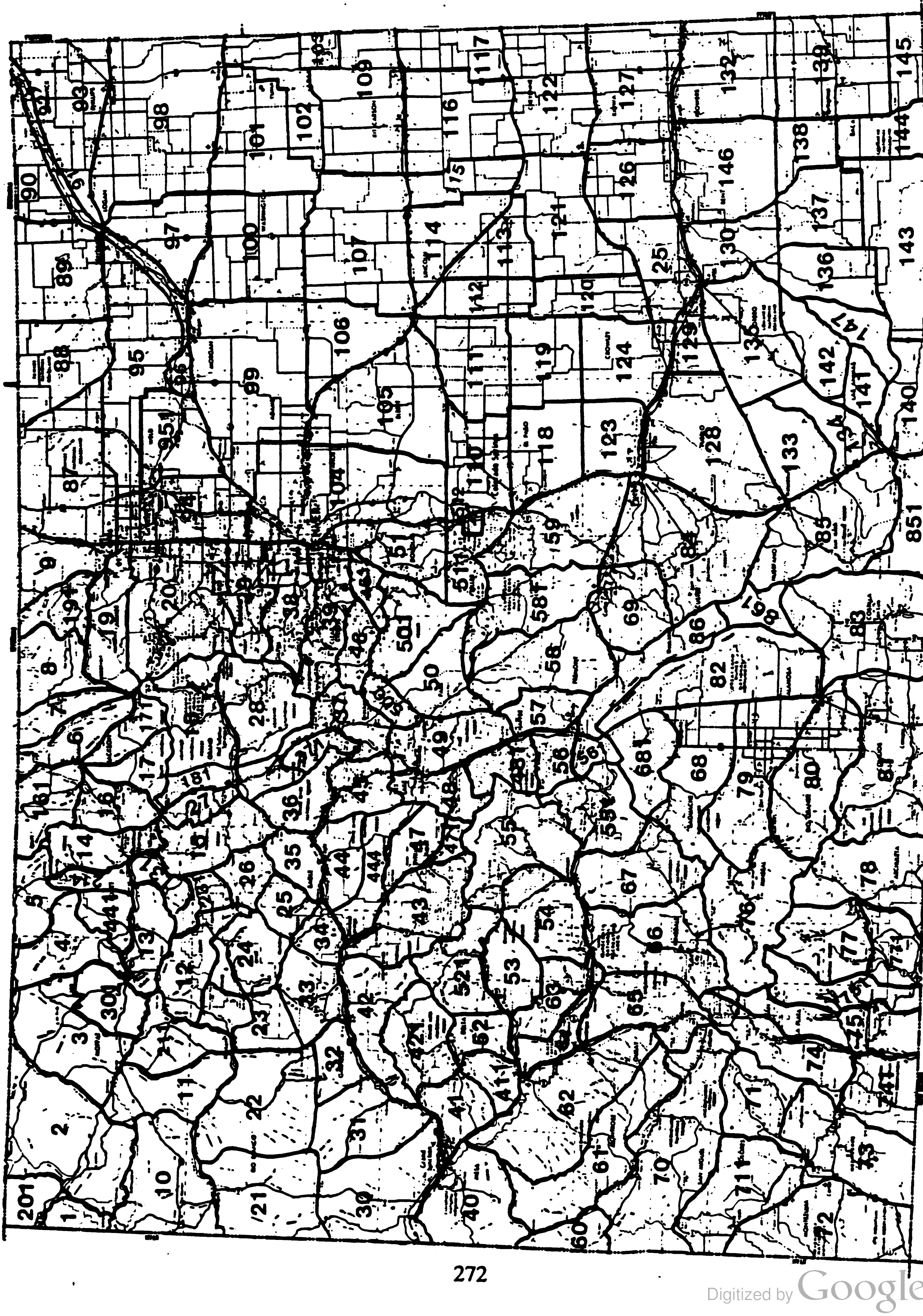

GAME MANAGEMENT UNITS

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APPENDIX H

Map of Bureau of Land Management District Boundaries in Colorado

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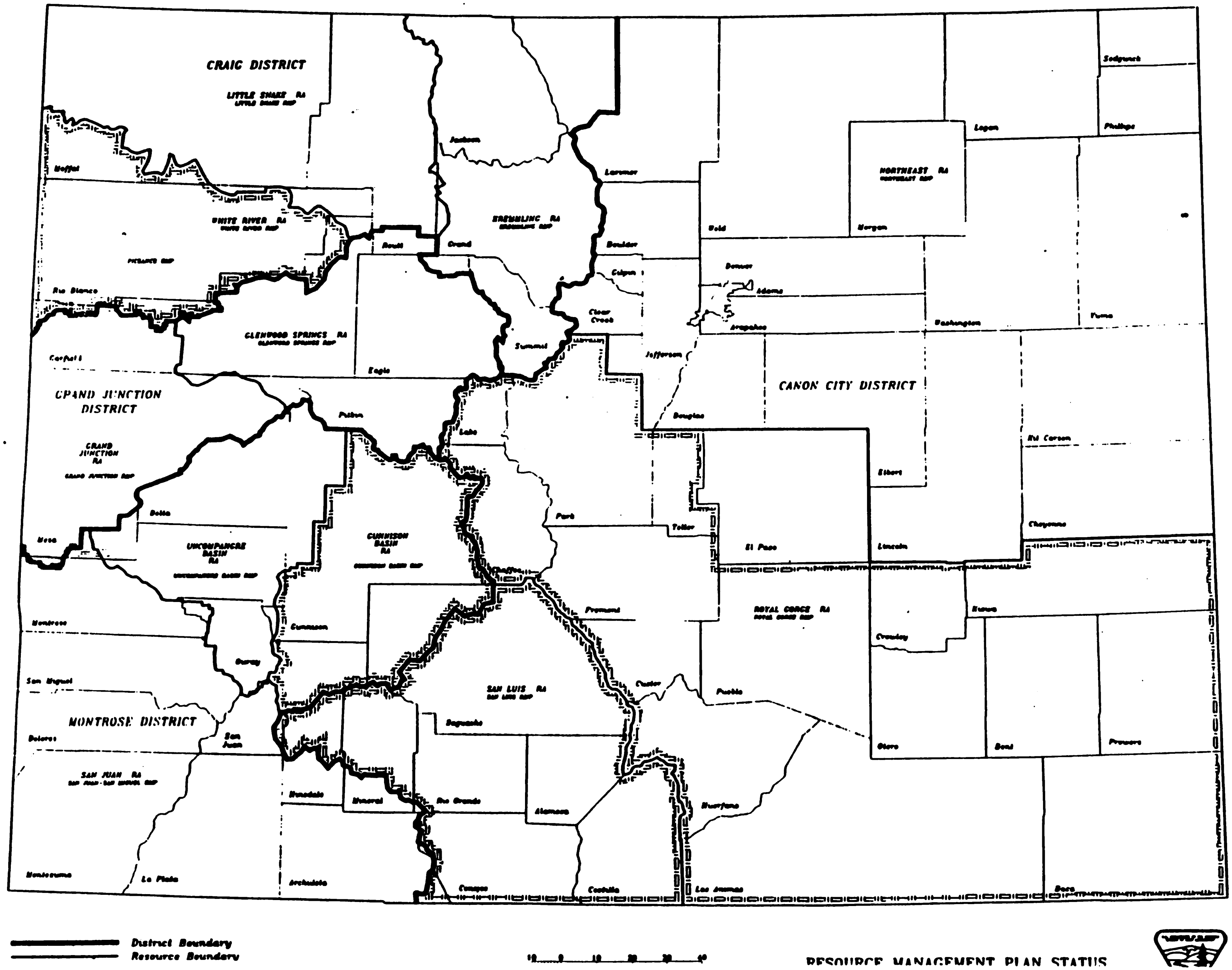

RESOURCE MANAGEMENT PLAN STATUS

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APPENDIX I

Wolf Density Calculations for Individual Potential Wolf Recovery Areas

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This Appendix was included to illustate the method and data used to estimate the potential wolf density of each PWRA based available prey biomass.

As mentioned in the text, the wolf density estimates are conservative based on minimum animal numbers and weights of the available primary prey species in each PWRA. No allowance was included for alternate prey species (i.e., snowshoe hare, beaver, pronghorn, moose, etc.) or carrion utilization. It was felt this approach standardized each PWRA to reflect a conservative wolf density estimate based on an absolute minimum primary prey biomass.

The following example (No. 1) shows the step-by-step procedure used to estimate the potential wolf density for the Grand Mesa-Uncompahgre-Gunnison PWRA. The procedure is identical for the other six PWRAs using their appropriate data.

Figure 8 (page 71) is reproduced in this section as a reference.

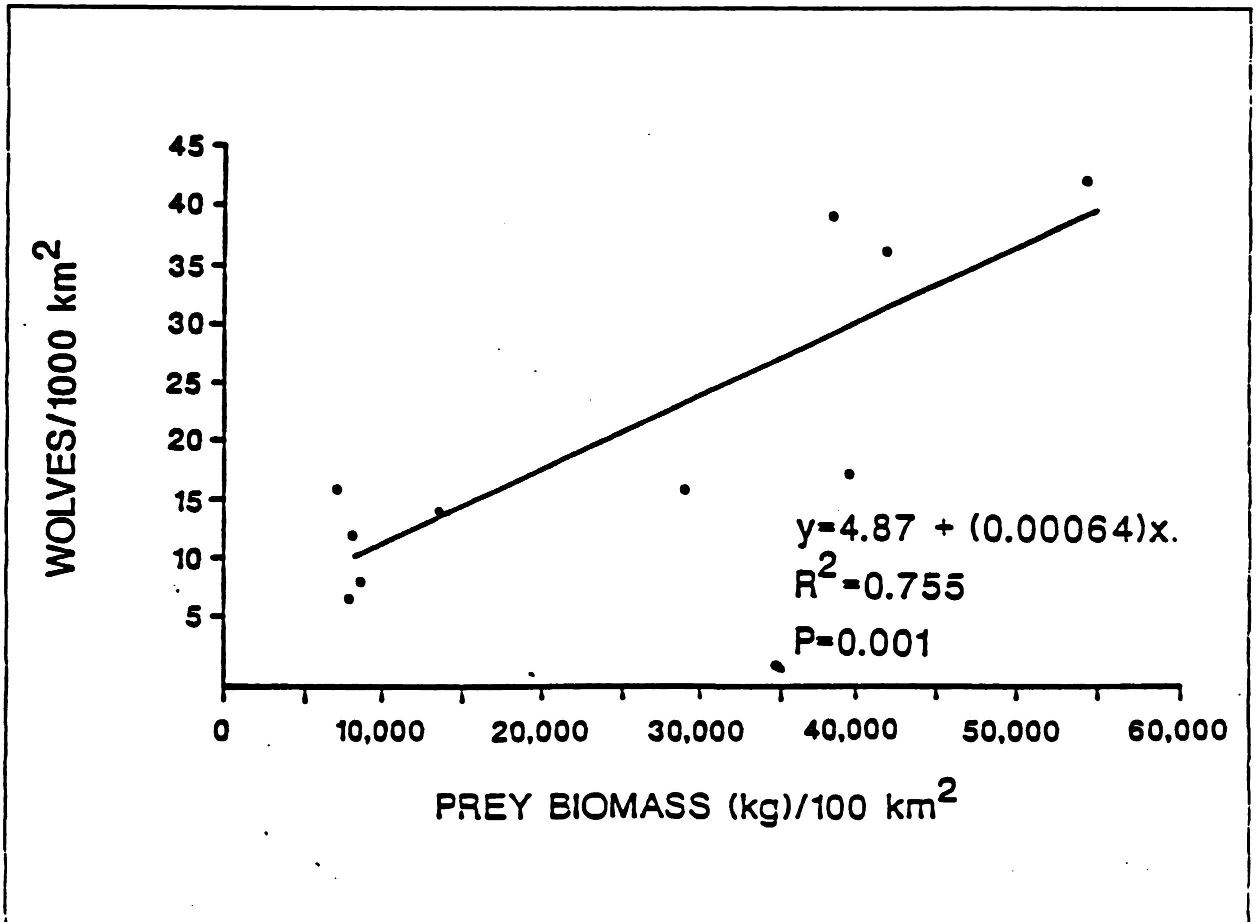

Figure 8. The Relationship between Wolf Density and Available Prey Biomass (Source: Bednarz 1988).

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EXAMPLE 1. Calculation of wolf density for Grand Mesa-Uncompahgre-Gunnison PWRA

A. Estimated minimum available mule deer density/mi^2. = 9.7

B. Estimated minimum available mule deer biomass/mi^2. = 1 261 lbs

C. Estimated minimum available elk density/mi^2. = 2.3

D. Estimated minimum available elk biomass/mi^2. = 780 lbs

E. Estimated minimum available combined mule deer and elk biomass/mi^2 (B + D). = 2 041 lbs

Convert (E) to kg

F. 2 041 lbs/2.2 = 928 kg

Convert (F) to kg/100 km^2

G. 928 kg X 38.6. = 35 821 kg/100 km^2 (x-axis)

Convert (G) to wolves/1000 km^2 (y-axis)

H. $y = 4.87 + (0.00064)35\,821$

$y = 28$

Convert PWRA gross land area to km^2

I. 4 941 mi^2 X 2.59 = 12 797 km^2

Convert (I) to reflect the probable loss of winter habitat due to elevation (9 500 ft.) and excessive snowfall (250 inches +).

J. 12 797 km^2 - (estimated 15% total land area). = 10 877 km^2

Convert (J) to 1000 km^2.

K. 10 877/1000 = 10.9

Calculate potential wolf population for PWRA.

L. (H X K) = 28 X 10.9. = 305

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WOLF TERRITORY SIZE CALCULATIONS

Based upon available prey biomass within each PWRA, the equation [$y = 1104 + (-0.015)x$] (Bednarz 1988) was used to determine the probable territory size that would be occupied by wolves. Figure 34 shows this relationship.

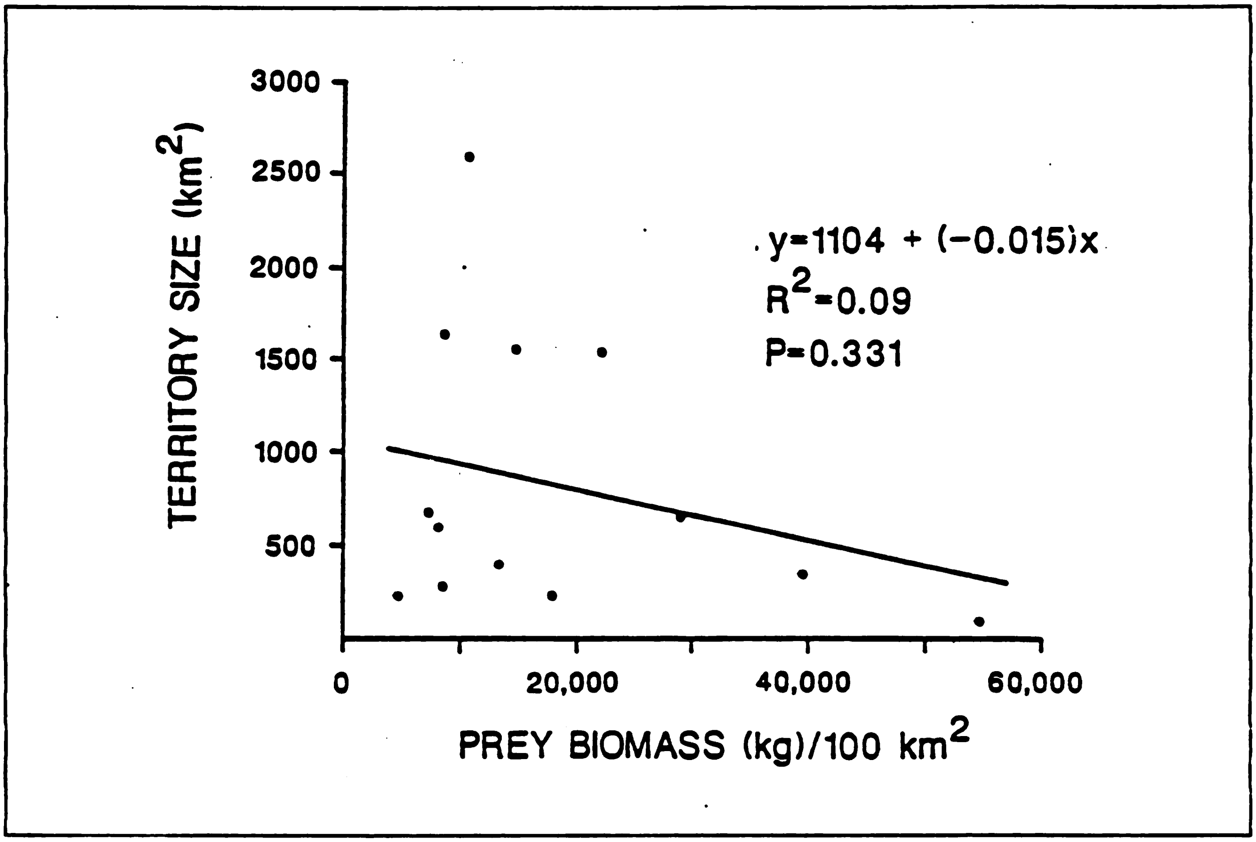

Figure 34. The Relationship of Wolf Territory Size and Available Prey Biomass (Source: Bednarz 1988).

As in example No. 1, the Grand Mesa-Uncompahgre-Gunnison PWRA will be used to illustrate estimated wolf territory sizes based on contemporary observations (Bednarz 1988).

A. Primary prey biomass (from G, example 1) = 35 821 kg/100 km²

B. Wolf territory size (y-axis) = $1104 + (-0.015)x$
= 567 km²

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Estimated gross area of habitat (J, Example 1) available to wolves

C. = 10 877 km^2

Number of available wolf territories in PWRA

D. (C) / (B) =
10 877 / 567 = 19

Estimated probable wolf population size range based on available territories at saturation:

(D) X 5 wolves/social unit = 95
(D) X 7 " = 133
(D) X 10 " = 190

The preceding method was used to calculate estimates for the remaining 6 PWRAs and the results are as follows:

Rio Grande PWRA

Estimated potential wolf population size based on minimum available combined mule deer and elk biomass = 89 wolves.

Estimated probable wolf population size range based on available territories at saturation:

5 wolves/social unit = 40
7 wolves/social unit = 56
10 wolves/social unit = 80

Arapaho-Roosevelt PWRA

Estimated potential wolf population size based on minimum available combined mule deer and elk biomass = 88 wolves.

Estimated probable wolf population size range based on available territories at saturation:

5 wolves/social unit = 32
7 wolves/social unit = 44
10 wolves/social unit = 64

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Routt PWRA

Estimated potential wolf population size based on minimum available combined mule deer and elk biomass = 94 wolves.

Estimated probable wolf population size range based on available territories at saturation:

5 wolves/social unit = 30
7 wolves/social unit = 42
10 wolves/social unit = 60

Pike-San Isabel PWRA

Estimated potential wolf population size based on minimum available combined mule deer and elk biomass = 188 wolves.

Estimated probable wolf population size range based on available territories at saturation:

5 wolves/social unit = 85
7 wolves/social unit = 119
10 wolves/social unit = 170

San Juan PWRA

Estimated potential wolf population size based on minimum available combined mule deer and elk biomass = 121.

Estimated probable wolf population size range based on available territories at saturation:

5 wolves/social unit = 40
7 wolves/social unit = 56
10 wolves/social unit = 80

White River PWRA

Estimated potential wolf population size based on minimum available combined mule deer and elk biomass = 243 wolves.

Estimated probable wolf population size range based on available territories at saturation:

5 wolves/social unit = 85
7 wolves/social unit = 119
10 wolves/social unit = 170

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APPENDIX J

Estimated Wolf Depredations on Livestock in Individual Potential Wolf Recovery Areas

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ERRATA

The formula on page 282 in Appendix J, had a step left out. In order to assist you in finding the final answer, the following step should be added to the formula:

Step 1

$$\frac{\text{Number of livestock in Analysis Area}}{\text{Number of livestock in Other areas}} \times \frac{\text{Number wolves in Analysis Area}}{\text{Number wolves in Other area}} \times \text{Average annual Depredation} = \text{Rate of Depredation}$$

Step 2

Rate of Depredation X Number of Livestock in Analysis Area = Estimtated annual depredations in Analysis Area

Therefore, the example from page 283 should read:

Cattle

$$\frac{64{,}000}{220{,}141} \times \frac{100}{1{,}625} \times 0.12\% = .0000215 \text{ Rate of Depredation/yr}$$

.0000215 X 64,000 = 1.3 Estimated cattle depredations/yr

Sheep

$$\frac{53{,}000}{15{,}904} \times \frac{100}{1{,}625} \times 0.211\% = .000432 \text{ Rate of Depredation/yr}$$

.000432 X 53,000 = 22.0 Estimated sheep depredations/yr

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The holistic approach to wolf reintroduction taken in this project dictated that any estimates should encompass a range to allow decision-makers to weigh both minimum and maximum estimates. The range of expected annual livestock depredations is based on two assumptions:

1. That wolves will remain within national forest unit boundaries throughout the year. These estimates probably represent the minimum annual depredations.

2. That wolves will depredate on livestock located in land areas adjoining the PWRA. These estimates probably represent the maximum annual depredations.

The following equation (from p 129) was used to estimate the annual depredations for each PWRA. Livestock numbers for livestock numbers within the PWRA unit boundaries were furnished by the individual NF District Supervisor Offices and represent the maximum number of animals permitted to graze. In many cases, the actual number of livestock that do graze in the individual NFs is less than the number permitted.

$$\frac{\text{Number of livestock in Analysis Area}}{\text{Number of livestock in Other area}} \times \frac{\text{Number wolves in Analysis Area}}{\text{Number wolves in Other area}} \times \text{Average annual depredation rate in other area} = \text{Estimated annual depredations in Analysis Area}$$

For the purpose of these calculations, the following values were used:

Number of livestock in Analysis Area (PWRA): maximum number permitted to graze (see Tables 16 - 23 for individual PWRAs).

Number of livestock in Other area: Cattle = 220 141, Sheep = 15 904 (see Table 26, p 127).

Number wolves in Analysis Area: several different numbers can be used based on data presented in the previous Appendix. In all probability, any potential wolf recovery program in Colorado will have a target population much less than the numbers presented in this report. The estimated annual cattle and sheep depredations for each Colorado PWRA was calculated using **100 wolves** as a target population.

Number of wolves in Other area: Fuller et al. (1992) reports that the estimated population of wolves in Minnesota's cattle and sheep range is about 1 500-1 750. The median of this estimate (**1 625 wolves**) was used for these calculations.

Average annual depredation rate in other area: Cattle = 0.012% of those available; Sheep = 0.211% of those available (see p 126, Minnesota livestock dataset).

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EXAMPLE: Grand Mesa-Uncompahgre-Gunnison PWRA:

Cattle

$$\frac{64\ 000}{220\ 141} \times \frac{100}{1\ 625} \times 0.12\% = 1.3 \text{ estimated cattle depredations per year}$$

Sheep

$$\frac{53\ 000}{15\ 904} \times \frac{100}{1\ 625} \times 0.211\% = 22.0 \text{ estimated sheep depredations per year}$$

Rio Grande PWRA: cattle = 1, sheep = 6

Arapaho-Roosevelt PWRA: cattle = 1, sheep N/A (none permitted in NF)

Routt PWRA: cattle = 1, sheep = 64

Pike-San Isabel PWRA: cattle = 1, sheep = 1

San Juan PWRA: cattle = 1, sheep = 4

White River PWRA: cattle = 1, sheep = 144

The maximum estimated cattle and sheep depredations for each PWRA and adjoining counties is based on 1987 county livestock inventories (Federal Census of Agriculture, in: Colorado Agricultural Statistics 1990). The Federal Census of Agriculture is performed at 5-year intervals in years ending with 7 and 2. The 1992 Census is presently in the process of printing and is expected to be made available in June or July 1994 (NASS, Phone Conversation, 5 May 1994). NASS personnel indicated that preliminary data would not be released, but that a reasonable estimate could be obtained by calculating county proportions for 1987 and comparing to the 1993 state total and reducing each county total by 10 percent to reflect the estimated reduction of livestock from 1987 to 1993. I elected to use the published 1987 Census data, keeping in mind, that these estimates are about 10% greater than present livestock inventory (1993).

Table 33 show the 1987 livestock inventories by county in Colorado. To obtain a reasonable estimate of livestock that would be actually exposed to wolf depredation, the "all cattle" values were adjusted to exclude "milk cows". The resulting estimates may still be high because "cattle on feed" are included. The majority of cattle feed lots are located in counties east of the Front Range (i.e., Baca, Bent, Crowley, Kit Carson, Logan, Morgan, Prowers, Weld, and Yuma) and should not affect the totals for the western counties in a significant manner.

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Table 33. Federal Census of Agriculture: Livestock Inventories by County, Colorado, 1987.

County	All cattle	Beef cows	Milk cows	All Hogs and pigs	All Sheep and lambs	All Chickens 3 month +
			Number			
Adams	33,784	7,540	2,664	21,205	1,286	3,075
Alamosa	14,210	7,389	236	1,456	4,982	656
Arapahoe	12,647	1/	1/	1,525	1,158	423
Archuleta	12,820	4,803	21	61	2,222	610
Baca	82,698	20,319	79	2,793	132	1,390
Bent	62,018	18,603	203	2,733	1,465	586
Boulder	19,578	5,364	1,727	2,216	12,133	449,756
Chaffee	11,263	1/	1/	1/	159	1/
Cheyenne	31,650	13,155	71	1,459	1/	589
Clear Creek	1/	1/	...	...	...	1/
Conejos	38,867	22,013	347	366	22,261	1,178
Costilla	8,079	3,878	4	293	6,057	308
Crowley	86,024	8,183	782	1,952	187	784
Custer	12,059	5,648	7	1/	1/	217
Delta	41,635	17,327	2,532	2,653	14,403	2,636
Denver	1/	1/	...	...	...	...
Dolores	6,120	2,955	19	10	1/	290
Douglas	10,797	5,264	17	226	706	898
Eagle	20,148	10,871	20	19	14,023	373
Elbert	55,176	23,889	781	988	713	1/
El Paso	46,344	20,759	2,363	354	302	1,750
Fremont	16,017	7,847	913	939	446	1,277
Garfield	41,036	20,950	76	414	19,073	1,294
Gilpin	284	127	...	...	...	...
Grand	24,381	11,962	8	30	419	269
Gunnison	30,343	18,253	23	1/	7,924	127
Hinsdale	1,563	1/	1/	...	...	1/
Huerfano	27,452	14,577	486	256	222	489
Jackson	40,849	20,736	28	1/	336	133
Jefferson	5,314	2,156	176	113	346	1,558
Kiowa	34,854	14,468	28	337	155	684
Kit Carson	134,620	27,686	1,270	7,260	3,338	1,235
Lake	311	159	...	1/	1/	...
La Plata	34,266	17,746	582	1,823	6,991	11,936
Larimer	76,926	16,557	8,306	7,770	37,812	6,442
Las Animas	65,380	35,918	493	282	695	1,996
Lincoln	72,239	24,622	63	4,092	404	898
Logan	106,775	24,423	767	21,091	3,137	1,814
Mesa	54,946	23,884	2,204	6,869	18,620	1/
Mineral	1/	1/	...	...	...	...
Moffat	27,044	16,223	43	136	59,506	1,334
Montezuma	27,174	16,728	258	119	7,937	1,674
Montrose	55,750	23,619	2,003	8,238	61,293	2,560
Morgan	198,890	16,693	2,784	51,384	1,234	1/
Otero	74,096	16,800	427	6,590	9,953	3,668
Ouray	11,112	7,568	13	1/	923	404
Park	10,074	5,709	17	37	837	512
Phillips	33,724	5,736	850	3,400	2,402	535
Pitkin	3,330	1/	1/	1/	179	301
Prowers	107,402	13,750	230	6,062	4,672	891
Pueblo	63,688	23,127	1,460	3,426	826	1,698
Rio Blanco	35,711	19,419	31	89	35,379	493
Rio Grande	16,567	9,264	85	2,228	17,478	633
Routt	30,973	19,524	70	119	28,014	948
Saguache	31,203	18,194	131	1/	4,617	951
San Juan	1/	1/	...	...	...	...
San Miguel	9,896	4,807	12	1/	11,296	131
Sedgwick	22,150	1/	1/	540	81	637
Summit	2,998	1/	1/	...	1/	1/
Teller	2,863	1,451	3	8	57	1,868
Washington	67,695	23,187	535	24,125	1,892	1,500
Weld	588,378	53,958	38,062	42,947	275,141	2,085,707
Yuma	151,569	36,073	1,270	16,065	1,297	2,243
State Total	2,946,334	830,216	76,285	258,725	708,070	3,118,767

1/ Included in state total to avoid disclosure of individual operations.

Source: Colorado Agricultural Statistics 1990.

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For those counties that chose to omit numbers to avoid disclosure of individual operation, the columns were totaled and then subtracted from the state total. The result was then divided by the number of counties not listed (4 in "all cattle" and 5 in "all sheep and lambs" columns) to give an average per county which was then added to the included county estimate. The results for each PWRA and included counties are shown in Table 34.

Table 34. Adjusted County Livestock Inventories in Potential Wolf Recovery Areas.

PWRA	Included county	All cattle (-milk cows)	All sheep and lambs
Grand Mesa	Delta	39 103	14 403
Uncompahgre	Garfield	40 960	60 109
Gunnison	Gunnison	30 343	7 924
Gunnison	Mesa	52 742	18 620
	Hinsdale	1 318	....
	Montrose	53 747	61 293
	Ouray	11 099	923
	San Juan	129	....
	San Miguel	9 884	11 296
	Saguache	31 072	4 617
Totals		270 397	179 185

Estimated annual depredations in 10 county area based on the equation and data presented on page 279:

Cattle = 24
Sheep = 256

PWRA	Included county	All cattle (-milk cows)	All sheep and lambs
Rio Grande	Alamosa	13 974	4 982
	Archuleta	12 799	2 222
	Conejos	38 520	22 261
	Custer	12 052	190
	Hinsdale	1 318	....
	Mineral	129	....
	Rio Grande	16 482	17 478
	Saguache	31 072	4 617
	San Juan	129	....
Totals		126 475	51 750

Estimated annual depredations in 9 county area based on the equation and data presented on page 229:

Cattle = 5
Sheep = 21

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Table 34. (Cont.)

PWRA	Included county	All cattle (- milk cows)	All sheep and lambs
Arapaho	Boulder	17 851	12 133
Roosevelt	Clear Creek	129	....
	Gilpin	284	....
	Grand	24 373	419
	Jackson	40 821	336
	Larimer	68 620	37 812
	Park	10 057	837
	Routt	30 903	28 014
	Summit	2 998	190
Totals		196 036	79 741

Estimated annual depredations in 9 county area based on the equation and data presented on page 279:

Cattle = 13
Sheep = 53

PWRA	Included county	All cattle (- milk cows)	All sheep and lambs
Routt	Garfield	40 960	19 073
	Grand	24 373	419
	Jackson	40 821	336
	Moffat	27 001	59 506
	Rio Blanco	35 680	35 379
	Routt	30 903	28 014
Totals		199 738	142 727

Estimated annual depredations in 6 county area based on the equation and data presented on page 279:

Cattle = 13
Sheep = 162

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Table 34. (Cont.)

PWRA	Included county	All cattle (-milk cows)	All sheep and lambs
Pike	Chaffee	11 018	159
San Isabel	Clear Creek	129	....
	Costilla	8 075	6 057
	Custer	12 052	190
	Fremont	15 104	446
	Huerfano	26 966	222
	Lake	311	190
	Park	10 057	837
	Saguache	31 072	4 617
	Summit	2 998	190
	Teller	2 860	57
Totals		123 642	12 965

Estimated annual depredations in 11 county area based on the equation and data presented on page 279:

Cattle = 5
Sheep = 1

San Juan	Archuleta	12 799	2 222
	Conejos	38 520	22 261
	Dolores	6 101	190
	Hinsdale	1 318	....
	La Plata	33 684	6 991
	Mineral	129	....
	Montezuma	26 916	7 937
	Rio Grande	16 482	17 478
	San Juan	129	....
Totals		136 078	57 079

Estimated annual depredations in 9 county area based on equation and data presented on page 279:

Cattle = 6
Sheep = 27

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Table 34. (Cont.)

PWRA	Included county	All cattle (-milk cows)	All sheep and lambs
White River	Eagle	20 128	14 023
	Garfield	40 960	19 073
	Moffat	27 001	59 506
	Pitkin	3 085	179
	Rio Blanco	35 680	35 379
	Routt	30 903	28 014
Totals		157 757	156 174

Estimated annual depredations in 6 county area based on the equation and data presented on page 279:

Cattle = 8
Sheep = 194

In summary, these calculations indicate that wolf depredation will occur, but I suggest that it will remain near the minimum estimate because:

(1). It is likely that the abundance of primary prey species in Colorado will discourage predation on domestic animals.

(2). Any future wolf recovery program in Colorado will probably have a target population of about 100 wolves. Careful management of a population this size could eliminate all but an isolated incident of depredation.

(3) Removal of problem wolves through prompt action by managing agencies, such as being demonstrated in Montana at the present, will maintain depredation at a minimum.

(4) In all probability, any reintroduced wolves to Colorado would be designated as nonessential experimental populations implementing special provisions within Section 10(j) of the ESA to address local concerns. Under these provisions (under certain conditions), the public could harass and kill wolves attacking livestock (cattle, sheep, horses, and mules).

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APPENDIX K

Colorado Agricultural Landholdings of Foreign Owners by County in the Primary Analysis Area, December 31, 1992

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Table 35. Colorado Agricultural Landholdings of Foreign Owners by County in the Primary Analysis Area, December 31, 1992[A]

County	Acres	Major Foreign Owner	Major Land Use
Alamosa	24,982	All others	Pasture
Boulder	1,861	United Kingdom	Crop land
Conejos	275	France	Crop land
Costilla	12,400	Germany	Pasture
Custer	200	Switzerland	Crop land
Delta	4,590	Germany	Pasture
Eagle	25,021	All others	Other Agriculture
Fremont	130	Germany	Pasture
Garfield	33,360	All others	Pasture
Gunnison	8,812	France	Pasture
Huerfano	3,741	All others	Pasture
Jackson	813	Switzerland	Forest
La Plata	90	All others	Forest
Larimer	8,832	Switzerland	Pasture
Mesa	12,129	All others	Pasture
Moffat	26,028	Germany	Pasture
Montezuma	58	United Kingdom	Other agriculture
Montrose	3,468	Switzerland	Pasture
Park	1,920	Switzerland	Pasture
Rio Blanco	38,845	All others	Pasture
Routt	22,848	Germany	Pasture
Saguache	15,981	All others	Pasture
San Miguel	875	All others	Forest
Summit	1,305	All others	Forest

[A]Source: United States Department of Agriculture. 1992. Foreign ownership of U. S. agricultural land through December 31, 1992, Statistical Bull. No. 854.

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APPENDIX L

Road Density Data in Primary Analysis Area

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The regional scale of this study did not allow for an in-depth evaluation of total road density in each of the PWRAs, however, an attempt was made to gather information on a gross scale to serve as an initial indicator of public land road density in each of the PWRAs. It is believed by the author that the Yellowstone and central Idaho DEIS (1993) describes the effect of road density on wolves in a manner that will also apply to Colorado:

> The relationships between roads, wolf survival, and wolf habitat use is far more complicated than simply road density alone. Wolf vulnerability is influenced by terrain, topography, cover, traffic, and road distribution in the landscape as well as the ability, opportunity, and desire of people to kill wolves. Because of differences in topography and vegetative cover, it is unknown if the information from the Great Lakes areas can be directly applied to the northern Rocky Mountains. Wolves may be less susceptible to human persecution in the Great Lakes area than they would be in the northern Rocky Mountains because in the western U.S., vegetation is less dense, mountainous terrain concentrates wolf movements, and there is more topographical relief. In contrast, wolves in the western U.S. may be less vulnerable to human persecution because of lower overall human densities, different patterns of seasonal road use, and different patterns of human settlement. Hence, road densities necessary to provide security for wolves in the West may be different than reported elsewhere. Two wolf packs in Montana have survived for least 3 years in areas with apparently high road density, but in contrast, most documented wolf mortalities have been associated with road access...
>
> Determining road density depends upon the definition of an open road, how much area is analyzed, and how seasonal or temporary roads are measured as well as the methodology used ("precise" road densities using a GIS "roving window" technique versus averaging road densities over a broad geographical area)...Based upon (1) current open road information, (2) the success of wolf packs in highly roaded habitats in Montana, and, (3) that these roaded areas of public land being proposed for wolf recovery are adjacent to large (about 4-5 million acres; 6 255-7 838 mi^2) roadless areas, it appears that, other than in localized areas and at certain times (den sites), it is unlikely at this time, that road density guidelines must be employed as a wide spread land management strategy to support wolf recovery....

It should be noted that habitat management guidelines for selected species such as mule deer and elk also recommend no more that 1 mile of open road per square mile of habitat (see pp 82 & 83 this document; Coordinating Elk and Timber Management, Lyon et al. 1985; and Managing Forested Lands for Wildlife, Hoover and Wills 1984 for further references). It is probably a coincidence, but road density management advocated by both the NFS and BLM for mule deer and elk (the primary prey species) will also benefit any potential wolf population.

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As a course indicator of road density in the individual PWRAs where wolves are speculated they will spend the majority of their time on public land, I solicited road data from the NFS and BLM to determine the amount of roads under their jurisdiction in the PWRAs. It must be emphasized that these totals underestimate the total road mileage in a given complex, which may be considerable in an area such as the eastern portion of the Arapaho-Roosevelt NF where urbanization is typical. The results are shown in Table 36.

Roadless land area size is an important aspect of wolf reintroduction and warrants a closer-examination. The roadless land areas given in Table 37 reflect only those areas administered by the NFS and total an approximate 6 779.4 mi^2. Perhaps the best total estimate of roadless areas in Colorado is presented by Foreman and Wolke (1992). Their data reflects those roadless areas managed by the NFS, BLM, NPS, State, CDOW, Tribal, and private parties. In Colorado, these various roadless areas amount to an estimated 9 578.1 mi^2. If the roadless areas of the Colorado Plateau are subtracted from this total, the result is an estimated 8 848.4 mi^2. Either total exceeds the reported Yellowstone/Central Idaho figures (p 292).

Further research is needed in this area if Colorado wolf recovery becomes likely.

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Table 36. Estimated Road Density of Bureau of Land Management and National Forest Service Administered Roads in Potential Wolf Recovery Areas.[A]

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
Grand Mesa	Delta	323.3	158.4	299.5	3 317.0
Uncompahgre	Garfield	926.3	263.9	804.8	
Gunnison	Gunnison	556.5	266.5	1 764.0	
	Hinsdale	195.2	8.6	1 091.2	
	Mesa	1 519.2	349.7	394.8	
	Montrose	973.4	297.4	493.9	
	Saguache	553.4	266.9	1 500.1	
	Ouray	41.6	18.2	198.6	
	San Juan	70.8	8.6	270.9	
	San Miguel	490.0	116.5	285.5	

Total BLM administered land area = 5 685.7 mi^2
Total NFS administered land area = 7 103.3 mi^2
Total BLM/NFS administered land area = 12 789.0 mi^2
Total BLM administered road miles = 1 754.0
Total NFS administered road miles = 3 317.0
Total BLM/NFS administered road miles = 5 071.0
Road density of BLM/NFS administered roads in PWRA = 0.40 mi/mi^2.
ROADLESS LAND AREA (NF ONLY) = 1 055.7 mi^2 closed; 645 mi^2 restricted

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
Rio Grande	Alamosa	72.8	20.3	40.1	2 270.0
	Archuleta	13.9	9.0	664.2	
	Conejos	295.4	184.1	467.5	
	Custer	21.9	15.2	256.3	
	Hinsdale	195.2	8.6	1 091.2	
	Mineral	0.0	0.0	820.4	
	Rio Grande	85.5	32.0	463.3	
	Saguache	553.4	266.9	1 500.1	
	San Juan	70.8	8.6	270.9	

Total BLM administered land area = 1 308.9 mi^2
Total NFS administered land area = 5 574.0 mi^2
Total BLM/NFS administered land area = 6 882.9 mi^2
Total BLM administered road miles = 544.7
Total NFS administered road miles = 2 270.0
Total BLM/NFS administered road miles = 2 814.7
Road density of BLM/NFS administered roads in PWRA = 0.41 mi/mi^2
ROADLESS LAND AREA (NF ONLY) = 873.4 mi^2

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Table 36. (Cont.)

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
Arapaho Roosevelt	Boulder	8.2	0.0	213.5	2 310.0
	Clear Creek	21.3	4.5	259.4	
	Gilpin	3.4	0.0	60.7	
	Grand	230.5	72.2	889.1	
	Jackson	296.8	46.9	522.2	
	Larimer	43.8	6.4	976.8	
	Park	116.2	32.4	1 017.2	
	Routt	125.6	1.0	912.3	
	Summit	5.9	0.01	484.9	

Total BLM administered land area = 851.7 mi^2
Total NFS administered land area = 5 336.1 mi^2
Total BLM/NFS administered land area = 6 187.8 mi^2
Total BLM administered road miles = 163.4
Total NFS administered road miles = 2 310.0
Total BLM/NFS administered road miles = 2 473.4
Road density of BLM/NFS administered roads in PWRA = 0.40 mi/mi^2
ROADLESS LAND AREA (NF ONLY) = 686.0 mi^2

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
Routt	Garfield	962.3	263.9	804.8	1 931.0
	Grand	230.5	72.2	889.1	
	Jackson	296.8	46.9	522.2	
	Moffat	2 377.5	550.9	65.3	
	Rio Blanco	1 786.5	542.3	560.1	
	Routt	125.6	1.0	912.3	

Total BLM administered land area = 5 779.2 mi^2
Total NFS administered land area = 3 753.8 mi^2
Total BLM/NFS administered land area = 9 533.0 mi^2
Total BLM administered road miles = 1 477.2
Total NFS administered road miles = 1 931.0
Total BLM/NFS administered road miles = 3 408.2
Road density of BLM/NFS administered roads in PWRA = 0.36 mi/mi^2
ROADLESS LAND AREA (FS ONLY) = 834.0 mi^2

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Table 36. (Cont.)

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
Pike San Isabel	Clear Creek	21.3	4.5	259.4	2 941.0
	Chaffee	85.5	51.2	710.8	
	Costilla	0.0	0.0	0.9	
	Custer	21.9	15.2	256.3	
	Fremont	547.4	236.4	37.1	
	Huerfano	111.5	80.9	22.1	
	Park	116.1	32.4	1 017.2	
	Saguache	553.4	266.9	1 500.1	
	Summit	5.9	0.01	484.9	
	Teller	49.1	12.0	195.4	

Total BLM administered land area = 1 512.1 mi^2
Total NFS administered land area = 4 484.2 mi^2
Total BLM/NFS administered land area = 5 996.3 mi^2
Total BLM administered road miles = 699.5
Total NFS administered road miles = 2 941.0
Total BLM/NFS administered road miles = 3 640.5
Road density of BLM/NFS administered roads in PWRA = 0.61 mi/mi^2
ROADLESS LAND AREA (FS ONLY) = 675.5 mi^2

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
San Juan	Archuleta	13.9	9.0	664.2	3 992.0
	Conejos	295.4	184.1	467.5	
	Dolores	137.0	42.0	522.5	
	Hinsdale	195.2	8.6	1 091.2	
	La Plata	34.1	5.0	628.1	
	Mineral	0.0	0.0	820.4	
	Montezuma	280.7	83.6	401.3	
	Rio Grande	85.5	32.0	436.3	
	San Juan	70.8	8.6	270.9	

Total BLM administered land area = 1 112.6 mi^2
Total NFS administered land area = 5 302.4 mi^2
Total BLM/NFS administered land area = 6 415.0 mi^2
Total BLM administered road miles = 1 438.3
Total NFS administered road miles = 3 992.0
Total BLM/NFS administered road miles = 4 364.9
Road density of BLM/NFS administered roads in PWRA = 0.68 mi/mi^2
ROADLESS LAND AREA (FS ONLY) = 964.1 mi^2

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Table 36. (Cont.)

PWRA	Included Counties	BLM Administered Land Area (mi^2)	Total Road Miles (BLM)	NFS Administered Land Area (mi^2)	Total Road Miles (NFS)
White River	Eagle	388.6	76.7	930.7	2 330.3
	Garfield	962.3	263.9	804.8	
	Moffat	2 377.5	550.9	65.3	
	Pitkin	41.6	3.5	762.4	
	Rio Blanco	1 786.5	542.3	560.1	
	Routt	125.6	1.0	912.3	

Total BLM administered land area = 5 682.1 mi^2
Total NFS administered land area = 4 035.6 mi^2
Total BLM/NFS administered land area = 9 717.7 mi^2
Total BLM administered road miles = 1 438.3
Total NFS administered road miles = 2 330.3
Total BLM/NFS administered roads = 3 768.6
Road density of BLM/NFS administered roads in PWRA = 0.39 mi/mi^2
ROADLESS LAND AREA (FS ONLY) = 1 045.7 mi^2

[A] Sources:

BLM administered land areas and road mileage estimates (personal communication, Lee Upham, BLM, 1993).

NFS administered land areas by county (USDA, FS. 1990. Land areas of the National Forest System, FS-383); see Table 10.

NFS road mileage estimates (personal communication, Kim Barber, NFS, 1993 & 1994).

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