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Conservation Plan for Gunnison's Prairie Dog (*Cynomys gunnisoni*) in New Mexico

12 May 2008

New Mexico Department of Game and Fish

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PREFACE

This plan addresses conservation of Gunnison's prairie dog (*Cynomys gunnisoni*) in New Mexico. It includes an overview of the taxonomy, distribution, and ecology of the species (chapters 1 and 2), an assessment of the status of the species in New Mexico and a recommended approach for its conservation (Chapter 3), and a conservation strategy (Chapter 4). It is anticipated that this conservation plan will be updated and revised as new information becomes available. Implementation of management actions and subsequent monitoring, if adequate, should result in new insights that likely will necessitate changes in the plan.

Chapters 1 through 3 were prepared by John Pittenger of Blue Earth Ecological Consultants, Inc., under Professional Services Contract No, 08-516-0000-00020. Chapter 4 was prepared by Jim Stuart of the New Mexico Department of Game and Fish.

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Additional copies of the plan may be obtained from:

> New Mexico Department of Game and Fish
> One Wildlife Way
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CONTENTS

LIST OF TABLES

LIST OF FIGURES

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1.0 INTRODUCTION

The purpose of this plan is to present an analysis of the current status of Gunnison's prairie dog (*Cynomys gunnisoni*) in New Mexico and, based on this analysis, prescribe actions to improve conservation and management of the species. It is part of a larger, multi-state effort to develop and implement a coordinated, range-wide initiative for conservation of Gunnison's prairie dog (Western Association of Fish and Wildlife Agencies, 2007).

The plan is organized into four chapters. Chapter 1 describes the recent development of attention to conservation of the species and presents a summary of its taxonomy, description, and distribution. Chapter 2 is a summary of the natural history of Gunnison's prairie dog, which is not meant to be exhaustive but rather to highlight those aspects most important to conservation of the species. Chapter 3 includes the conservation goal and a diagnosis of factors affecting the distribution, abundance, and persistence of Gunnison's prairie dog. The diagnosis is then used in formulation of a conservation objectives. Finally, Chapter 4 identifies management actions to achieve the objectives and, ultimately, meet the conservation goal.

1.1 Concern for Conservation of Gunnison's Prairie Dog

In 1961, the Acting Chief of the Branch of Predator and Rodent Control identified the need for statewide prairie dog inventories:

> "Because of the increasing number of articles and news items implying that prairie dogs are becoming extinct ..." (Bureau of Sport Fisheries and Wildlife, 1961).

Recognition of the important ecological role filled by prairie dogs in grassland ecosystems increased following listing of black-footed ferret (*Mustela nigripes*) as an endangered species under the federal Endangered Species Act in 1964 and particularly following discovery of and research on an extant population of black-footed ferret discovered in 1981 in Wyoming.

The National Wildlife Federation published a status review of white-tailed (*C. leucurus*) and Gunnison's prairie dog in 2002 which concluded that abundance of both species had declined significantly and that immediate efforts to conserve the species were needed (Knowles, 2002). In 2004, Forest Guardians petitioned the U.S. Fish and Wildlife Service to list Gunnison's prairie dog under the federal Endangered Species Act because of a 90 percent decline in area occupied by the species and ongoing threats to its continued existence (Rosmarino, 2004). The Western Association of Fish and Wildlife Agencies convened a working group to develop a multi-state conservation effort for black-tailed prairie dog in 1998, and this was expanded to include Gunnison's prairie dog in March 2002 (Seglund *et al.*, 2006: 1).

In February 2008, the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service, 2008) issued a 12-month finding on a petition to list the Gunnison's prairie dog under the Endangered Species Act. That finding considered two distinct sets of populations throughout the range of the species: "prairie" populations which generally occur at lower elevations in all four states where the species occurs, and "montane" populations which are limited to higher elevation areas of Colorado and New Mexico. The U.S. Fish and Wildlife Service determined that the montane

segment of the species' distribution, which constitute approximately 40 percent of its total range, are warranted for listing and thus has been designated as a Candidate for listing.

The New Mexico Department of Game and Fish (NMDGF) identified Gunnison's prairie dog as a Species of Greatest Conservation Need (SGCN) in the Comprehensive Wildlife Conservation Strategy for New Mexico completed in 2006 (New Mexico Department of Game and Fish, 2006: 55). The Comprehensive Wildlife Conservation Strategy was developed to maintain New Mexico's eligibility for federal funding under the State and Tribal Wildlife Grants Program. The State and Tribal and Wildlife Grants Program is federal legislation that was passed by Congress for conservation of the nation's biodiversity, with the intent of precluding the necessity of listing more species as threatened or endangered under the federal Endangered Species Act. New Mexico's Comprehensive Wildlife Conservation Strategy focuses on SGCN, key wildlife habitats, and overcoming the challenges affecting conservation of both (New Mexico Department of Game and Fish, 2006: iv). The goal of the Comprehensive Wildlife Conservation Strategy is that "New Mexico's key habitats persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land uses with reduced resource use conflicts" (New Mexico Department of Game and Fish, 2006: iv). This conservation plan for Gunnison's prairie dog was developed in that context.

1.2 Taxonomy and Systematics

Gunnison's prairie dog is in the class Mammalia, order Rodentia, family Sciuridae (Hall, 1981). It is one of five species of prairie dogs, all of which occur in North America (Pizzimenti, 1975). The five species are grouped into two subgenera: the white-tailed forms (subgenus *Leucocrossuromys*) and the black-tailed forms (subgenus *Cynomys*). Gunnison's prairie dog is placed in the subgenus *Leucocrossuromys* (Pizzimenti, 1975; Goodwin, 1995). The subgenus *Leucocrossuromys* is differentiated by having a white-tipped tail versus a black-tipped tail in *Cynomys*, five pair of functional mamme versus four, differences in the jugal bone (*i.e.* central part of the cheek bone) and baculum (*i.e.* bone present in the penis), and a chromosome count of 2N = 40 as opposed to 2N = 50 in subgenus *Cynomys* (Hoffmeister, 1986: 193).

Gunnison's prairie dog was described in 1855 from specimens collected in Saguache County, Colorado (Baird, 1855, cited in Hubbard and Schmitt, 1984: 38). A putative subspecies, *C. g. zuniensis*, was described in 1916 from specimens collected in McKinley County, New Mexico (Hollister, 1916: 32-34, cited in Hubbard and Schmitt, 1984: 38). Some authors have accepted the subspecies as valid (*e.g.* Bailey, 1931: 125-131; Hall, 1981: 415; Hoffmeister, 1986: 196; Fitzgerald *et al*., 1994: 185) while others consider *C. gunnisoni* to be monotypic (*e.g.* Findley *et al*., 1975: 133-134; Pizzimenti, 1975).

Pizzimenti's (1975) analysis of geographic variation in *C. gunnisoni* employed measurement of 15 cranial and three external characteristics in a sample size of 19, and concluded that subspecific differentiation in Gunnison's prairie dog was not recognizable. However, Hoffmeister (1986) and Hubbard and Schmitt (1984) have questioned the analysis. Hoffmeister (1986: 196) faulted the analysis because it did not examine variation within *C. gunnisoni* apart from all *Cynomys*. Rather, all species and subspecies were lumped in one treatment. Similarly, Hubbard and Schmitt (1984: 38-39) were skeptical of the results because several samples of both of the

putative subspecies were placed more closely to other species of *Cynomys* than to *C. gunnisoni*. They also questioned the use of a fixed set of characters as opposed to only those that showed potential to segregate samples.

Recent analysis of variation in mitochondrial DNA (mtDNA) indicated past geographic isolation and genetic differentiation of *C. g. zuniensis* and *C. g. gunnisoni* (Hafner *et al*., 2005). However, the authors cautioned that the mtDNA phylogeography should not serve as a basis for subspecies recognition. In any event, it seems clear that there is some restriction of gene flow between the two putative subspecies groups, which has given rise to the observed divergence in morphological and genetic characteristics. Populations assignable to the subspecies *C. g. gunnisoni* and *C. g. zuniensis* correspond approximately to the "montane" and "prairie" populations, respectively (U.S. Fish and Wildlife Service, 2008), although the distribution limits of these two forms is presently unclear.

1.3 Description

Gunnison's prairie dog resembles a ground squirrel in general appearance, but lacks any patterns on its back (Figure 1; Findley, 1975:130-134). The following description is taken from Fitzgerald and others (1994: 183). Gunnison's prairie dog is yellowish buff to cinnamon colored dorsally, with many interspersed black hairs, and paler ventrally. While the top of the head, cheeks, and area above the eye are typically darker, the species does not bear any distinct facial markings. The distal one-third or so of the tail is gray to whitish. The putative subspecies *C. g. gunnisoni* is described as being smaller, paler, and buff colored while *C. g. zuniensis* is described as being larger, brighter, and more cinnamon-colored (Bailey, 1931: 125-127). Total length ranges from about 11.8 to 15.3 inches, with the tail measuring 1.6 to 2.5 inches. Weight ranges from about one to three pounds, with males being heavier than females.

1.4 Evolutionary Perspective

The earliest fossil records of prairie dogs are from the Great Plains and date to the late Pliocene (*i.e.* late Blancan North American Land-Mammal Age vertebrate fauna; 2.7 to 1.8 million years ago [mya]). The two subgenera of prairie dogs (*Leucocrossuromys* and *Cynomys*) appear in the fossil record in the early Pleistocene and are found in the early Irvingtonian fauna (1.7 to 0.6 mya; Goodwin, 1995).

The divergence of the subgenera *Cynomys* and *Leucocrossuromys* (*i.e.* mountain prairie dogs) during the early Pleistocene corresponded to a period of glacial advances and intervening retreats, or pluvial periods, with corresponding fluctuations in vegetation. For example, in the late Pleistocene, vegetation zones were 3,000 to 4,000 feet lower than they are today and most of what is now New Mexico was covered by montane forest (Dick-Peddie, 1993: 16). During this time the climate was considerably moister and cooler and the subgenus *Leucocrossuromys* occurred well east of its present range (Hubbard and Schmitt, 1984: 25), while *Cynomys* occurred farther east in the Great Plains region. Reconstruction of the Pleistocene distribution of the subgenus *Leucocrossuromys* in New Mexico indicates it was associated with shrub-steppe vegetation then as now (Goodwin, 1995). Consequently, the association of Gunnison's prairie dog with montane grassland and shrub-steppe vegetation appears to be an evolutionary adaptation, not a recent phenomena (Pizzimenti, 1975: 59-62; Harrison *et al*., 2003).

Figure 1. Gunnison's prairie dog (*Cynomys gunnisoni*) at the Rio Grande Zoological Park in Albuquerque. Photo by R. B. Forbes, 1987, courtesy of the American Society of Mammalogists - Mammal Image Library (image #1184).

The subgenus *Leucocrossuromys* is thought to be the more primitive of the two subgenera because it is more closely allied with ground squirrels, in terms of karyotype. Ground squirrels (spermophilines) are thought to be ancestral to prairie dogs (Pizzimenti, 1975).

1.5 Distribution

The historic distribution of Gunnison's prairie dog includes southeastern Utah, south-central to southwestern Colorado, central to northeastern Arizona, and west-central, north-central, and central New Mexico. Although abundance of Gunnison's prairie dog in New Mexico has declined significantly since the late 1800s (*cf.* Chapter 3), the current geographic distribution of the species in the state is thought to be similar to the presumed historic distribution (Hubbard and Schmitt, 1984: 29-40). Bailey (1932: 125-127) described the distribution of the two putative subspecies. The range of *C. g. gunnisoni* was described as:

> "... high plateau country of southern Colorado and northern New Mexico, including the Sangre de Cristo, San Juan, and Jemez Mountain Ranges ... Here they occupy the elevated open valleys mainly in the Transition Zone, but extending often into the Canadian Zone parks and in places even to the Upper Sonoran valleys" (Bailey, 1931: 125).

The distribution of the subspecies *C. g. zuniensis*, which Bailey (1931: 127) referred to as the Zuni prairie dog, was described as:

> "Northwestern New Mexico, southwestern Colorado, and northern Arizona. In New Mexico the greater part of the range of this species lies in the Upper Sonoran Zone west of the Jemez and north of the Mogollon Mountains, but it also extends into the Rio Grande Valley at Albuquerque and south along the western side of the valley to Fairview" (= present-day community of Winston; *cf*. Hubbard and Schmitt, 1984: 32).

Hubbard and Schmitt (1984: 41) identified occupied habitats within the ranges of both subspecies that are disjunct or near-disjunct, being separated from other occupied or suitable habitats by extensive forested areas. Disjunct or near-disjunct habitats identified within the range of *C. g. gunnisoni* include:

- Moreno Valley (Colfax County);
- Vermejo Ranch (Colfax County);
- Taos Plain (Taos County);
- Chama Valley (Rio Arriba County); and
- Valle Grande (Sandoval County).

Disjunct or near-disjunct habitats within the range of *C. g. zuniensis* identified by Hubbard and Schmitt (1984: 41) include:

- Mesa de los Chivatos (McKinley and Cibola counties); and
- Roberts Park - Centerfire Basin (Catron County).

The distribution of Gunnison's prairie dog was extensive and more contiguous in grassland and steppe vegetation on broad alluvial valleys between low ranges of mountains and hills (Hubbard and Schmitt, 1984: 41). The range of Gunnison's prairie dog in New Mexico includes all or parts of the following 16 counties: Bernalillo, Catron, Cibola, Colfax, Los Alamos, McKinley, Mora, Rio Arriba, Sandoval, San Juan, Santa Fe, Sierra, Socorro, Taos, Torrance, and Valencia.

About 40 percent of the gross geographic range of Gunnison's prairie dog, or about 27.8 million acres, is in New Mexico (Figure 2; Table 1; Seglund *et al*., 2006: 25). This acreage includes all land area within the boundary of the polygon encompassing the range of the species, even those areas that are not suitable habitat for the species. The estimated acreage within the gross geographical range is similar to the historic range delineated by Hubbard and Schmitt (1984), which encompassed about 30.3 million acres.

A spatially explicit predictive range model was developed to map potentially suitable habitat within the boundary of the gross geographic range of Gunnison's prairie dog (Seglund *et al*., 2006: 9-11). This model used three classification criteria to identify potentially suitable habitat: 1) elevation range of 4,921 to 12,139 feet; 2) slope range of zero to 20 percent; and 3) 23 land cover classes encompassing the range of vegetation types used by Gunnison's prairie dog (Seglund *et al.*, 2006: 68). Resolution of the land cover mapping was 30-meter pixels with a minimum mapping area of one acre (Lowry *et al*., 2005: 18).

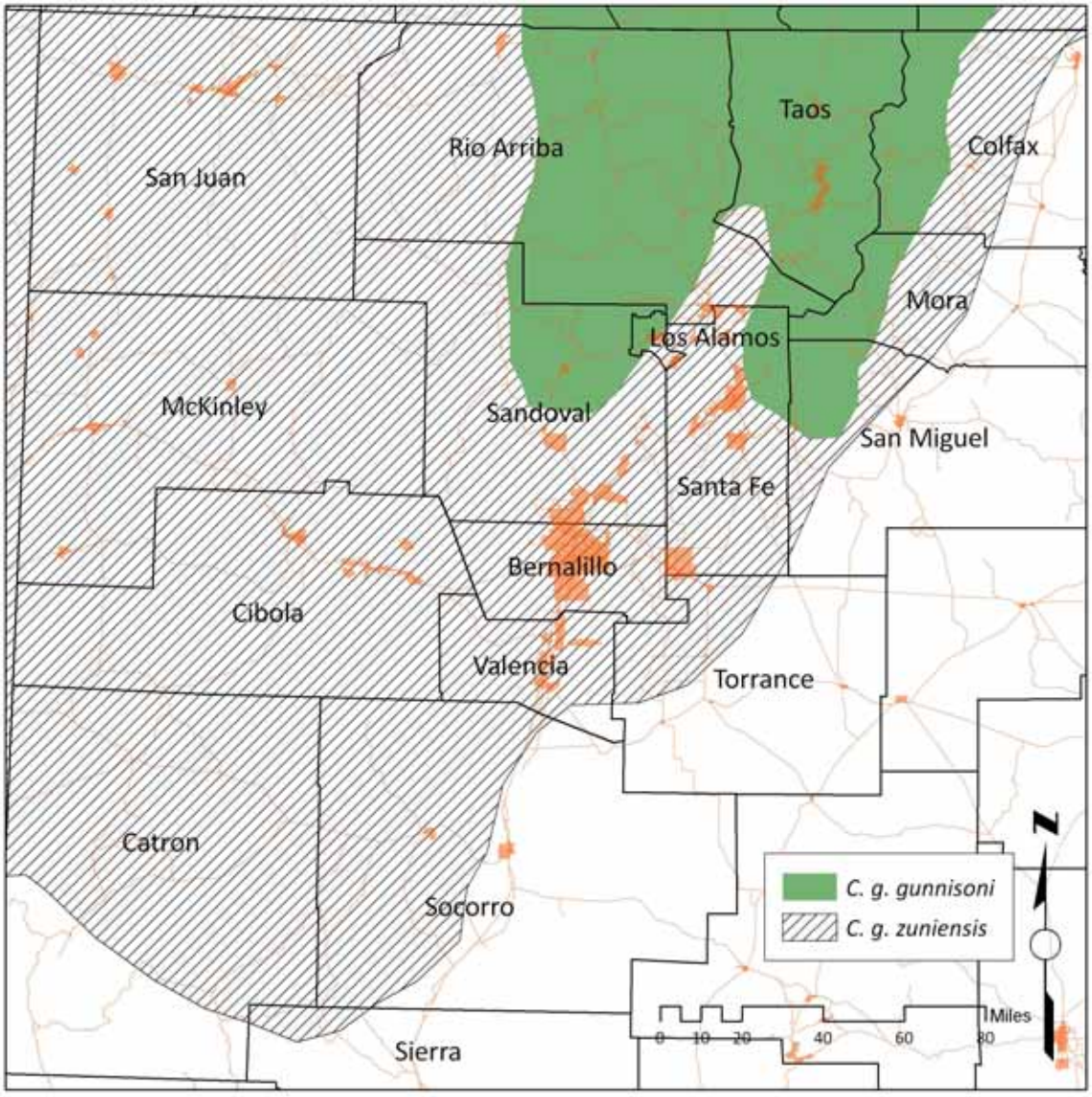

Figure 2. Approximate distribution of the two subspecies of *Cynomys gunnisoni* in New Mexico. Major roads are shown by light red lines and light-red shaded areas indicate cities and towns. Light-gray dashed lines are 1,640-ft (500 meter) contours and light gray solid lines are county boundaries. Range limits were approximated from the revised predictive range model (Neville and Johnson, 2007) and results of mtDNA analysis (Hafner *et al*., 2005).

Application of the predictive range model determined that only about 10.5 million acres in New Mexico are potentially suitable habitat for Gunnison's prairie dog (Table 1). This is about 38 percent of the acreage encompassed by the gross geographic range of the species. About 28 percent of the potentially suitable habitat for Gunnison's prairie dog in New Mexico is on publicly-owned lands. Another 34 percent consists of tribal lands and Native American trust lands administered by the Bureau of Indian Affairs (Table 1).

Bureau of Land Management administered lands and tribal lands together compose about 50 percent of all of the potentially suitable habitat for Gunnison's prairie dog in New Mexico. Bureau of Land Management lands make up about 54 percent of potentially suitable habitat on publicly-owned lands in New Mexico. Privately owned lands make up about 38 percent of all potentially suitable habitat in the state (Table 1).

Table 1. Gross and predicted range of Gunnison's prairie dog in New Mexico, categorized by land ownership (from Seglund *et al.*, 2006: 75; Table 6). Predicted range is defined as potentially suitable habitat within the gross range. As described in Seglund and others (2006: 9), the gross range acreage was developed from the range map in Hall (1981).

Land Ownership	Gross Range		Predicted Range	
	acres	percent	acres	percent
Publicly-Owned Lands				
Bureau of Land Management	3,808,101	13.70%	1,586,837	15.14%
Department of Defense	55,629	0.20%	24,214	0.23%
U.S. Forest Service	5,139,436	18.49%	434,874	4.15%
U.S. Fish and Wildlife Service	81,808	0.29%	13,510	0.13%
National Park Service	172,520	0.62%	25,796	0.25%
Other Federal Lands	64,829	0.23%	8,901	0.08%
State Lands	1,668,741	6.00%	841,884	8.03%
Publicly-Owned Lands Total	**10,991,064**	**39.54%**	**2,936,016**	**28.00%**
Tribal Lands Total	**7,524,611**	**27.06%**	**3,556,842**	**33.93%**
Private Lands Total	**9,287,192**	**33.40%**	**3,991,387**	**38.07%**
Grand Total	**27,803,080**		**10,484,245**	
Historic Gross Range	30,262,833	estimated from Hubbard and Schmitt (1984)		

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2.0 NATURAL HISTORY OF GUNNISON'S PRAIRIE DOG

2.1 Habitat

Gunnison's prairie dog is found in grassland and shrub-steppe habitat at elevations ranging from semi-desert to montane (Fitzgerald *et al*., 1994: 183). In New Mexico, Gunnison's prairie dog may occur from about 4,500 to 10,00 feet elevation. The species is found in montane grassland, juniper savanna, plains-mesa grassland, Great Basin desert scrub, plains-mesa sand scrub, desert grassland vegetation (*cf.* Dick-Peddie, 1993) in New Mexico, as well as in urban and cultivated areas.

Vegetation structure in occupied habitats is characterized by predominately graminoid and herbaceous plant cover with few or no trees and variable shrub density. Cully (1988: 18) found total plant cover at three colony sites in the Moreno Valley, Colfax County, New Mexico, ranging from about 55 percent to about 70 percent. Total shrub cover at these sites was about seven to eight percent and consisted mostly of rubber rabbitbrush (*Ericameria nauseosa*) and snakeweed (*Gutierrezia sarothrae*; Cully, 1988: 22). Shrub density ranged from 1,126 to 1,835 per acre (Cully, 1988: 26). Others have reported total shrub cover composing less than 25 percent of plant cover at Gunnison's prairie dog colony sites (Hubbard and Schmitt, 1984: 41; Rayor, 1985*a*; Cully *et al*., 1997).

Gunnison's prairie dog occurrence in habitats with substantial shrub cover was summarized by Cully (1988: 22-23):

> "To an even greater extent than the other prairie dogs, however, Gunnison's prairie dog towns are often associated with substantial shrub cover. At lower elevation sites in New Mexico Gunnison's prairie dog towns may be obscured by dense stands of big sagebrush (*Artimisia* [sic] *tridentata*) or mixed four-wing saltbush (*Atriplex canescens*) and black greasewood (*Sarcobatus vermiculatus*) ... Throughout the species range in northern New Mexico Gunnison's prairie dog towns are located on the sides and tops of ridges, rather than the bottoms of drainages, probably to avoid flooding caused by runoff melt water ... or summer flooding. The valley bottoms where soils are dense tend to be characterized by the lowest shrub densities. Densities of some species of shrubs increase on the steeper, better drained soils of the sides of washes and ridge tops while others, such as four-winged saltbush and black greasewood thrive in the valley bottoms."

Cully (1988: 30-32) concluded that the association of Gunnison's prairie dog with habitats containing substantial shrub cover is coincidental and that the species is not selecting areas with shrub cover *per se* but rather areas with suitable soils conditions for burrow construction. However, shrubs may provide important hiding cover for Gunnison's prairie dogs, particularly in colonies with low population density (Cully, 1988: 32).

Burrows created by Gunnison's prairie dog are an important feature of their habitat. Cully (1988: 26-27) found burrow density at colony sites in the Moreno Valley to range from about 220 to 500 per acre. Cully (1988: 32) postulated that burrow density was not solely a function of population

density but is positively related to an interaction between population density and colony age. Eight-one percent of the burrows in the Moreno Valley evaluated by Cully (1988: 35) were simple (*i.e.* having only one entrance). Nineteen percent had a second entrance; none had more than two entrances. The ratio between numbers of burrows and prairie dog abundance was 15:1 prior to juvenile emergence and about 5:1 following juvenile emergence (Cully, 1988: 36).

Important abiotic variables determining suitability of habitats for Gunnison's prairie dog are adequate soil depth for burrows to be dug below the frost line, moderate to low slope and low slope variability, and low rock cover (Wagner and Drickamer, 2004). Colonies of Gunnison's prairie dog encompassed from 39.5 to 370.6 acres of land in a 1980 survey (Clark *et al.*, 1982).

2.2 Food Habits

The diet of Gunnison's prairie dog consists mainly of grasses (Fitzgerald and Lechleitner, 1974), but forbs, sedges and rushes, big sagebrush (*Artemisia tridentata*), and rabbitbrush (*Ericameria* spp.) are also consumed. Digging for roots and tubers is not common. Unlike black-tailed prairie dog, Gunnison's prairie dog does not appear to clip vegetation to reduce plant height around burrows (Fitzgerald *et al.*, 1994: 183). Bailey (1931: 129) reported that seeds, particularly of grasses, were a large part of the diet in the fall, prior to hibernation.

2.3 Social Behavior

2.3.1 Coloniality

Like black-tailed prairie dogs, Gunnison's prairie dogs are highly social and colonial. However, they form smaller colonies that are more loosely organized than colonies of black-tailed prairie dogs (Findley *et al.*, 1975: 134). Coloniality confers benefits to the species by lowering predation (Hoogland, 1996). Gunnison's prairie dogs give an alarm call when a predator is detected, and variation in the call may indicate the type of predator that is approaching (Slobodchikoff *et al.*, 1991). Within colonies, Gunnison's prairie dogs organize themselves into clans or family groups, which are characterized by extensive spatial overlap among individuals and amicable behavioral interactions. Spatial overlap between clans is minimal and behavioral interactions between members of different clans are typically agonistic (Rayor, 1988).

2.3.2 Hibernation

Unlike black-tailed prairie dogs (Hoogland, 2006), Gunnison's prairie dogs hibernate during the cold winter months (Bailey, 1931: 127; Fitzgerald *et al.*, 1994: 184). In the Moreno Valley, Colfax County, New Mexico, at an elevation of about 8,200 feet, Gunnison's prairie dog typically enter hibernation from September to November and emerge from mid-March to mid-April, depending on the persistence of snow cover (Cully, 1988: 77-79, 89). In the Moreno Valley complex, adult males emerged from hibernation about two weeks before adult females (Cully, 1988: 79). Juveniles in the Moreno Valley typically emerged in June, although emergence dates for juveniles extended as late as 8 July (Cully, 1988: 80).

2.3.3 Mating System and Reproductive Cycle

Gunnison's prairie dogs have a polygamous mating system (*i.e.* males typically breed with several females; Haynie *et al.*, 2003). Mating occurs in spring following emergence from hibernation (Fitzgerald *et al.*, 1994: 183). Males

eat little and steadily lose weight during the breeding period (Cully, 1988: 81). Breeding pairs submerge into a burrow to mate. After mating, the female selects a nursery burrow in which she constructs a nest made of grasses. Gestation is estimated at about 30 days (Fitzgerald *et al*., 1994: 183). Pups remain below ground for four to five weeks following birth and typically emerge from the burrow from late June to the beginning of July (Bailey, 1931: 129; Cully, 1988: 80).

2.4 Population Dynamics

2.4.1 Age of First Reproduction

Males may copulate with females as yearlings, but the percentage that do so may be relatively low (*ca.* 24 percent; Hoogland, 2001). Females are typically sexually mature as yearlings (Hoogland, 2001) and may bear litters in their first year at productive sites (Rayor, 1985*a;* Cully, 1988: 94).

2.4.2 Fecundity

Habitat quality and abundance of nutritious forage plants are major factors influencing fecundity of Gunnison's prairie dogs (Cully, 1988: 95-96). The percentage of sexually mature females in a colony that may produce litters in a colony of Gunnison's prairie dog in Colorado was dependent on availability of high quality forage and body mass (Rayor, 1985*a*; Cully, 1988: 92-93).

The percent of adult females that may breed and produce offspring also varies with habitat condition and colony density. Sixty-seven percent of the female prairie dogs in one studied colony produced weaned offspring (Haynie *et al*., 2003). In the Moreno Valley, 100 percent of adult females bore litters in low-density colonies, while only 46 percent of the adult females produced young at a high-density colony (Cully, 1988: 92-94). In another study, the probability that a female Gunnison's prairie dog may wean a litter was estimated at 82 percent (Hoogland, 2001). Gunnison's prairie dogs have one litter per year, with an average litter size of three to four (Fitzgerald *et al*., 1994: 183-184; Hoogland, 2001). Hoogland (2001) reported a mean litter size at first juvenile emergence from the nursery burrow of 3.77. In the Moreno Valley, the mean number of pups per reproductive female was five at low-density sites and 3.7 at a high-density site (Cully, 1988: 93; Table 2).

2.4.3 Survivorship

The two most-trying periods for survival of Gunnison's prairie dogs are as neonates after they emerge from the natal burrow and during the over-wintering period (Hoogland, 2006: 31-35). Survivorship in the first year is typically less than 60 percent (Hoogland, 2001). In the absence of a plague epizootic, over-winter survival is influenced by availability of water, duration of the growing season, and diversity and quantity of edible vegetation (Rayor, 1985*a*). Cully (1988: 33) noted badger (*Taxidia taxus*), coyote (*Canis latrans*), domestic dog (*Canis familiaris*), gray fox (*Urocyon cineroargenteus*), and long-tailed weasel as predators in Gunnison's prairie dog colonies in the Moreno Valley. Raptor species that preyed on Gunnison's prairie dog included Ferruginous Hawk (*Buteo regalis*), Red-tailed Hawk (*Buteo jamaicensis*), and Golden Eagle (*Aquila chrysaetos*; Cully, 1988: 118-119). Infanticide is rare or absent in Gunnison's prairie dog (Hoogland, 1999). Age-specific survivorship rates for high-density and low-density colonies in the Moreno Valley were estimated by Cully (1988: 98-99; Table 2). Average life span of Gunnison's prairie dog in the wild is not known. Cully (1988: 97) assumed a maximum life span of females in the wild of five years.

Table 2. Estimated age-specific life history parameters for Gunnison's prairie dogs in the Moreno Valley (data from Cully, 1988: 98-99).

Age-Specific Life History Parameter		Age Class					
		0	1	2	3	4	5
Survival	High Density Colony	1.0	0.4	0.8	0.8	0.4	0.0
	Low Density Colony	1.0	0.8	0.7	0.7	0.5	0.0
Fecundity	High Density Colony	0.0	0.0	1.5	2.0	2.0	0.0
	Low Density Colony	0.0	2.5	3.0	3.0	2.0	0.0

2.4.4 Dispersal

Dispersal attributes of a species are an important consideration in conservation because they strongly influence distribution and abundance patterns across the landscape, genetic exchange, and resilience in the face of demographic events or local extirpations. For example, dispersal attributes of Gunnison's prairie dog determine the limits for potential natural re-colonization of unoccupied suitable habitats following local extirpation by plague or historically occupied habitat where the species was eradicated by control programs.

Female Gunnison's prairie dogs are predominately philopatric (*i.e.* they stay in the colony where they were born) throughout their life while most males are philopatric only during the first year (Hoogland, 1999). However, both females and males may disperse and such dispersal is most often to adjacent clan territories (Hoogland, 1999). Colonies with higher reproductive success and growth rates have greater numbers of dispersing yearlings (Rayor, 1985*a*). Specific information on dispersal of Gunnison's prairie dog is not known. However, most inter-colonial dispersal in black-tailed prairie dogs is by individual yearlings, not groups of individuals (Hoogland, 2006: 49). In black-tailed prairie dogs dispersal is usually to another colony, with individuals rarely dispersing and establishing new colonies (Hoogland, 2006: 48). Maximum dispersal distance in black-tailed prairie dogs is about 3.7 miles but may range up to six miles (Hoogland, 2006: 49). Individuals rarely disperse to previously unoccupied areas to establish new colonies. Most dispersal is to other prairie dog towns with existing burrows. The mortality rate associated with inter-colony dispersal is likely very high (Hoogland, 2006: 48-49).

2.4.5 Population Density and Size

Population size in prairie dog colonies may expand to an equilibrium level and then remain at that level for extended periods of time (*e.g.* Cully, 1988: 97-103; Hoogland, 2006: 50). In the absence of plague and human-induced mortality (*i.e.* poisoning, shooting), population density in Gunnison's prairie dog colonies is a function of food availability (Cully, 1988: 97). Population growth is very sensitive to age at first reproduction, which is earlier in more productive habitats (Rayor, 1985*b*; Cully, 1988: 100).

Reported densities of Gunnison's prairie dog have ranged from about 12 per acre to over 140 per

acre in favorable habitat (Fitzgerald *et al.*, 1994: 184). In the Moreno Valley in north-central New Mexico, an area of about 10,000 acres supported a population of about 30,000 Gunnison's prairie dogs prior to a plague epizootic (Cully, 1988: 10). A high-density colony in the valley had 74 prairie dogs per acre after juvenile emergence and before the plague epizootic (Cully, 1988: 45, 77).

2.5 Plague

Plague (*Yersinia pestis*) is a gram-negative bacteria introduced to North America in 1899, probably by infected rats from a ship anchored in San Francisco Bay (Cully, 1988: 41). Plague was first discovered in New Mexico in 1938, in Gunnison's prairie dogs near Zuni (Hubbard and Schmitt, 1984: 51; Cully, 1988: 43). It now occurs throughout the range of Gunnison's prairie dog in New Mexico (Hubbard and Schmitt, 1984: 51).

Plague epizootics in Gunnison's prairie dog, although infrequent, can periodically result in drastic reductions in population density and even local extirpation of colonies (Lechleitner *et al.*, 1962; Lechleitner *et al*., 1968; Rayor, 1985*b*; Cully, 1988; Cully *et al*., 1997; Wagner *et al*., 2006). For example, Cully (1988: 45) documented a 90 percent over-winter mortality rate in a colony in the Moreno Valley, Colfax County, New Mexico, with onset of a plague epizootic in the preceding summer. In one year, the population had declined an estimated 99 percent (Cully, 1988: 48). Populations of thirteen-lined ground squirrel (*Spermophilus beechiei*) also crashed during the epizootic. Mesic habitats not occupied by Gunnison's prairie dog, such as Six-mile Creek, may have served as a barrier to slow the spread of plague from one colony to the next (Cully, 1988: 47).

Enzootic plague species (*i.e.* those in which the disease is constantly present but only affects a small number at any time) are not definitively known. Cully (1988: 67) hypothesized that deer mouse (*Peromyscus maniculatus*) and meadow vole (*Microtus pennsylvanicus*) were potential enzootic species in the Moreno Valley. In south-central Colorado, deer mouse and golden-mantled ground squirrel (*Citellus lateralis*) were suspected as being possible reservoirs for plague (Lechleitner *et al.*, 1968).

Flea species that tested positive for plague in the Moreno Valley included *Monopsyllus wagneri*, *M. vison*, *Opisocrotis hirsutus*, *O. labis*, *O. tuberculatus cynomuris*, *Rhadinoptilla sectilis*, and *Thrassis bacchi*. Cully (1988: 60) found three of these species to be predominately on prairie dogs (*O. hirsutus*, *O. labis*, *O. tuberculatus cynomuris*), although they also occurred on other mammal species. Two of these flea species, *O. hirsutus* and *O. labis*, were the species most often plague positive. However, *T. bacchi* was suggested as an important flea species in transferring plague from enzootic species to prairie dog, either directly or indirectly via thirteen-lined ground squirrel (see below). The three flea species most important in transferring plague to Gunnison's prairie in a population in Saguache County, Colorado were *O. tuberculatus*, *O. labis*, and *Oropsylla idahoensis* (Lechleitner *et al*, 1968).

Cully (1988: 68-74) proposed a model of plague epizootic in Gunnison's prairie dog, whereby outbreak of the disease is related to expanding population size and subsequent overlap of occupied habitat with areas occupied by deer mice or meadow voles. Plague from these assumed enzootic species is then transferred via shared fleas either directly to Gunnison's prairie dog or intermediately by thirteen-lined ground squirrels, which were found in close contact with prairie

dogs in Cully's Moreno Valley study area. The highly social nature of prairie dogs allows plague to spread rapidly through a colony and from colony to colony in a densely populated area. Survival of a Gunnison's prairie dog colony is dependent upon some individuals being resistant to plague, as was the case in the Moreno Valley study (Cully, 1988: 75).

Plague outbreaks and incidence in humans in New Mexico are associated with higher than average precipitation in the preceding winter and spring, suggesting a trophic cascade (Parmenter *et al*., 1999) or, considering feedbacks, a trophic vortex (Ray and Collinge, 2007; Figure 3). Presumably, wet winter-spring weather increases soil moisture levels, resulting in increased plant production and fruiting. This heightened abundance of food resources translates into increased reproduction and growth of rodents. The larger population sizes of plague hosts and moist soil conditions provide the basis for increased flea reproduction and survivorship.

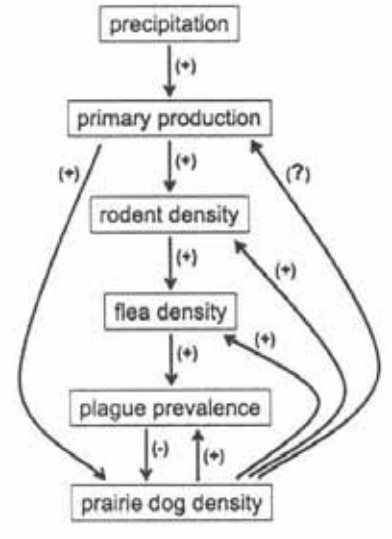


Figure 3. Hypothesized trophic vortex describing dynamics of sylvatic plague in prairie dog habitat. Excerpted from Ray and Collinge (2007; Figure 1b).

2.6 Role in Grassland Ecosystem Structure and Function

All five species of prairie dog have been recognized as keystone species (Miller *et al*., 1994; Miller *et al.*, 2000), although most of the evidence cited for this role comes from studies of black-tailed prairie dogs in the Great Plains grassland ecosystem (Stapp, 1998). Several studies of Gunnison's prairie dog suggest that it may not have a strong influence on plant or rodent species diversity, at least in the short term (Bartz *et al*., 2007; Davidson *et al*. 1999). However, other studies have indicated a strong influence by Gunnison's prairie dog on arthropod abundance and species richness (Bangert and Slobodchikoff, 2006; Davidson and Lightfoot, 2007) and landscape structure (Bangert and Slobodchikoff, 2000).

Prairie dog burrows and mounds influence a number of important ecosystem processes. Mixing of subsurface soils with surface materials (*e.g.* litter, organic matter) fertilizes and aerates the soil. Burrows may also enhance infiltration of water into deeper root zones. Also, many plant require disturbed sites for germination and growth (Parmenter and Van Devender, 1995: 218). Gunnison's prairie dog colonies support a large number of associated species. For example, Clark and others (1982) recorded 16 species of reptiles, 23 species of birds, and 16 species of mammals during observations made at 11 colonies of Gunnison's prairie dogs. Some species closely associated with Gunnison's prairie dog include Burrowing Owl (*Athene cunicularea*), Mountain Plover (*Charadrius montanus*), Ferruginous Hawk (*Buteo regalis*), and Golden Eagle (*Aquila chrysaetos*).

3.0 STATUS ASSESSMENT AND CONSERVATION APPROACH

3.1 Status Assessment

Gunnison's prairie dog is a Species of Greatest Conservation Need in New Mexico (New Mexico Department of Game and Fish, 2006: 55). The factors contributing to designation of Gunnison's prairie dog as a Species of Greatest Conservation Need in New Mexico are its role as a keystone species or ecosystem engineer, its vulnerability, and its recreational use. It is also listed as a state sensitive species. Gunnison's prairie dog is not listed as a game or protected animal in New Mexico. As discussed in Section 1.1, the U.S. Fish and Wildlife Service recently conferred Candidate status to montane populations of Gunnison's prairie dog in Colorado and New Mexico. These montane populations are presently considered warranted but precluded for listing under the Endangered Species Act.

3.1.1 Trends in Distribution and Abundance

The geographic range of Gunnison's prairie dog in New Mexico does not appear to have changed substantially since the mid-1800s (Hubbard and Schmitt, 1984: 29). However, there is considerable evidence to indicate that abundance of the species has declined significantly within its geographic range in New Mexico (New Mexico Department of Game and Fish, 2006: 165) and that it now has a highly fragmented distribution.

The historic abundance of Gunnison's prairie dogs within its geographic range is not specifically known but anecdotal information strongly suggests that the species was quite abundant in suitable habitat throughout its range. Shriver (1965: 6), recounting historical information on rodent control in New Mexico, stated:

> "Early pioneers in New Mexico found a great part of the range lands heavily infested with prairie dogs, rabbits, kangaroo rats, gophers, and other field rodents."

The earliest statewide assessment of acreage occupied by prairie dogs in New Mexico is from 1919 (Shriver, 1965), which was about five years after significant eradication efforts were initiated in the state (Hubbard and Schmitt, 1984: 43). Shriver (1965: 6) noted that: "By 1914, large crews of men were distributing strychnine grain" to control prairie dogs. It was estimated that habitat occupied by prairie dogs in New Mexico had been reduced to about 11.9 million acres by 1919 (Table 3). This figure included both Gunnison's and black-tailed prairie dogs. By 1965, the number of acres occupied by prairie dogs in the state had further declined to only about 370,000 acres (Table 3); a reduction of about 97 percent from 1919 occupied acreage. Occupied acreage continued to decrease and by 1971 it totaled a mere 248,000 acres (Stuart and Christensen, 1973) – only two percent of the acreage occupied by prairie dogs in 1919. This acreage comprised 840 prairie dog towns throughout the entire state (Stuart and Christensen, 1973: 48). This time series of statewide assessments indicates that abundance of Gunnison's prairie dog was reduced well over 90 percent in the 70-year period from around 1900 to 1970.

This marked decline in abundance is further evidenced by qualitative reports in the literature. For example, in a discussion of the distribution of Gunnison's prairie dog, Findley and other (1975: 133-134) observed that:

> "While not abundant, Gunnison's prairie dogs are fairly common periodically ... Formerly they were common around Albuquerque, but now they have largely disappeared from the middle Rio Grande Valley. In the upper Rio Grande Valley, the upper Chama Valley, and the San Juan-Chaco basin one may still expect to see a few animals along the roadsides."

Following cessation of toxicant use for prairie dog control on federal lands in 1972 (Executive Order 11643), qualitative assessments suggested an increasing abundance of prairie dogs throughout the state (Stuart and Christensen, 1973: 48). Executive Order 11643 was subsequently revoked in 1982 by Executive Order 12342.

A 1981 study involving a questionnaire survey reported a total of 154,060 acres occupied by prairie dogs in New Mexico (Bodenchuk, 1982: 2), indicating continued decline of prairie dogs in New Mexico (Table 3). The 1981 data may have under-represented actual abundance though, because of potential non-reports of prairie dog occurrences by survey respondents (Bodenchuk, 1982: 3). Current trends in abundance of Gunnison's prairie dog are unknown. However, a sampling program was initiated in fall 2007 to establish a baseline for future monitoring of Gunnison's prairie dog distribution in New Mexico. This program follows the sampling methodology developed by Andelt and Seglund (2007).

Table 3. Trends in acreage occupied by prairie dogs in New Mexico, 1919 to 1981.

Year	Occupied Habitat (acres)		Source
	Gunnison's and Black-tailed Prairie Dogs	Gunnison's Prairie Dog	
1919	11,951,000	---	Shriver (1965: 6)
1921	---	7,731,940	Oakes (2000), cited in Seglund *et al.* (2006: 21)
1961	402,270	384,940	Bureau of Sport Fisheries and Wildlife (1961)
1965	370,000	---	Shriver (1965: 6)
1971	248,000	---	Stuart and Christensen (1973: 48)
1981	154,060	107,204	Bodenchuk (1982: 2)

3.1.2 Trends in Habitat Suitability

Grassland habitats throughout the range of Gunnison's prairie dog in New Mexico have been invaded by woody vegetation since the turn of the 20th century (*e.g.* Dick-Peddie, 1993: 19, 29). Sagebrush habitat in the northwestern portion of New Mexico has been altered by livestock use, energy development, and other human activities (New Mexico Department of Game and Fish, 2006: 158). These alterations likely have decreased habitat quality for Gunnison's prairie dog by reducing cover of native perennial grasses and forbs. Decreased habitat quality, in turn, can result in lower fecundity and survival rates (*e.g.* Rayor, 1985*a*). Habitat loss through urbanization has occurred in localized areas (*e.g.* Santa Fe, Albuquerque).

3.2 Diagnosis of Factors Affecting Status

Factors implicated in the decline of Gunnison's prairie dog in New Mexico include poisoning, shooting, sylvatic plague, and habitat loss (New Mexico Department of Game and Fish, 2006: 165). While the relative importance of these factors can only be qualitatively assessed, two conclusions appear to be reasonable:

> 1) historic decline and fragmentation of distribution of Gunnison's prairie dog in New Mexico was primarily the result of widespread poisoning and introduction of sylvatic plague; and
>
> 2) currently, the primary threats to the species are sylvatic plague acting in conjunction with fragmented distribution of Gunnison's prairie dog.

These conclusions are consistent with findings in Arizona, where reduction in active Gunnison's prairie dog colonies was primarily due to plague. There was little evidence that poisoning, recreational shooting, or habitat conversion played an important role in the persistence of 270 colonies of Gunnison's prairie dog that were studied (Wagner *et al*., 2006).

3.2.1 Prairie Dog Eradication and Control

Eradication efforts were the most important factor involved in range-wide reduction of abundance of Gunnison's prairie dog from the beginning of the 20th century through the early 1960s (*cf.* section 3.1.1). Current control efforts directed at Gunnison's prairie dog are localized and sporadic. Area treated for control of Gunnison's prairie dog in New Mexico was 2,180 acres in 2002, 1,280 acres in 2003, and 2,230 acres in 2004 (K. Podborny, U.S.D.A. Wildlife Services, pers. comm., 10 May 2006). There is no longer a concerted, range-wide program to eradicate the species, but lethal control of Gunnison's prairie dog is still implemented in various locations throughout its range.

3.2.2 Sylvatic Plague

Plague began to become an important factor affecting Gunnison's prairie dog in New Mexico since the late 1930s, when it was detected in a colony near Zuni (Cully *et al*., 1997). Mortality rates are typically very high, usually exceeding 90 percent. Plague epizootics in Gunnison's prairie dog in New Mexico are reported in the literature from the Moreno Valley (Cully, 1988), the Taos and Tres Piedras area (Cully *et al*., 1997), Santa Fe (Rosmarino, 2004: 66), and Catron County (Rosmarino, 2004:65). Although it is certain that plague has affected Gunnison's prairie dog in

other parts of its range in New Mexico, data on the frequency, extent, and severity of epizootics are lacking.

Colonies may persist following an epizootic (*e.g.* Cully *et al*., 1997), but local extirpation may also occur (*e.g.* Rayor, 1985*b*). Additionally, plague continues to cycle through prairie dog colonies periodically (*cf.* section 2.5) and population recovery, if it occurs, is typically slow. Persistence of Gunnison's prairie dog in the presence of plague is a function of the size of the colony complex (Wagner *et al*., 2006). Consequently, small, isolated colonies are more vulnerable to local extirpation by plague than are complexes of colonies distributed across the landscape.

3.2.3 Recreational Shooting

Shooting may be a significant cause of mortality in Gunnison's prairie dog colonies (Cully, 1985: 37; Rosmarino, 2004: 59). There are no data on the extent or impact of shooting on Gunnison's prairie dog in New Mexico. However, anecdotal evidence indicates that shooting may be an important factor affecting Gunnison's prairie dogs in specific areas such as the Moreno Valley (Cully, 1985) and the Plains of San Agustin (Rosmarino, 2004: 60).

Hunting-associated disturbance has been shown to have a deleterious effect on black-tailed prairie dogs through changes in behavior (Pauli and Buskirk, 2007). Non-lethal effects of shooting (*i.e.* effects on prairie dogs not killed by hunting) included lowered body condition, higher stress as measured by fecal corticosterone levels, and near-cessation of reproduction in colonies subjected to shooting. No compensatory density-dependent effects, such as increased over-winter survival, from shooting mortality were observed (Pauli and Buskirk, 2007). Recreational shooting would likely have a similar effect on Gunnison's prairie dogs because of the similarity in social structure and behavior.

Hunting or shooting of Gunnison's prairie dog is not regulated by any government agency in New Mexico. The species is not listed as a game animal under Chapter 17, Article 2 of the New Mexico Statutes, which lists the species for which hunting and harvest regulations may be promulgated. Consequently, NMDGF has no authority to regulate shooting of Gunnison's prairie dog. However, other groups of animals in the Family Sciuridae, which include prairie dogs, are listed as game animals in Chapter 17-2-3 of the New Mexico Statutes. Groups of sciurids listed as game animals include squirrels, red squirrels, and marmot.

3.2.4 Habitat Loss and Alteration

Habitat loss is a significant issue primarily in metropolitan areas such as Taos, Santa Fe, and Albuquerque. More than 200 acres of occupied habitat was lost to development in Santa Fe from 1996 through 2003 (Rosmarino, 2004: 33). Approximately 2,560 acres of habitat formerly occupied by Gunnison's prairie dog in the Eldorado suburb of Santa Fe has been lost to development. Similarly, thousands of acres of suitable, formerly occupied habitat have been lost in the Albuquerque metropolitan area (Rosmarino, 2004: 35).

Alteration of vegetation in Gunnison's prairie dog habitat occurs through land uses such as energy development and livestock grazing (New Mexico Department of Game and Fish, 2006: 158). However, there is no clear evidence that livestock grazing has an adverse effect on prairie dogs (*e.g.* O'Melia *et al*., 1982). Decreased abundance of native grasses and forbs, and replacement by invasive non-native species such as crested

wheatgrass (*Agropyron cristatum* and *A. desertorum*) may reduce habitat quality for Gunnison's prairie dog, which forages primarily on native forbs and grasses (Shalaway and Slobodchikoff, 1988). In any event, habitat quality has a strong influence on body condition, reproduction, and survival of Gunnison's prairie dog (Rayor, 1985*a*; Hoogland, 2001).

3.3 Conservation Approach

3.3.1 Conservation Goal

The goal of this plan is to ensure the long-term ecological viability of Gunnison's prairie dog in New Mexico as part of a multi-state effort spanning the range of the species. Ecological viability is defined here as populations of sufficient size and spatial distribution to maintain critical ecosystem functions (*cf.* Tear *et al.*, 2005). Population viability, maintenance of genetic diversity, and conserving evolutionary potential are subsumed in this definition.

Two perspectives are required to achieve this goal. First, identification and analysis of the factors that drove the species to its current state are needed. This diagnosis provides the basis for developing actions that will eliminate or reduce the continuing impacts that adversely affect the species and thereby halt its decline. The second perspective is that of risk assessment, which provides the basis for conservation actions that, when implemented, will provide a reasonable degree of certainty that the species will persist in the future. Without this second perspective, threats to the species may be alleviated but continued persistence in its current state may be untenable. That is, removal of known threats may not be enough for effective conservation of the species. Other actions to restore and protect habitat areas, address novel threats, increase population density, or repatriate animals to areas where it has been locally extirpated may be needed to secure its probability of long-term persistence.

The ecological viability goal for conservation of Gunnison's prairie dog would constitute a "coarse filter" (Groves *et al.*, 2002) in that it would also address, at least in part, conservation needs of other high-priority species including black-footed ferret, mountain plover, ferruginous hawk, and burrowing owl.

Three initiatives were defined that, if implemented adequately, would result in achieving the goal of ecological viability of Gunnison's prairie dog. These conservation initiatives are to:

1. establish focal areas for conservation of Gunnison's prairie dog in the geographic ranges of both subspecies;
2. ensure persistence of populations in each focal area; and
3. provide habitat connectivity between focal areas.

3.3.2 Conservation Initiative 1: Establish Focal Areas

The first initiative in achieving the goal of ecological viability of Gunnison's prairie dog is to restore and conserve representation of the species in the landscape. An approach to conservation of prairie dogs involving establishment of focal areas or networks of reserves addresses this need (Lomolino *et al.*, 2003; Proctor *et al.*, 2006).

In order for Gunnison's prairie dog to fulfill its ecological role in the landscape, both restoration and conservation are required. The status assessment in section 3.1 indicates that

Gunnison's prairie dog abundance has been reduced to less than five percent of its historic (*ca.* 1900) level in New Mexico. Consequently, using current distribution and abundance as the reference condition or baseline for conservation of Gunnison's prairie dog is not ecologically appropriate because current conditions represent a significant change from the historic status of the species (*cf.* the "shifting baseline syndrome" described by Pauly, 1995).

3.3.2.1 Focal Area Size

Focal areas should be of sufficient size to meet the ecological viability goal (*cf.* Knowles, 2000). For black-tailed prairie dogs, criteria for selection of focal areas included: 1) minimum size; 2) presence of suitable habitat quality; 3) ability to manage (*i.e.* public lands were preferred, but also included were private lands with landowners agreeable to managing prairie dogs); 4) some habitat already occupied by prairie dogs; and 5) distribution across the range of the species to preserve genetic diversity (Proctor *et al*., 2006). These criteria are appropriate for defining focal areas for conservation of Gunnison's prairie dog.

Appropriate minimum size of focal areas for Gunnison's prairie dog can be established based on the area required to support black-footed ferret. Using an energy requirement approach, Stromberg and others (1983) estimated that 413 to 877 acres of white-tailed prairie dog colonies would support one black-footed ferret. This estimate is based on an assumption that black-footed ferret is preying exclusively on prairie dogs. In New Mexico, the Moreno Valley historically supported a population of black-footed ferret and had about 24,000 acres of habitat occupied by Gunnison's prairie dog (Cully, 1988: 9-10). The Aubrey Valley in Arizona has about 17,300 acres of habitat occupied by Gunnison's prairie dog and black-footed ferret has been repatriated there (Wagner *et al*., 2006: 337).

A population viability analysis for black-tailed prairie dogs in North Dakota estimated that a minimum population size for long-term viability with plague was 100,000 individuals and that a 10,000-acre colony complex would be suitable to sustain a black-footed ferret population and survive a plague epizootic. Smaller areas, on the order of 1,000 acre complexes distributed over several colonies, would be sufficient to maintain viable populations over the long term and would also be used by some associated species (Knowles, 2000).

Based on these findings, a minimum of 10,000 acres of suitable habitat for Gunnison's prairie dog should be contained within each focal area. Larger areas containing clusters of colonies would be preferable as they would likely provide increasingly higher probabilities for long-term persistence (Wagner *et al*., 2006). Suitable habitat within focal areas can be defined in terms of variables such as soil depth, variation in slope, and surface rock cover (Wagner and Drickamer, 2004). These three parameters were important in predicting the probability of Gunnison's prairie dog occurrence in northern Arizona.

3.3.2.2 Number and Spatial Distribution of Focal Areas

The number of focal areas should be sufficient to capture the genetic diversity within the species in New Mexico and to encompass the variation in habitat conditions throughout its geographic range in the state. These considerations apply to maintaining the evolutionary potential of the species and providing ecological functions of Gunnison's prairie dog (*e.g.* prey base for predators, burrows for other animals) throughout its range.

Hafner and others (2005) found substantial genetic variation within *C. gunnisoni*, represented by three haplotype lineages: two lineages primarily within the putative subspecies *C. g. zuniensis* (an eastern and a western lineage), and a northern lineage within the putative subspecies *C. g. gunnisoni* (Figure 2). Identification of focal areas in the higher elevation range of *C. g. gunnisoni*, across the geographic range of *C. g. zuniensis*, and at the overlap zone of the two subspecies (*e.g.* near Cuba, Sandoval County; Hafner *et al*., 2005), is therefore warranted.

The higher elevation populations, which correspond approximately to the range of the subspecies *C. g. gunnisoni* and to the "montane" populations identified by U.S. Fish and Wildlife Service (2008), are designated as a Candidate for federal listing and therefore are of high priority in terms of designating focal areas.

The historic distribution of Gunnison's prairie dog consisted of naturally disjunct or near-disjunct population segments and extensive and more contiguous population segments in grassland and steppe vegetation on broad alluvial valleys between low ranges of mountains and hills (section 1.5; Hubbard and Schmitt, 1984: 41). Identification of focal areas should capture these geographic characteristics as much as possible. To recapitulate, the disjunct or near-disjunct population segments within the range of *C. g. gunnisoni* were Moreno Valley and Vermejo Ranch in Colfax County, Taos Plain (Taos County), Chama Valley in Rio Arriba County, and Valle Grande in Sandoval County. The disjunct or near-disjunct population segments within the range of *C. g. zuniensis* were the Mesa de los Chivatos in McKinley and Cibola counties and Roberts Park - Centerfire Basin in Catron County.

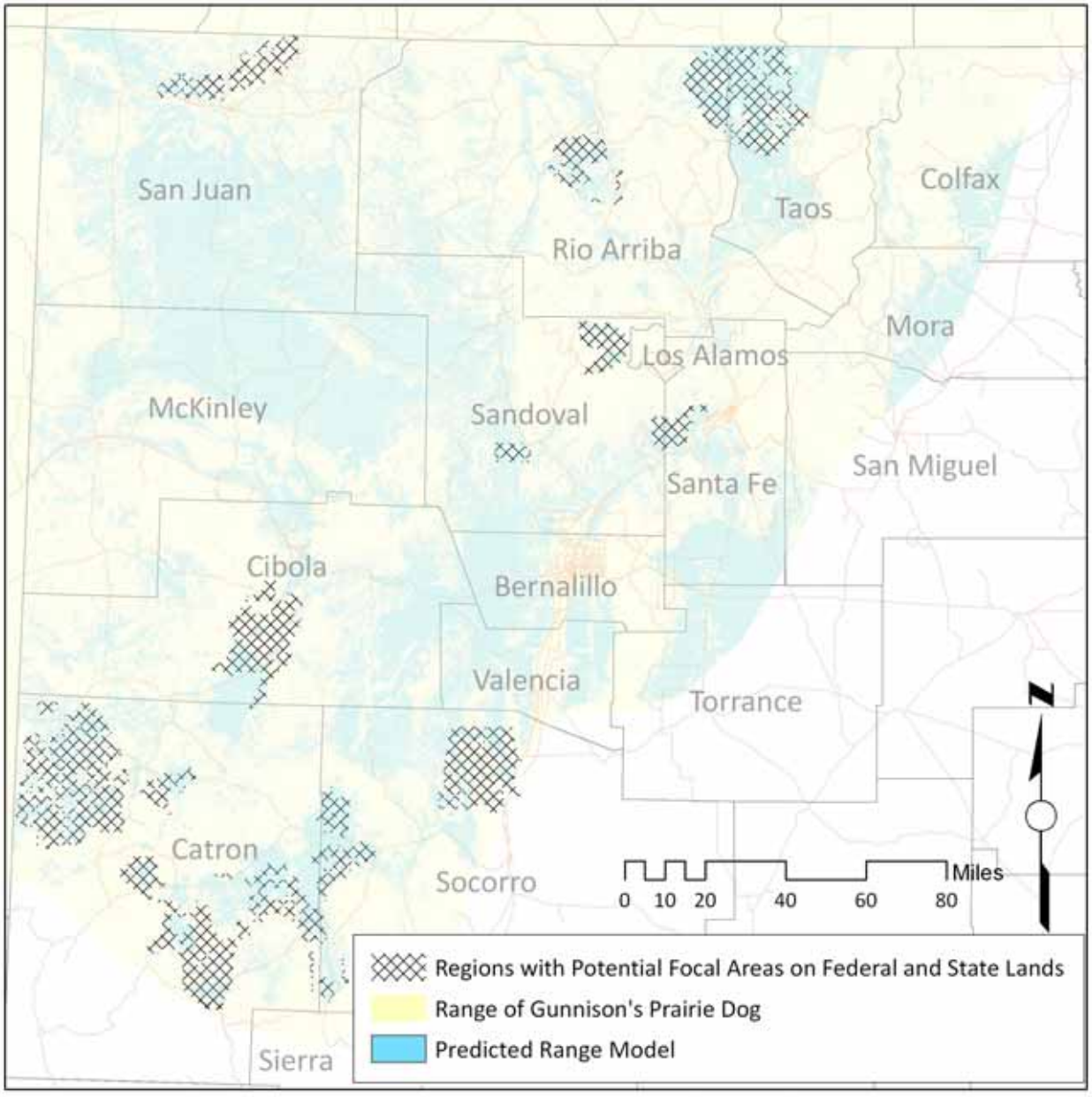
3.3.2.3 Establishing Focal Areas

Criteria for establishing focal areas include 1) minimum size of 10,000 acres; 2) presence of suitable habitat quality; 3) ability to manage (*i.e.* public lands and private lands with landowners interested in conservation of prairie dogs); 4) some habitat already occupied by prairie dogs; and 5) representation of the genetic diversity present in the species in New Mexico.

A preliminary analysis using these criteria resulted in identification of 12 regions where focal areas could be identified. The first step in the analysis used mapping of known colonies of Gunnison's prairie dog, provided by Natural Heritage New Mexico (T. Neville, 7 November 2007, unpubl. data), and a revised predictive range model for New Mexico (Neville and Johnson, 2007). These data were combined with mapping of federal and state lands in blocks exceeding 10,000 acres. The result of this preliminary analysis is shown in Figure 4.

This analysis should be refined to exclude unsuitable habitat areas, update colony locations, and potentially include private and tribal lands, where landowners are interested in conservation of Gunnison's prairie dog. The latter task should be accomplished by contacting specific landowners individually to assess their interest and confirm suitability of areas for conservation of the species. Another important consideration in identifying focal areas is the potential for conflict with adjacent landowners. A buffer of at least one mile is recommended to avoid such conflicts (Truett *et al*., 2001).

Figure 4. Potential focal area regions on state and federal lands. Potential areas do not include private or tribal lands. The predicted range model provides an approximation of areas potentially suitable for Gunnison's prairie dog.



Existing, large complexes of Gunnisons's prairie dog on public lands may constitute *de facto* focal areas. These known areas include the Bureau of Land Management's North Unit on the Taos Plateau (*ca.* 123,000 acres; Hawks Aloft, 2005), the Valles Caldera National Preserve, and large colonies on state and federal lands in northern Catron County (Luce, 2005). Tribal lands throughout the range of Gunnison's prairie dog in New Mexico likely contain tracts that meet the criteria of focal areas. The Navajo Nation, and the Zuni, Acoma, Zia, Jemez, Isleta, Santa Ana, Sandia, San Felipe, and Santo Domingo tribes all have significant land holdings within the range of Gunnison's prairie dog. Tribal entities should be contacted to assess interest in being involved in the statewide conservation planning effort for the species. Areas where private landowner involvement would be particularly beneficial to conservation of Gunnison's prairie dog include the east side of the Sangre de Cristo Mountains in Colfax, Mora, and San Miguel counties, the Galisteo Basin in southern Santa Fe County, and the northern part of the Estancia Basin in Torrance County.

When the "population" of potential focal areas is developed, a final set should be developed. It is understood that identification of a focal area will not change land ownership or impose any restrictions on land use that are not agreeable to specific land owners or land management agencies. The process of finalizing the set of focal areas for conservation of Gunnison's prairie dog should involve the interested stakeholders to ensure that all relevant issues are addressed, while keeping in mind the main reason for establishing these areas.

Monitoring of the spatial distribution and density of Gunnison's prairie dog within each focal area should be conducted on an annual basis. Ideally, a quantitative sampling method, such as distance sampling (Buckland *et al*., 2001), should be employed in each focal area to provide rigorous monitoring data that can be used to assess changes in prairie dog density and distribution over time. Without such monitoring, it would be difficult to determine if and when performance measures associated with the focal areas have been reached. A program of three-year interval monitoring of Gunnison's prairie dog in New Mexico was initiated in 2007. This program could potentially be adapted to provide at least some degree of monitoring in focal areas.

3.3.3 Conservation Initiative 2: Ensure Population Persistence

The second conservation initiative, once focal areas are established, is to ensure that populations of Gunnison's prairie dog are large enough to fulfill ecological functions and that these populations have a high probability of persisting through the next 100 years.

3.3.3.1 Population Size in Focal Areas

One of the criteria for selecting focal areas is the occurrence of Gunnison's prairie dog, so it can be assumed that populations will be present in each area. However, populations may be small or highly fragmented. In such cases, appropriate measures, such as translocation, should be implemented to increase the abundance and distribution of Gunnison's prairie dog within the focal area.

Without specific information on effective population size, maintenance of genetic diversity within each focal area may be addressed by setting a minimum population size of 500 (Soulé, 1980), with periodic movement of individuals between isolated colonies, where appropriate. However, meeting the ecological viability goal

likely will require larger population sizes. Reported densities of persistent Gunnison's prairie dog colonies range from 12 to 140 per acre and a density of 74 per acre was reported as high in the Moreno Valley in New Mexico (*cf.* section 2.4.5). Therefore, minimum population density in focal areas should be 12 prairie dogs per acre.

Existing populations of Gunnison's prairie dog should be augmented, and new populations established, where appropriate, through translocation of Gunnison's prairie dogs. Augmenting existing populations should take the form of translocating prairie dogs to formerly inhabited areas near existing prairie dog colonies to increase the size and spatial extent of colony complexes within focal areas and corridor habitats. When focal areas and connecting habitats are established, specific locations that would benefit from translocating prairie dogs to augment existing populations or establish new populations can be identified.

Translocation of Gunnison's prairie dogs should be conducted by experienced, trained personnel using appropriate equipment and following an appropriate protocol (*e.g.* Truett *et al.*, 2001; Appendix A). Guidelines regarding source populations and appropriate release sites for those animals will be developed to ensure preservation of genetic diversity. An appropriate starting point for defining areas within which Gunnison's prairie dogs should be moved is the genetic analysis by Hafner and others (2005), which identified three haplotype lineages in the state.

Several areas have already been established to receive Gunnison's prairie dogs and animals have been successfully relocated to these areas. These include an area on the west mesa of Albuquerque (Y. Boudreaux, Prairie Dog Pals, pers. comm., 9 November 2007), Sevilleta National Wildlife Refuge (Friggens *et al.*, 2006), and the El Malpais Prairie Dog Enhancement Area south of Grants (Bureau of Land Management, 2000: 2-108). Human relocation of Gunnison's prairie dogs has also occurred within the Pueblo of Sandia (Morales, 2007).

3.3.3.2 Management to Control Factors Affecting Probability of Persistence

In order to secure populations in each focal area, factors that negatively affect population growth or persistence must be addressed to the extent possible by management actions. These negative factors may include plague, shooting, poisoning, and habitat alteration. An assessment of each focal area should be made to identify management needs to ensure population persistence, with respect to the need for augmenting existing populations, establishing new populations, and removing or reducing threats to population persistence.

3.3.3.3 Implementing Conservation Management

There currently is no statewide program of plague monitoring in New Mexico. Monitoring is conducted in the Albuquerque area on a regular basis (J. Sheyka, City of Albuquerque, pers. comm., 7 November 2007). In other portions of the range, monitoring of plague by the New Mexico Department of Health is conducted only in response to potential human health concerns (P. Reynolds, New Mexico Department of Health, pers. comm., 28 January 2008). Application of an appropriate pesticide to control fleas may lessen the impacts of plague on prairie dog colonies (*e.g.* Hoogland *et al.*, 2004).

Currently, the NMDGF has no authority to regulate shooting or harvest of Gunnison's prairie dog. In order to be able to regulate shooting of

the species, it would have to be listed as a game animal under Chapter 17-2-3 of the New Mexico Statutes or as a state endangered species under the Wildlife Conservation Act.

Adding a species to the list of game animals under Chapter 17-2-3 can be initiated in either of two ways. Both require a change in state law and thus would be an action by the state legislature. A proposal to add Gunnison's prairie dog to the list of game animals could originate within the NMDGF or from outside the agency as a bill sponsored by a legislator. A proposal initiated by the NMDGF would have to be added to the agency's legislative agenda, which then would be forwarded to the Game Commission and, if still viable, then to the Governor. If the proposal has the approval of the Game Commission and the Governor, the NMDGF then works with the Legislative Council Service to identify a sponsor to introduce the legislation. The bill would then go through the standard process of being considered in committee, debated on the floor, sent to the other house, sent back for concurrence, then sent on to the Governor. The bill may be terminated at any point in this process.

A proposal to add Gunnison's prairie dog to the list of state-endangered species would originate from within the NMDGF and then be reviewed by the Game Commission. If the proposal moved forward, the Wildlife Conservation Act process requires substantial public involvement and analysis before the species could be listed. Once listed, any take of the species would be prohibited except for research or educational purposes authorized under a valid Scientific Collecting Permit.

In the absence of specific legal protection for Gunnison's prairie dog, conservation of the species is primarily a function of land management. For example, the Bureau of Land Management currently requires project-specific avoidance of prairie dog colonies in New Mexico, such as for pipeline construction (J. Sherman, Bureau of Land Management, pers. comm.).

Management guidelines should be developed for focal areas in cooperation with the land management authority based on the assessment described in section 3.4.2.2. Additionally, management recommendations for land uses in corridor areas and occupied habitats outside of focal areas should be developed which could be provided as comment on proposed actions. Projects proposed on federal lands with suitable habitat should include pre-project surveys for Gunnison's prairie dogs.

Lethal control of Gunnison's prairie dogs should be used only as a last resort, with translocation of animals being the preferred alternative. No lethal control should be conducted in focal areas and connecting habitats. Municipalities should be encouraged to develop prairie dog ordinances, similar to that developed by the City of Santa Fe (Ordinance No. 2001-35), which requires humane relocation of prairie dogs for all developments except single-lot, single-family residential development. A database of areas treated to control Gunnison's prairie dogs each year should be developed and maintained. These data would provide insights into geographic areas where conflicts between people and prairie dogs are highest and provide the basis for subsequent formulation of potential non-lethal alternatives to address problems, such as properly implemented translocation to appropriate areas (*cf*. Appendix A).

3.3.4 Conservation Initiative 3: Provide Habitat Connectivity

This initiative addresses management of intervening habitats between focal areas to allow for connectivity (Lomolino and Smith, 2003). Persistence of Gunnison's prairie dog colonies is positively associated with persistence of nearest neighboring colony (Wagner *et al.*, 2006).

When focal areas are identified, habitat corridors between focal areas with intervening landscapes of suitable habitat for Gunnison's prairie dog should be identified. No attempts should be made to establish connecting habitats to naturally disjunct focal areas (*e.g.* Valles Caldera National Preserve).

Long-range dispersal distances in Gunnison's prairie dog are not known. Most dispersal appears to be short-range, with the ultimate destination being a neighboring colony (*cf.* section 2.4.4). Consequently, a network of colonies across the landscape that connects focal areas would provide a means whereby areas can be recolonized following local extirpation and an avenue for gene flow. Maximum intercolony dispersal distance in black-tailed prairie dogs may be up to about six miles, with average intercolony dispersal distances on the order of one to two miles (Hoogland, 2006: 48-49). Based on this information, corridors connecting focal areas should have a target intercolony distance of no more than 6.0 miles, with an average intercolony spacing between 1.0 and 2.0 miles.

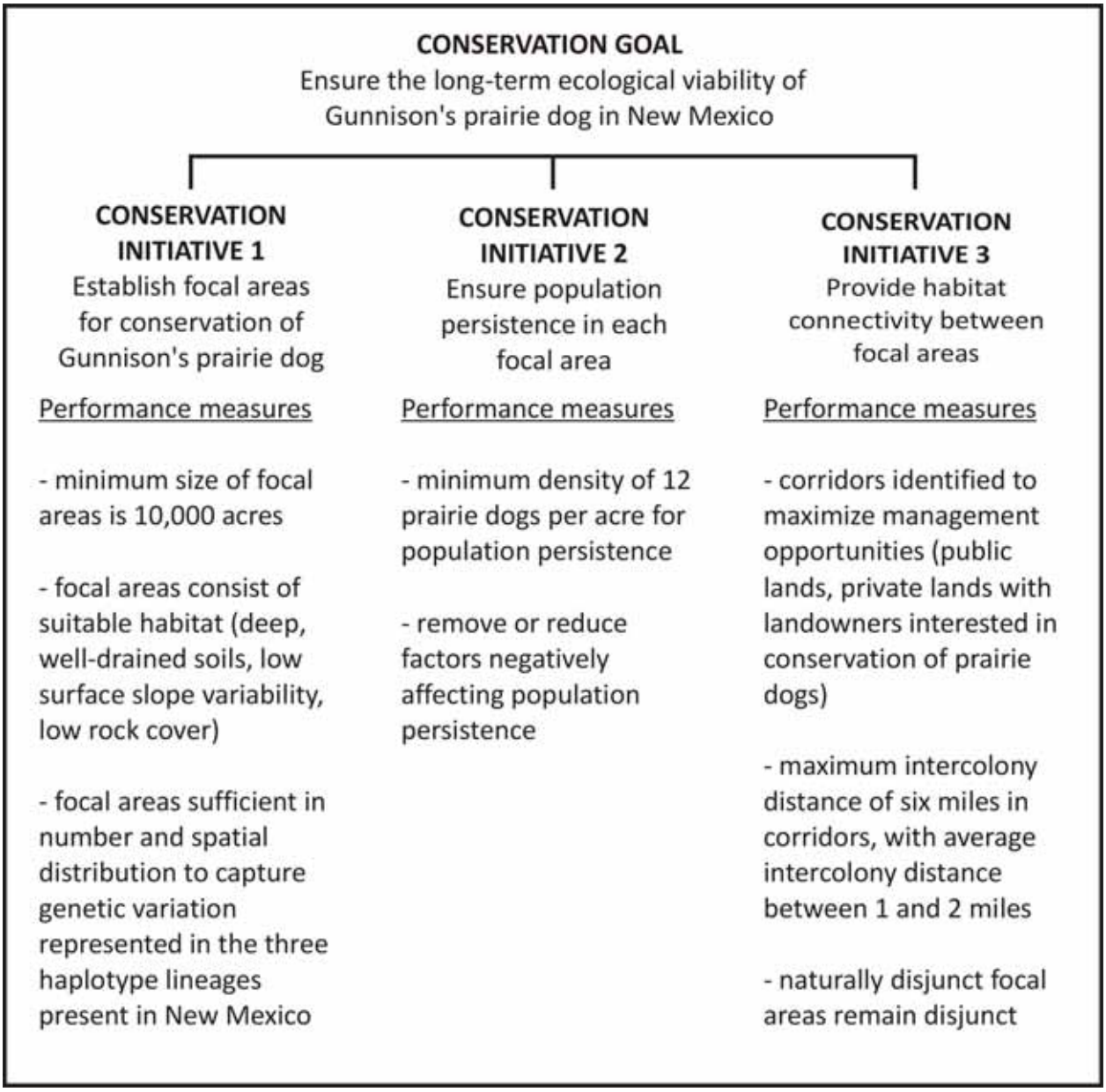
Locations of corridors should be identified to maximize management opportunities. In this light, corridors should include public lands and private lands of landowners who are interested in prairie dog conservation and who are willing to allow prairie dog colonies to persist on their lands. Some focal areas may not be connected to others via corridors because they are naturally disjunct (*i.e.* separated from other occupied areas by unsuitable habitat such as forest). These disjunct or near-disjunct areas are identified in section 1.5.

As with the focal areas, assessments of each connecting habitat should be made to identify management needs in coordination with the respective land management authority. Based on the assessments, management actions should be recommended to remove or reduce threats to the persistence of Gunnison's prairie dog in these areas. Monitoring of prairie dog abundance and distribution is necessary to determine if and when maximum and mean intercolony distance performance measures are met.

3.4 Summary of Conservation Approach

The general approach for achieving the conservation goal for Gunnison's prairie dog is depicted in Figure 5. Performance measures are summarized under each of the three conservation initiatives discussed above. These performance measures provide quantitative and qualitative benchmarks for assessing progress in implementation of the initiatives and, ultimately, achieving the conservation goal.

Figure 5. Diagram of the conservation approach. Performance measures are listed under each conservation initiative. See text for discussion of basis for conservation initiative and performance measures.



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4.0 CONSERVATION STRATEGY AND ACTIONS

This chapter identifies the goals, objective, objective parameters, issues, and strategies for conservation of Gunnison's prairie dog in New Mexico. An Action Plan is also included which identifies specific tasks to achieve the identified goal. The following conservation strategy and actions were developed in accordance with the long-range plan guidelines of the New Mexico Department of Game and Fish (Graves, 2002).

4.1 Goal

A goal is a general statement expressing a desired future condition; it is an outcome that we wish to be an actuality.

The goal of this plan is:

To ensure the long-term ecological viability of Gunnison's prairie dog in New Mexico where Gunnison's prairie dog occurs in sufficient numbers within populations and in a sufficient number of discrete populations within its known range in New Mexico that its persistence in the state will not be in jeopardy.

4.2 Objective

An objective is a quantitative, measurable, and time-limited restatement of the goal; it identifies a single, realistic outcome for a plan.

The objective of this plan is:

That by 2020, viable populations of Gunnison's prairie dog will be secure within the historic range in New Mexico in approximately 10 focal areas of conservation, that conservation and protective measures be in place in these focal areas, and that monitoring and research programs be fully established to provide information needed for management of the species in the state.

4.3 Objective Parameters

Objective parameters are means or approaches to establish measurable targets (*i.e.* the intermediate outcomes we believe will foster the stated objective). Parameters for achieving the objective of this Conservation Plan are:

Parameter 1: Conservation. Maintain or expand the existing distribution and abundance of the species where possible.

Parameter 2: Restoration. Repatriate the species where possible to locations within the historic range where extirpated, such as through translocation from sites where prairie dogs are not desirable.

Parameter 3: Research. Conduct surveys of distribution and monitor the status of existing colonies. Also, initiate scientific investigations of known or potential threats to the species and aspects of the natural history that are not known but may be relevant to conservation.

Parameter 4: Mitigation. Develop means to reduce conflict between human activities and Gunnison's prairie dog, where appropriate, and thereby reduce the need for lethal control and/or translocation.

4.4 Issues

Issues are situations that are expected to impede attainment of the objective. The following issues associated with attainment of the objective parameters were identified. The objective parameter(s) that each issue relates to is indicated at the end of the issue statement.

Issue 1: Information is lacking or inadequate on the historic distribution and abundance of the species in New Mexico, thereby making conclusions about its current status and trend in the state difficult. (Parameters 1 and 3)

Issue 2: Many aspects of the biology of the species in New Mexico or elsewhere are unknown, including the direct or indirect effects on species persistence resulting from disease, habitat alteration from development, population dynamics, population fragmentation, poisoning, and recreational shooting. The status of the two recognized subspecies and possible differences in the biology of montane versus lower elevation populations is largely unknown. (Parameter 3)

Issue 3: The species is not afforded any protection from take (poisoning, shooting) or habitat loss in New Mexico, except in areas where land ownership or management by government or private entities provides such protection. (Parameter 1)

Issue 4: The species is widely viewed as a nuisance or a reservoir for disease and its presence often conflicts with land uses such as farming, grazing, or urban/suburban development. Translocation of problem animals is frequently done where poisoning is inappropriate or undesirable, although no comprehensive approach to translocation has been developed for the state. (Parameters 2 and 4)

4.5 Strategies

Strategies are the broad approaches or interventions to be used to overcome a problem or take advantage of an opportunity. They are intentionally broad, directional, and nonspecific so as not to constrain the selection of actions for implementing them. The following strategies address each of the issues identified in the previous section.

Issue 1: Information is lacking or inadequate on the historic distribution and abundance of the species in New Mexico, thereby making conclusions about its current status and trend in the state difficult.

Strategy 1: Although the historic distribution and abundance is impossible to reconstruct completely, available information will be compiled and evaluated for use in making estimations. Initiation of surveys and monitoring of existing populations will provide necessary information for future status and trends.

Issue 2: Many aspects of the biology of the species in New Mexico or elsewhere are unknown, including the direct or indirect effects on species persistence resulting from disease, habitat alteration from development, population dynamics, population fragmentation, poisoning, and recreational shooting. The status of the two recognized subspecies and possible differences in the biology of montane versus lower elevation populations is largely unknown.

Strategy 2: Initiate research work to address the natural history and effects of known or potential threats to the species, either in New Mexico or in other states where the species is present.

Issue 3: The species is not afforded any protection from take (poisoning, shooting) or habitat loss in New Mexico, except in areas where land ownership or management by government or private entities provides such protection.

Strategy 3: Investigate the potential for some level of protection for the species in New Mexico by involving all stakeholders in the process and assessing the possible ramifications of any protective measures on human activities. Implement protection and conservation on lands where human conflict is minimal or absent.

Issue 4: The species is widely viewed as a nuisance or a reservoir for disease and its presence often conflicts with land uses such as farming, grazing, or urban/suburban development. Translocation of problem animals is frequently done where poisoning is inappropriate or undesirable, although no comprehensive approach to translocation has been developed for the state.

Strategy 4: Initiate efforts to provide information to the public on the species, develop methods to reduce human-prairie dog conflicts, and develop a state-wide approach for conducting translocation where conflicts cannot be resolved.

4.6 Action Plan

This section identifies specific tasks to be carried out to address the strategies identified in the previous section. Actions may be implemented independently or cooperatively by NMDGF, New Mexico Prairie Dog Working Group, land and resource management agencies, local and tribal governments, non-governmental organizations, or private landowners, as appropriate. Some strategies have been combined here for clarity and because of redundancy of actions. The original strategies are identified parenthetically following each action statement.

A. Maintain and where possible enhance the current distribution of the species in New Mexico (Strategy 3)

1. To ensure that large, contiguous populations are maintained and protected from eradication, develop a "focal area" approach to conserving Gunnison's prairie dog in New Mexico (*cf.* section 3.3.2) using the following steps:

a. Identify potential focal area locations in New Mexico consisting of at least 10,000 acres of contiguous suitable habitat, where the species is extant, and where long-term conservation can be achieved through land management practices or conservation easements. Such areas may also be suitable for conservation of other wildlife species associated with prairie dog colonies and could be similarly protected from human activities.

b. Initiate discussions with land management agencies or other land owners regarding the potential for development of focal areas on their lands.

c. Develop necessary agreements and plans for the management and monitoring of focal area colonies.

d. Investigate the potential for using focal areas as translocation release sites.

e. Investigate and identify opportunities for establishing habitat connectivity between focal areas.

f. Establish focal areas.

g. Initiate monitoring of focal areas and devise

an adaptive management approach to long-term management of the areas based on information provided by monitoring and on changing conditions in surrounding areas.

h. Dusting may be implemented at colonies where plague is a concern.

2. Investigate and identify funding sources to support the above-referenced activities.

3. Investigate the necessity for protection of the species, either through legislative change that would provide NMDGF authority or through existing law, particularly the New Mexico Wildlife Conservation Act.

B. Improve our current knowledge about known or potential threats to the species in New Mexico, its natural history, and the biological status of the two recognized subspecies (Strategy 2)

1. Working in conjunction with other states within the range of Gunnison's prairie dog (*i.e.* Arizona, Colorado, and Utah), identify research projects that can be funded and carried out within New Mexico to address questions concerning the biology and conservation of the species, including:

a. Studies of the genetic relationships among populations in different geographic locations and in montane versus lower elevation sites.

b. Presence and life history characteristics of sylvatic plague in colonies.

c. Effects of oil and gas and other development projects on the habitat and life history of the species.

d. Effects of livestock grazing and agricultural development on the habitat and life history of the species.

e. Effects of Gunnsion's prairie dog on native or altered habitat.

f. Relationship of Gunnison's prairie dogs to other wildlife species that co-occur such as burrowing owl, ferruginous hawk, mountain plover, etc. (this research would provide an opportunity for collaborative projects with other wildlife researchers).

g. Effects of recreational shooting on the behavior, persistence, and life history of colonies.

h. Effects of lethal removal (*e.g.* poisoning) on metapopulations and rates of recolonization.

i. Other research not identified above.

2. Investigate and identify funding sources (*e.g.* NMDGF, land management agencies, private sources) to support research on the species in New Mexico.

C. Develop and implement monitoring and survey efforts to assess the current status and future trends of the species in New Mexico (Strategies 1 and 2)

1. Continue occupancy modeling surveys of established survey plots in New Mexico (initiated in 2007) once every three years and concurrently with parallel surveys in Colorado, Arizona, and Utah.

2. Develop a protocol for collection and storage of data on extant colonies of Gunnison's prairie dogs in New Mexico, potentially as a cooperative effort between NMDGF and Natural Heritage New Mexico, with provisions for the security of

private lands data.

3. Compile data on current colonies of Gunnison's prairie dogs in the state and maintain a database of all such localities.

4. Work with New Mexico Department of Health, City of Albuquerque Environment Division, U.S. Department of Agriculture - Animal and Plant Health Inspection Service, and possibly other entities to develop an approach to identify, collect, and compile data on sylvatic plague occurrences in Gunnison's prairie dog in New Mexico.

5. Investigate and identify funding sources (*e.g.* NMDGF, land management agencies, private sources) to support the above-referenced activities on the species in New Mexico.

D. Develop better information on conflicts with human activities and cooperative relationships with stakeholders and other entities with concerns about the species (Strategy 4)

1. Through the New Mexico Prairie Dog Working Group and its participants, identify locations and actions where conflicts between human activities and Gunnison's prairie dog require eradication or translocation.

2. Develop informational materials for dissemination to property owners and land managers with prairie dog conflicts, including contacts, available resources for controlling or removing prairie dogs, etc.

3. Investigate and identify funding sources (*e.g.* NMDGF, land management agencies, private sources) to support the above-referenced activities on the species in New Mexico.

E. Pursue translocation of the species where appropriate and other methods to avoid or mitigate conflicts between the species and human activities (Strategy 4)

1. Through the New Mexico Prairie Dog Working Group, develop standardized protocol(s) for the capture, handling, and translocation of Gunnison's prairie dogs from areas where conflicts with human activity cannot be otherwise resolved.

2. To coordinate translocation activities in New Mexico, develop a computerized database of known or proposed translocation sites, individuals and organizations involved in translocation, and numbers of animals moved.

3. Initiate research into methods other than translocation to avoid or reduce human-prairie dog conflicts, including establishment of buffer zones through the use of exclusion fencing, habitat modification, and other techniques.

4. Investigate and identify funding sources (*e.g.* NMDGF, land management agencies, private sources) to support the above-referenced activities on the species in New Mexico.

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APPENDIX A Capture and Translocation Protocol

The following guidelines for capture and translocation of prairie dogs was provided by Yvonne Boudreaux of Prairie Dog Pals, Albuquerque, New Mexico, 19 November 2007.

1. CAPTURE

The capture and relocation of prairie dogs should only be undertaken as a last resort to insure the survival of the colony. There are only two acceptable and humane methods of capturing prairie dogs: flushing and trapping. The use of vacuum equipment is not humane nor effective and should be prohibited for all species of prairie dogs.

1a. Flushing Method

If the flushing method is used, then the following standards should be met:

• A water tanker and attached pump capable of delivering water at a suitable pressure to create foam. A vehicle to tow the tanker. Hoses, nozzles, towels for drying the prairie dogs, saline solution for rinsing out soap and grit from the eyes, dye for marking families, sufficient number of kennels filled with timothy hay for holding the prairie dogs and family groups, duct tape and Sharpies for keeping records of the prairie dogs captured.

• The soap to water ratio should be not less than 7 liters to 500 gallons of water which creates a highly foamy (less watery) mixture. The soap should be biodegradable and non-toxic such as Crystal White by Palmolive.

• Fresh, clean water should be used for flushing. If tertiary treated or river water is used, consideration should be given to treating the water with a very low concentration of chlorine or other suitable chemical. The use of contaminated water presents a risk to both the prairie dog and people.

• The water pressure should be high enough to create a high volume of foam into the burrow with the least amount of water used for the safety of the prairie dogs.

• The use of a foam-enhancing device such as a tube filled with baffles, to increase the amount of foam, is recommended.

• The prairie dog should be captured by hand or net while working at the flushed burrow. Every effort should be made to prevent a flushed prairie dog from exiting without capture and escaping to another burrow.

• All prairie dogs exiting the same burrow should be marked with a non-toxic dye, such as food coloring, to identify family groups.

• The water temperature used for flushing should not exceed 90 degrees or fall below 65 degrees for the safety of the prairie dogs. Higher temperatures can occur in the length of hose if water is allowed to remain in the hose for extended periods. This high temperature water should be purged before resuming flushing. During early spring the temperature of the supply water should be checked to ensure that it is not too cold for flushing.

• Prairie dogs should be placed in sturdy kennels with wire windows and doors that cannot be chewed through allowing escape.

• Kennels should be filled with fresh timothy (grass hay) to calm the prairie dogs and provide some natural bedding.

• The number of prairie dogs placed in a kennel should not cause crowding. Large kennels can accommodate 15 to 20 prairie dogs depending on

the size of the prairie dogs. Large males should be segregated to avoid fighting, but identified to indicate the family group from which it came so that they can be reunited with the family group during relocation.

• Kennels should be marked to identify the area from where the prairie dogs were captured as well as, the number, sex and age (adult/juvenile) of the prairie dogs that the kennel contains. Duct tape and Sharpies provide a waterproof durable record for the kennel for the day.

• Kennels should be kept out of direct sunlight to avoid heat stress.

• Kennels should be covered with wet towels if ambient temperature exceeds 90 degrees. On days when morning temperatures exceed 90 degrees consideration should be given to a midday transfer of the prairie dogs to the staging facility to avoid heat stress.

• Prairie dogs should be dried off completely after flushing to avoid hypothermia or shock.

• Eyes should be treated with saline solution to remove any soap solution or grit.

• A field exam should be conducted to separate any injured, wounded or disabled prairie dogs to a small treatment carrier for later first aid.

• Prairie dogs should be transported in a closed, air-conditioned (or appropriately heated during the winter) vehicle.

• The capture crew must keep accurate records because an imbalance in the male to female ratio could indicate that:

- An absence of female captures during the pre breeding season may indicate that pregnancy has already occurred. The appearance of enlarged nipples may help to indicate that the females are pregnant.

- Post pup season that some nursing mothers and pups are not yet mobile.

Capture can occur during the following periods:

• After emerging from hibernation but before breeding season (approximately March).

• 10 days after the pups have emerged from the burrows and are of a sufficient mobility and size to safely tolerate relocation (approximately mid June).

• Up to two months prior to hibernation (mid September) depending on the weather and the elevation.

• Timing of capture in the day should not occur before prairie dog families, especially with newly emerging pups are observed above ground for the day.

1b. Live Trap Capture Method

Live traps should be single or double door entry and size appropriate for the species. Prairie dog traps are approximately six to eight inch square at the doors and between eighteen to twenty-four inches long.

• The trapper should survey the site to plot out the family groups prior to capture.

• The trapper should make notations of active burrows and prairie dog activity (with binoculars) to assess family groups.

• The number of traps used should be verified before setting, during, and at final collection.

• All traps should be set for 100% visibility at all times.

• Traps should be set near the active burrows.

• Traps should be "planted" so the bottom is slightly buried in dirt. Consideration should be given to staking or anchoring the traps if they are likely to be upturned by trap-savvy prairie dogs.

• Each trap should be tested to verify it is in working order when baiting.

• Each trap should be baited for the requirements of the specific site.

• "Teaser" food may be used as appropriate. Teaser food, if used, should be placed to lead up to the entrance of the trap.

• Trappers should allow fifteen to thirty minutes for the prairie dogs to resume activities after disturbances.

• The traps can be relocated at appropriate intervals (disturbances, picking up a trap) if prairie dogs are inactive in one area.

• The site or the traps should never be left unattended.

• The trapper should immediately walk, not run (not directly to avoid panicking the prairie dog), towards the trap with the captured prairie dog and cover the trap with a heavy towel.

• The trapper should carry the covered trap by the handle or the ends without extending fingers through the wire.

• The prairie dog should be transferred from the trap to the hay-filled kennel using a second person as a spotter by inserting trap into the kennel set on its end and then opening the bottom door of the trap (two person job).

• Kennels should be marked to quantify the area from where the prairie dogs were captured as well as number, sex and age (adult/juvenile) of the prairie dogs that the kennel contains. Duct tape and Sharpies provide a waterproof durable record for the kennel for the day.

• Individual prairie dogs should be marked with food coloring if more than one family is placed in the same kennel.

• Trappers should place holding kennels in a protected location away from exposure to the elements and potential passers-by.

• Trappers should collect all traps at the end of the session confirming and reconfirming the numbers of traps used. Left over bait may be left near burrows for remaining prairie dogs.

2. STAGING

Prairie dogs should be staged for a period of not less than one week prior to relocation, as long as health and weight conditions are good. Prairie dogs captured from a day's trapping or flushing requires several steps of processing before being transferred into the holding facility.

• All used hay from the kennels should be removed, bagged and disposed of.

• All prairie dogs are to be liberally dusted with Permethrin, or any compound that contains Permethrin in sufficient quantities to kill fleas.

• The prairie dogs should be allowed to move about in the emptied kennel for approximately 15-20 minutes to allow the prairie dogs to shed any parasites. Once most of the dust has been shaken

off, the prairie dogs are then ready to be transferred to the holding tank.

• Prairie dogs are to be transferred to the timothy hay filled livestock tanks. Fresh timothy hay should be placed in the livestock tank to approximately half the height of the tank to allow transferred prairie dogs to burrow below for their comfort. Alfalfa is not recommended because the curling nature of the leaf as it dries can harbor bacteria.

• Livestock tanks should be not less than 30" high. Custom fitted hardware cloth lids (not chicken wire) framed in wood should be constructed to prevent any prairie dog from escaping by clinging to the hardware cloth lid and nosing through the gap. Gallon jugs filled with water placed on cross panels may be used to weight lids. Livestock tanks may be placed on furniture dollies to facilitate the ease of processing, feeding, and transfer.

• The prairie dogs should be processed into the staging facility as follows:

• The prairie dogs should be examined using a "2-4-20" examination protocol; 2 eyes in good condition, 4 canine teeth in straight alignment and proper length, 20 toes without wounds, scrapes or broken toe nails. The body weight and condition should be noted at the same time. Any prairie dogs with wounds, injuries or chronic disabilities should be noted and treated accordingly. Prairie dogs that fit into this compromised category should be placed into a treatment cage for first aid and monitoring. Processing staff should use Betadyne, hydrogen peroxide, etc., or veterinary care as required.

• The age and sex of the prairie dogs should be noted again, checked against the kennel tally, and along with the capture date and location, recorded on a temporary tape strip (duct tape) or clipboard attached to the livestock lid. The total number of prairie dogs categorized by adult male/female, juvenile male/female should be checked, verified, and recorded to assist in determining the amount of food dispensed.

• The prairie dogs should be staged within family groups with one exception. Adult males should be separated from the females and juveniles while in the staging facility and noted accordingly regarding the family group from which they originated. Any special observations or conditions should be noted and dated on the temporary tape strip or clipboard.

• Prairie dogs may be fed a combination of apples, carrots, sunflower seeds and timothy hay while being prepared for relocation at the staging facility. Underweight or stressed prairie dogs should have their diets supplemented with corn, high protein food such as unsalted peanuts in the shell or other dietary formulae to encourage growth. Food should be provided in gnaw-proof, tip-proof containers to avoid contaminating fresh dry hay with moist food.

• Bowls of water or water dispensers are not required, and are in fact, inappropriate, as spillage may contaminate the hay. Sufficient fruit and vegetables, in appropriate containers provide sufficient moisture for this drought tolerant species.

• The fruit and vegetables provided should comprise at least 4 oz per prairie dog per day, (hence the accurate head count requirements per livestock tank), plus all the timothy hay and sunflower seeds the family groups could consume. The formula of 4 oz per prairie dog per day is appropriate until end of season relocations are staged. Staged prairie dog family groups being relocated near the end of the season can be

observed to consume less food, if they are already of a sufficient body weight and condition for hibernation.

• As end of season relocations are staged, the moist food provided may be reduced to approximately 2-3 oz per prairie dog per day, with no decrease in the amount of sunflower seeds or hay provided.

• Every precaution should be taken to avoid attracting flies to the moist food and resulting feces. Fly strips/traps should be hung at appropriate intervals to minimize the chance of prairie dogs being compromised by fly attacks.

• Day-old food is to be removed and replaced with fresh food daily.

• Spoiled hay (wet, contaminated, flattened) is to be removed and replaced with fresh hay as needed until final transfer to the relocation site.

3. SITE DEVELOPMENT

An appropriate site should be selected for the relocation area. There are a number of factors to consider such as:

• Appropriate soil conditions

• Appropriate short grass vegetation

• A proper mix of prairie grasses and conditions

• Suitable conditions for predators, rolling countryside, some trees for raptors

• Good drainage

• Absence of an active prairie dog population (abandoned burrows are acceptable)

• Documented historical prairie dog habitat

• No political or legal constraints

Definitions:

Cage Cap A six sided hardware-cloth enclosure approximately 12" square and 24" long with a hole in one side that fits over the tubing. The cage cap is typically filled 1/2 full with timothy hay when in use. The six sided cage cap is replaced by a 5 sided or bottomless cage cap during the relocation process when the prairie dogs are ready for release.

Tubing 4" corrugated plastic tubing that connects the nesting box to the surface.

Nesting box A container, usually a 15-25 gallon nursery pot (injected not blow molded) that serves as a temporary residence for the prairie dogs during the relocation process. The open end of the pot is covered with hardware cloth and 2, 4" slotted holes, are cut into the side and top to accommodate the 4" tubing. Fill the nesting box 1/2 full of timothy hay before it is set in place. The hay will act as bedding for the prairie dogs. The pot is set top down into the excavated hole.

End cap Plastic cap used to close the tubing and prevent access by other prairie residents.

Once an area has been selected the site is prepared as follows.

• Develop a plan that reflects the areas, coteries, and number of burrows for the prairie dogs that are to be relocated.

• Using a backhoe, excavator, or auger dig out a subterranean space for the artificial burrows. The bottom of the hole should be approximately 4' deep. This will ensure that the nesting box is

sufficiently buried to maintain constant temperature and to reduce the possibility of being dug up by coyotes or wild dogs.

• Set the artificial burrow and backfill. Restore vegetation or plant new grass as appropriate to the area. Cap the tubes to prevent occupation by unwanted species.

4. RELOCATION

Prairie dogs that have been observed within their family groups for not less than one week and meet the health, weight, and body condition requirements suitable for relocation may be released to the artificial burrows at the relocation site. Juveniles relocated within their family groups must be a minimum of 350 grams (14 ounces) before being relocated.

• The prairie dogs are health checked one last time, placed into marked kennels according to their family groups at the staging area then transported to the relocation site. Once at the site, the prairie dogs are placed into the tubing leading to the nesting box one by one. Ensure that the prairie dogs actually go down the tube and into the nesting box as sometimes they will stop and block the tubing. When this occurs either use the other tube or wait until the prairie dog has moved down the tube. Do not allow them to back up in the tubing as they can suffocate.

• After each group is placed into their artificial burrow, an above ground cage cap is attached to the tubing to contain the animals. Sufficient favorite foods are placed in containers in the cage cap. The cage cap should be fixed in place using stakes. This will prevent the cage cap from becoming dislodged prematurely.

• The prairie dogs remain in these structures for up to one week. Daily feeding and replenishing of the hay is conducted.

• When the time is appropriate, the cage caps are removed from the tubing leading to the artificial burrows. They are replaced with a 5 sided or bottomless cage cap that will allow the prairie dogs to dig out while still affording them some protection. A minimum of two days of intensive monitoring is required to insure the prairie dogs commit to digging home burrows within the accepted release area.

• Predator monitoring and non-lethal discouragement may be conducted, such as installing fencing around the release area.

• Regular monitoring is to be conducted while daily feeding is ongoing.

• Maintenance efforts may require regular flea dusting around burrows, and supplemental feeding may be necessary during drought conditions.