GUNNISON'S PRAIRIE DOG CONSERVATION ASSESSMENT

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EXECUTIVE SUMMARY

On 23 February 2004, the U.S. Fish and Wildlife Service was petitioned to list the Gunnison's prairie dog (*Cynomys gunnisoni*) under the federal Endangered Species Act. After the petition was received, the White-tailed and Gunnison's Prairie Dog Working Group of the Western Association of Fish and Wildlife Agencies' 12-state Prairie Dog Conservation Team began work on a Conservation Assessment for the Gunnison's prairie dog. The Conservation Assessment was intended to evaluate the rangewide population status of the species and identify factors limiting conservation. This information would then be incorporated into a comprehensive conservation strategy that could be adopted by all states within the Gunnison's prairie dogs range.

Data used for the Conservation Assessment came from many sources, including published literature, evaluation of potential black-footed ferret (*Mustela nigripes*) habitat for possible reintroduction sites, and state and federal unpublished reports. These sources provided information to evaluate gross changes in occupied habitat and to examine current management of Gunnison's prairie dogs within each state of occurrence (Arizona, Colorado, New Mexico, and Utah). In addition, a Geographic Information Systems spatially detailed Predictive Range Model for the Gunnison's prairie dog was produced. This model was developed to determine the number of hectares comprising the gross and predicted ranges of the species, evaluate the percent of range being impacted by anthropogenic disturbances, act as a first-cut guide in locating appropriate areas for more intensive field surveys, and identify rangewide habitat corridors for genetic maintenance of the species. Finally, a risk assessment was completed based on the 5 criteria used by the U.S. Fish and Wildlife Service when evaluating a species' potential for listing under the Endangered Species Act.

This assessment of Gunnison's prairie dog populations suggests a decline in occupied habitat. However, these declines could not be quantified, due to a history of incomplete and inconsistent surveys, variable time periods between estimates at specific sites, and information that was anecdotal at best. In addition, information regarding the status of Gunnison's prairie dogs was limited mainly to public lands, as trespass restrictions inhibited field surveys on private and tribal lands. Finally, current occupied habitat and densities could not be estimated because (1) none of the states within the Gunnison's prairie dog range have completed exhaustive mapping surveys and (2) standardized monitoring techniques to evaluate long-term population trends are still being developed. Thus, this Conservation Assessment used the best available data to evaluate the rangewide population status of the species, recognizing that the information represents a minimum estimate of Gunnison's prairie dog distribution.

After careful analysis of the information presented in the Conservation Assessment, the Western Association of Fish and Wildlife Agencies and its Prairie Dog Conservation Team and White-tailed and Gunnison's Prairie Dog Working Group concluded that, although continued active management and development of a comprehensive conservation strategy for the species and its habitat are needed, listing of the Gunnison's prairie dog under the Endangered Species Act is not warranted at the current time. The basis for these conclusions is: 1) all 4 states within the Gunnison's prairie dog range currently are managing for conservation of the species by developing monitoring protocols, instituting shooting closures, and incorporating it in their

Comprehensive Wildlife Conservation Strategies; 2) there is lack of quantifiable data to evaluate the status of the species on tribal and private lands that together, comprise 73% of the predicted range; 3) the Western Association of Fish and Wildlife Agencies is developing a rangewide prairie dog conservation strategy (for all species, including the Gunnison's) that will be adopted in January 2006; and 4) many of the facets identified within the Conservation Assessment that might negatively affect the Gunnison's prairie dog are already being addressed by states and federal agencies, such as rangeland improvements, invasive weed control programs, and plague research and monitoring. Because of the programs already in place and because a rangewide conservation strategy for the species will be completed by January 2006, the states believe that listing of the species to protect it from further declines is not warranted. Regardless, the Western Association of Fish and Wildlife will continue to encourage Gunnison's prairie dog states to reduce and eliminate current and potential impacts from anthropogenic sources and to explore agreements to monitor and control plague on a rangewide scale.

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INTRODUCTION

Five species of prairie dog inhabit western North America, with each differing with regard to current federal conservation status. The Mexican prairie dog (MPD; *Cynomys mexicanus*) is federally listed as endangered in Mexico, the Utah prairie dog (UPD; *C. parvidens*) is listed as threatened, and the black-tailed prairie dog (BTPD; *C. ludovicianus*) was formerly a candidate species. On 11 July 2002, the white-tailed prairie dog (WTPD; *C. leucurus*) was petitioned to be listed as threatened under the Endangered Species Act (ESA; Center for Native Ecosystems 2002). However, the U.S. Fish and Wildlife Service (USFWS) produced a negative 90-day finding for that species. On 23 February 2004, the Gunnison's prairie dog (GPD; *C. gunnisoni*) was the last of the 5 species petitioned to be listed under the Endangered Species Act (Forest Guardians 2004). Like the WTPD petition, the GPD petition cited habitat loss/conversion, shooting, disease, a history of eradication efforts, and inadequate federal and state regulatory mechanisms as threats to the long-term viability of this species.

Under auspices of the Western Association of Fish and Wildlife Agencies (WAFWA), the 11 states within the range of the BTPD began a multi-state conservation effort in 1998, with formation of the BTPD Conservation Team (BTPDCT). The team developed a rangewide Conservation Assessment and Strategy for the BTPD (Van Pelt 1999), which documented that conservation for all prairie dog species was needed. In addition, the team published an addendum to the Conservation Assessment and Strategy, entitled *A Multi-State Conservation Plan for the BTPD in the United States* (Luce 2003).

In March 2002, the BTPDCT was expanded to include WTPDs and GPDs. Expansion was warranted because many of the management issues, such as survey protocols, identification and ranking of threats, regulation changes, recreational shooting, management plan frameworks, relocation techniques, and long-term monitoring, were considered similar for all prairie dog species. State wildlife agency biologists from the WTPD and GPD states, all of which, except Utah, were already members of the BTPDCT, formed a White-tailed and Gunnison's prairie Dog Working Group (Working Group) that agreed to emulate, where possible, methodologies and expertise developed during the BTPD multi-state conservation effort. The BTPDCT was subsequently (September 2002) renamed the Prairie Dog Conservation Team (PDCT), and the WAFWA Interstate Coordinator's duties were expanded to include coordination of conservation for these 3 prairie dog species. The PDCT continues to meet annually to evaluate and discuss rangewide management goals for the 3 species of prairie dogs.

Following the process used to address rangewide conservation of BTPDs, WAFWA agreed at its July 2002 meeting to develop a rangewide Memorandum of Understanding (MOU) that would implement a similar collaborative effort and result in Conservation Agreements for WTPDs and GPDs. Though this MOU was never completed, the 3 species of prairie dogs are included in

WAFWA's Shortgrass Prairie MOU approved for state signatures in July 2005. Specific conservation objectives in the MOU are:

1. Complete a white-tailed prairie dog (WTPD) conservation assessment and a Gunnison's prairie dog (GPD) conservation assessment by September 30, 2005.
2. Develop WTPD and GPD conservation strategies and integrate them with WAFWA's existing black-tailed prairie dog conservation strategy to complete a rangewide prairie dog conservation strategy by December 31, 2005.
3. Develop state-specific prairie dog management plans, or integrate prairie dog management components into other state-specific and/or regional management plans, as appropriate, by December 31, 2007.
4. Develop a cohesive shortgrass prairie conservation strategy by December 31, 2009 that integrates the appropriate components of companion efforts for the WTPD, GPD, BTPD, black-footed ferret, swift fox, burrowing owl, ferruginous hawk, mountain plover, Swainson's hawk, loggerhead shrike, and as appropriate and feasible, other shrub and grassland species in the Western Great Plains.
5. Coordinate with, establish, or otherwise convene various conservation teams, work groups, etc. as necessary to implement this MOU.
6. Cooperate to maintain and enhance, to the extent practicable, the populations and habitats of the species addressed pursuant to this MOU.
7. Coordinate with, as necessary and appropriate, companion conservation efforts in the United States, Canada, and Mexico.
8. Enhance awareness of the Signatories and local communities, industries, nongovernmental organizations, and private individuals regarding this conservation effort, and encourage and enhance their participation in partnerships to accomplish mutually agreeable conservation objectives.
9. Remain aware of, and inform WAFWA on, any legal, regulatory, or policy action associated with the species addressed pursuant to this MOU.

On 4 March 2003, WAFWA's President Dr. Jeff Koenings sent letters to USFWS Regional Directors Dale Hall (Region 2) and Ralph Morgenweck (Region 6) detailing the states' intent to prepare Conservation Assessments for the WTPD and GPD. WAFWA proposed to the USFWS that the states take the lead role in writing the Conservation Assessments. The objectives put forth by Working Group to be incorporated into both the WTPD and GPD Conservation Assessments were:

1. Summarize and evaluate the current distribution and population status of the WTPDs and GPDs across their gross historic range.
2. Develop Predicted Range Models.
3. Identify specific threats impacting the viability of these species.
4. Identify management and research options for consideration in the future development of a conservation strategy.

Information used to meet the above objectives included published literature, Environmental Impact Statements for energy clearances on black-footed ferret habitat, and state and federal reports. Temporal population changes and gross spatial changes in occupied habitat across the ranges were examined, and current and historic management of WTPDs and GPDs within each state were evaluated. Finally, a risk assessment for each species, based on the 5 listing factors used by USFWS, was completed.

TAXONOMY

The family Sciuridae is widespread. It includes 49 genera and 262 recent species, such as tree and ground squirrels, chipmunks, marmots, and prairie dogs. Prairie dogs, like ground squirrels, have characteristic flattened heads, straight claws, short tails, and unspecialized ankles (Lawlor 1979). As a group, prairie dogs diverged from ground squirrels about 1.8 million years ago, during the late Pliocene or early Pleistocene (Clark et al. 1971).

Today, there are 5 extant species of prairie dogs, all of which inhabit western North America and belong to the genus *Cynomys*. The genus has been divided into 2 subgenera based on pelage color and tail length (Clark et al. 1971, Pizzimenti 1975). The WTPD, GPD, and UPD comprise the subgenus *Leucocrossuromys*, distinguished by relatively short, white-tipped tails, weaker social organization, and less specialized dentition and morphology than the black-tailed forms (Pizzimenti 1975). The black-tailed subgenus *Cynomys*, which includes the BTPD and MPD, has characteristic long, black-tipped tails and is more specialized morphologically, behaviorally, and ecologically (Pizzimenti 1975). The BTPD occupies short or mixed grass prairies across much of the Great Plains, whereas the MPD is restricted to a small area of grasslands in northeastern Mexico (Goodwin 1995). The *Cynomys* subgenus shows the greatest divergence from ancestral ground squirrel stock (Pizzimenti 1975).

Within the subgenus *Leucocrossuromys*, the GPD is genetically, morphologically, and behaviorally distinct from the other white-tailed species (Pizzimenti 1975). Genetic analysis of populations of WTPDs and GPDs in Ouray, Delta, and Montrose counties in Colorado confirmed that the genetic makeup of the 2 species is unique (Pizzimenti 1975).

Some taxonomists divide the GPD into 2 subspecies: the Gunnison's (*C. g. gunnisoni*) and the Zuni (*C. g. zuniensis*; Hollister 1916). *C. g. gunnisoni* is thought to be confined to the Rocky Mountain region of central and south-central Colorado and northern New Mexico. *C. g. zuniensis* ranges from extreme southeastern Utah, northwestern, and west-central New Mexico, and southwestern Colorado to the San Francisco Mountain Region and the Hualapai Indian Reservation in Arizona (Hollister 1916). Pizzimenti (1975), however, concluded that recognition of this subspecies is not warranted because the division by Hollister was primarily based on coloration and size incongruities. Pizzimenti's (1975) genetic analysis indicated relative homogeneity for chromosomes and serum proteins, and morphological analyses revealed essentially smooth geographic gradients for all characters across sub-specific boundaries. Currently, a genetic analysis is being conducted through a cooperative agreement between the USFWS and the New Mexico Museum of Natural History and Science to clarify the taxonomic status of this species (Knowles 2002).

DESCRIPTION

The GPD is the smallest species within the subgenus *Leucocrossuromys* (Pizzimenti 1975). Its weight varies seasonally, ranging from 250 to1350 g (0.6-3.0 lb; Fitzgerald et al. 1994). Body mass is sexually dimorphic, with males typically heavier than females (Hoogland 2003). Total body length ranges from 300 to 390 mm (11.8-15.4 in), and tail length measures 40 to 64 mm (1.6-2.5 in; Fitzgerald et al. 1994, Hoogland 1996). Its overall coloration is darker than *C. leucurus* and *C. parvidens* – the top of the head, cheeks, and superciliary line are darker than the rest of the body, although they do not exhibit the striking facial pattern found in the other 2 white-tailed species (Fitzgerald et al. 1994).

DISTRIBUTION

GPDs occur along the Colorado Plateau in southeastern Utah, southwestern Colorado, northern Arizona, and northwestern, west-central, north-central, and central New Mexico (Fitzgerald et al. 1994; Goodwin 1995; Knowles 2002; Fig. 1). They inhabit shortgrass and mid-grass prairies, grass-shrub habitats in low valleys, and mountain meadows. They occur at elevations ranging from 1536 m (5039 ft) in the Chihuahua grasslands of New Mexico (Davidson et al. 1999) to 3660 m (12,008 ft) in the Rocky Mountain region of Colorado (Pizzimenti and Hoffman 1973; Fitzgerald et al. 1994).

Annual precipitation within the range of the GPD varies from 10 to 50 cm (3.9-19.7 in), with most precipitation falling as snow in the winter months and as monsoonal rains in the summer months (Lechleitner et al. 1962; Shalaway and Slobodchikoff 1988; Navajo Natural Heritage Program 1996; Cully 1997; Davidson et al. 1999; Bangert and Slobodchikoff 2000). Diurnal temperatures within habitats occupied by GPDs range from below 0° C (32º F) in winter to above 30º C (86º F) in summer (Longhurst 1944; Shalaway and Slobodchikoff 1988; Davidson et al. 1999; Bangert and Slobodchikoff 2000).

LIFE HISTORY

Habitat requirements

Habitat requirements for the GPD have not been examined over a large number of colonies or across large geographic areas (Wagner and Drickamer 2003). Slobodchikoff et al. (1988) studied GPD habitat use in Arizona, but only at 7 colonies. A few studies have described GPD life history, but were limited to a few colonies and did not directly address habitat requirements (Longhurst 1944; Fitzgerald and Lechleitner 1974). Common plant species noted to occur in GPD colonies from these studies include shrubs (*Atriplex jonesii*, *A. canescens, Artemisia tridentata*, *A. frigida*, *Sarcobatus vermiculatus, Potentilla fruticosa*, *Chrysothamnus* spp.), grasses (*Bromus tectorum*, *Oryzopsis hymenoides, Aristida purpurea, Muhlenbergia spp., Sporobolus aeroides, Scleropogon brevifolius, Bouteloa gracilis*, *Hilaria jamesii*, *Agropyron smithii, A. trachycaulum, Koleria cristata*, *Festuca* spp.), and forbs (*Descurainia* spp., *Cardaria draba, Lepidium virginicum, Cryptantha* spp., *Senecio* spp., *Sisymbrium altissimum, Penstemon* spp., *Lappula redowski*; Longhurst 1944; Lechleitner et al. 1962, 1968; Fitzgerald and

Lechleitner 1974; Rayor 1985; Shalaway and Slobodchikoff 1988; Davidson et al. 1999; Bangert and Slobodchikoff 2000; Lorance et al. 2002). Total vegetative cover measured on GPD colonies in Gunnison County, Colorado was 24% to 35% herbaceous, 9.5% to 25% shrub, and 39% to 66% bare ground (Rayor 1985). In Moreno Valley, New Mexico, cover by shrubs on colonies varied from 9% to 23% and grasses covered from 23% to 52% (Cully et al. 1997). In Northern Arizona, total ground cover measured on colonies ranged from 26% to 56% (Shalaway and Slobodchikoff 1988).

Since the 1800s, the total area occupied by prairie dogs (any species) has declined by an estimated 98%, due to habitat conversion, eradication campaigns, and plague (Oldemeyer et al. 1993). Kotliar et al. (1999) argued that the loss of prairie dogs across their range has influenced current ecological processes, because all 5 species are keystone species due to their activities and colonial nature. For example, prairie dogs serve as prey for a number of predators, including the endangered black-footed ferret. In addition, their burrows provide structural habitat for burrowing owls (*Athene cunicularia*) and various small mammals (Miller et al. 1994). Prairie dogs also alter plant species composition and affect ecosystem processes such as nutrient cycling rates (Whicker and Detling 1988). GPD grazing and burrowing activities create unique habitats within their grassland ecosystem, and their colonies represent distinct patches of vegetation structure and composition relative to the surrounding landscape (Bangert and Slobodchikoff 2000). Presence of GPDs increases habitat heterogeneity at large spatial scales, making their presence important to other animal species (Bangert and Slobodchikoff 2000).

GPDs are semi-fossorial animals and require well drained, deep soils for burrow construction (Wagner and Drickamer 2003). Rocks on the surface of the ground may indicate rocky soils that make establishment of a burrow system difficult. Wagner and Drickamer (2003) documented an inverse relationship between the amount of rock covering the surface of the ground and presence of GPDs. Dalsted et al. (1981) emphasized that soils free from rocks were important to establishment of BTPD colonies. In addition, because GPDs hibernate and many colonies occur at high elevations, these burrowing animals rely on placement of hibernacula below the frost line. Coffeen and Pederson (1993 as interpreted by Wagner and Drickamer 2003) stated that suitable transplant sites for UPDs should have soils at least 1 m (3.3 ft) deep over the caliche layer, for successful establishment of hibernacula.

GPDs generally inhabit areas that are flat, but sometimes occupy areas with steeper slopes if the slopes are also long (i.e. low variability; Wagner and Drickamer 2003). Fitzgerald and Lechleitner (1974) did not find burrows on slopes greater than 15%. In New Mexico, slopes measured in occupied habitat ranged from 2% to 5% (Lorance et al. 2002; Yazzie and Sanders 2003). Selection of flat areas with less variable slopes may provide GPDs with a less obstructed view in all directions, increasing their ability to detect predators and warn conspecifics.

Dietary requirements

GPDs feed extensively on grasses, forbs, and sedges, but also consume insects. Rayor (1985) found that the primary foods consumed by GPDs at 2 sites in Gunnison County, Colorado, were borages (Boraginaceae), mustards (Brassicaceae), grasses (Poaceae), and some shrubs. Shalaway and Slobodchikoff (1988) found that, although there were dramatic differences in both plant species availability and use in colonies located < 20 km (12.4 mi) apart, GPDs maintained a consistent pattern of dietary selection for general types of plants. They fed on grasses and forbs when available and switched to seeds as the grasses and forbs died out, suggesting a seasonal shift in their diet as plant phenology progressed.

GPDs, like other white-tailed prairie dog species, have evolved in arid, nutrient-limited environments with pronounced changes in moisture patterns and temperature extremes. To deal with these constraints, GPDs hibernate and aestivate when metabolically stressed. During the surface-active season, they mate, give birth, and build fat stores, making the quality and quantity of vegetation an important component for survival and reproductive output (Beck 1994). During spring and fall, there is little growing vegetation, resulting in GPDs feeding primarily on seeds and dead vegetation. Selection of a high energy food source, such as seeds, allows GPDs to maintain their physical condition during emergence and the reproductive season and to increase body weight prior to winter hibernation. In summer, as plants begin to grow, GPDs consume large amounts of live vegetation. Juvenile emergence in late May to July (dependent on elevation) allows young prairie dogs to take advantage of the abundant green vegetation. This is crucial because juvenile body mass appears to significantly influence survival rates, percentage of 1-year old breeders, and may be the mechanism driving fluctuations in prairie dog populations (Rayor 1985; Menkens and Anderson 1989). Grant (1995) found the most significant growth and increase in body mass of juvenile WTPDs occurred after emergence in early June until mid-July; this period coincided with abundant above-ground biomass of succulent, highly nutritious grasses and forbs. Weights of 80 GPD pups increased from 100 to 150 g (3.5-5.3 oz) at emergence to more than 400 g (14.1 oz) when they entered hibernation (Fitzgerald and Lechleitner 1974). Because GPDs rely primarily on body fat, rather than stored food, during hibernation, overwinter survival is dependent to some extent on accumulated fat reserves. Therefore, high quality habitats are crucial to overwinter survival.

Prairie dogs lack an effective system for conserving water (Vorhies 1945; Schmidt-Nielsen and Schmidt-Nielsen 1952), and obtain most of their needed liquid from the plants they eat. Collier (1975) found that higher moisture content in plants was correlated with higher population densities of UPDs. UPDs traveled up to 400 m (1312 ft) in summer months to access vegetation growing in moist areas (Crocker-Bedford 1976; Crocker-Bedford and Spillett 1981). Similarly, Koford (1958) found that BTPDs congregate near moist vegetation and new colonies and colony expansion are more likely to occur in these areas. GPDs have also been described using areas near the edges of wet meadows (Longhurst 1944).

Social structure

The GPD has a complex social system, living in colonies of up to several hundred individuals with each colony subdivided into smaller territories occupied by social groups or solitary individuals (Slobodchikoff 1984, 1988; Rayor 1988). Social groups vary from 2 to 19 individuals and may be composed of a single male/single female, single male/multiple females, or multiple male/multiple females (Slobodchikoff 2003). Structure of the social group appears to be correlated with distribution of food resources. Relatively uniform areas support single male/single female social groups whereas patchy resource areas support single male/multiple female or multiple male/multiple female groups. Territories are used and defended by social groups; agonistic behavioral interaction is common toward nonmembers. GPDs often feed in weakly defended peripheral sections of their territories that belong to other groups, but when members from different groups meet in these common feeding areas, conflicts can arise, with one animal chasing the other back toward its territory (Fitzgerald and Lechleitner 1974; Rayor 1985, Travis et al. 1995, 1996).

GPDs are diurnal, and most active in early morning and afternoon (Fitzgerald and Lechleitner 1974). Movements are reduced when vegetation is wet; heavy rain and snow causes them to cease above-ground activities. On cloudy days, prairie dogs appear to be more cautious and stay closer to their burrow entrances. Winds below 37 km/hour (23 mi/hour) do not appear to alter GPD behavior (Fitzgerald and Lechleitner 1974).

Reproduction

Female GPDs are sexually receptive for a single day during the breeding season each year (Hoogland 1999) and will mate with up to 5 males (Hoogland 1998). The GPD mating strategy varies with regard to resource availability and population density. When population densities are low and resources uniform, GPDs employ a monogamous mating system. As plant patchiness and population densities increase, monogamy gives way to polygyny, with females mating with multiple males throughout the colony (Travis et al. 1995, 1996). Females copulate with multiple males to maximize reproductive success and promote genetic diversity among litter mates. Hoogland (1998) reported a 92% probability of pregnancy and parturition in GPDs for females that copulated with 1 or 2 males, as compared to 100% for females that copulated with at least 3 males. Hoogland (1998) also found that litter size varied directly with the number of a female's sexual partners. The frequency of multiple paternities is as high as 77% (Haynie et al. 2003).

Mating occurs from mid-March to mid-May, with gestation lasting 29 to 30 days and lactation lasting approximately 38 to 40 days (Hoogland 1997). Young emerge above ground at 4 weeks of age, in late May to early July (Rayor 1985; Hoogland 1999). The age of first reproduction for females appears to depend on forage availability. Female GPDs are sexually mature at 1 year and copulate when food is abundant, but may not copulate until their second year if food is limited (Hoogland 1999). Age of first reproduction for males is also variable, and appears to depend on the number of older, breeding males in the population (Rayor 1985, 1988; Hoogland 1996).

Hoogland (2001) found that GPDs in Arizona reproduce slowly for 5 reasons: 1) survivorship was < 60% in the first year and remained low in subsequent years, 2) females produced only 1 litter per year, regardless of resource availability, 3) as few as 24% of the males copulated as yearlings, 4) the probability of weaning a litter each year was approximately 82%, and 5) mean litter size at the time of the first juvenile emergence was 3.77. Hoogland (2001) noted, however, that other factors can enhance reproductive output, with body mass being the most important. Hoogland (2001) also found that heavy males are more likely to copulate and sire more offspring, litter size correlates directly with maternal body mass and age.

Hibernation

GPDs have evolved in arid, nutrient-limited environments with pronounced changes in moisture patterns and temperature extremes. To deal with these constraints, GPDs hibernate and aestivate when metabolically stressed (Harlow and Menkens 1986). Emergence from hibernation occurs from February to late April and immergence occurs from mid-September to November; both are dependent on elevation (Fitzgerald and Lechleitner 1974; Rayor 1988; Hoogland 1998).

Movements and home range

Dispersal occurs in fall prior to hibernation and in spring prior to the mating season (Travis et al. 1996). Offspring usually remain in their natal territory into their yearling summer (Rayor 1988). Most females (95%) remain in their natal territory for life, whereas only 5% of males remain in their natal territory for more than 1 year (Hoogland 1999). Hoogland (1999) found that the majority of dispersing females dispersed to an adjacent clan, a distance ranging from 38 to 221 m (125-725 ft), and 56% percent of dispersing males went to an adjacent territory, a distance of 34 to 575 m (112-1886 ft).

Little work has been done with GPDs to examine home range sizes in different habitats and for different sex and age classes. Rayor (1988) found that the area of individual home ranges in Colorado did not differ significantly between sites, sexes, or age groups, with median home range sizes of 0.07 to 0.08 ha (0.17 – 0.2ac). In comparison, WTPD home ranges range from 0.15 to 1.9 ha (0.37-4.7 ac; Clark 1977; Cooke 1993) and UPD home ranges range from 0.5 to 1.8 ha (1.2-4.4 ac). In UPDs, the size of the home range is inversely related to density (Wright-Smith 1978 as interpreted by McDonald 1992).

Densities

GPDs occur in extensive colonies with densely aggregated burrows and in areas with scattered, isolated burrows. Densities within colonies vary among habitats and are likely driven in part by vegetation quantity and quality, with hyper-productive environments correlating with higher densities of prairie dogs. For example, Crocker-Bedofrd (1976) examined UPD life history traits at 3 locations and found densities ranging from 2.3 prairie dogs/ha (1/ac) at a high elevation site, 16 prairie dogs/ha (6/ac) at a low elevation site, and 36 prairie dogs/ha (15/ac) at a low elevation site associated with an alfalfa field. Crocker-Bedford (1976) attributed the difference in densities to quantity and quality of available vegetation. On wildlands, GPD densities are thought to average 3 to 5/ha (1-2/ac). However, as brush is cleared to make fields, densities can exceed 70/ha (28/ac; Longhurst 1944). Other researchers have found GPD densities to range from 4 to more than 57 prairie dogs/ha (2 to >23/ac) in favorable habitat (Fitzgerald and Lechleitner 1974; Rayor 1985; Van Pelt 1995).

Disease, especially the introduced pathogen *Yersinia pestis* (which causes sylvatic plague) may contribute to variation in year-to-year population densities. Turner (2001) found that after a plague epizootic severely reduced a population of UPDs in Bryce Canyon, survival of juveniles, juvenile mass, and the number of females successfully weaning young increased. Similarly, Cully (1997) found that in Moreno Valley, New Mexico, GPD populations tripled annually after a plague epizootic, due to increased survivorship of juveniles and reproduction at an early age. These factors were thought to contribute to rapid recovery of the population. Rayor (1985) described a plague outbreak that eliminated a colony of GPDs in Colorado in 1981. When Cully (1989) revisited this colony in 1986, prairie dogs were again abundant, despite several attempts to poison them. Repeated plague epizootics and subsequent recovery of local populations from these outbreaks can result in a cycle of expansion and contraction in individual prairie dog colonies (Wagner and Drickamer 2003). Long-term consequences of continued plague infection on prairie dog populations can result in increased variance in local population densities. Low points in such cycles do not necessarily indicate endangerment in a legal sense.

EVALUATION OF GUNNISON'S PRAIRIE DOG POPULATION STATUS BY STATE

Development of a rangewide GPD assessment was difficult, due lack of complete and consistent surveys, variable time periods between estimates at specific sites, and a lack of standardized monitoring techniques to evaluate long-term population trends. The total amount of occupied habitat is unknown. States within GPD range have not completed comprehensive mapping surveys for the species and trespass restrictions on private and tribal lands (which have 73% of the projected occupied habitat) prevent access for field surveys. Consequently, this assessment (1) provides a summary of surveys completed within each state, followed by inferences regarding population status from evaluation of quantitative data collected at a limited number of occupied sites on public lands, and (2) is therefore a minimum estimate of distribution.

PREDICTIVE RANGE MODEL

Typically lacking for most species is a spatially detailed, regional representation of the species' range. However, with advancement of computer-aided mapping and accessibility of digital Geographic Information Systems (GIS) datasets, a spatially detailed, Predictive Range Model (PRM) for the GPD was produced. The first step in development of the PRM was to acquire pre-existing digital GIS data layers via the Internet:

> Bureau of Land Management Ownership: BLM. 2001. Representation of statewide and regional land ownership of 11 western states. 1:100,000. Landholders in the dataset are federal, state, local governments, universities, tribal, and private lands.
>
> State Boundaries: Environmental Systems Research Institute, Inc. (ESRI) Data Team. 2001. A generalized representation of the fifty U.S. States and the District of Columbia. 1:3,000,000. ESRI, Redlands, CA. 92373.
>
> County Boundaries: ESRI Data Team. 2001. A generalized representation of the counties of the fifty U.S. States and the District of Columbia. 1:3,000,000. ESRI, Redlands, CA. 92373.

Gross Range Map: Modified from Hall (1981). Arizona Game and Fish Department (AGFD) provided a more detailed and accurate description of the current GPD range for Arizona.

Colony Data: Current and historical colony localities were provided by the Colorado Division of Wildlife (CDOW) and Utah Division of Wildlife (UDWR) for Colorado and Utah.

National Elevation Dataset: U.S. Geological Survey (USGS). 2000. Designed to provide national elevation data in a seamless form with a consistent datum, elevation unit (30-meter), and projection. http://gisdata.usgs.net/ned/default.asp

Provisional Digital Landcover Dataset for the Southwestern United States. USGS GAP Analysis Program. 2005. Multi-season satellite imagery (Landsat ETM+) from 1999-2001 was used in conjunction with digital elevation model (DEM) derived datasets (e.g. elevation, landform, aspect) to model natural and semi-natural vegetation. Landcover classes were drawn from NatureServe's Ecological System concept, with 109 of the 125 total classes mapped at the system level http://earth.gis.usu.edu/swgap/landcover.html

Colorado Oil and Gas Conservation Commission Oil and Gas Well Spatial Data Set. 2004. A representation of more than 57,000 oil and gas well locations in Colorado.

Utah Division of Oil, Gas, and Mining. State of Utah, Department of Natural Resources. 2004. Individual records of basic information for each well in the Utah Division of Oil, Gas, and Mining database.

New Mexico Oil Conservation Division. New Mexico Energy, Minerals and Natural Resources Department. 2004. Individual records of basic information for each well including well name and number, and three years of summarized production and injection.

2000 Urbanized Areas Cartographic Boundary. 2000. U.S. Census Bureau. Densely settled territories that contain 50,000 or more people.

The second step in creating the PRM was to process the unrelated input data layers. The individual data layers were imported into ArcGIS 9.0 and then projected to Albers Equal-Area map projection. This projection system is used in the United States and other countries that have a longer east-west than north-south extent, so areas are portrayed over the entire map with the same proportional relationship as the actual geographic areas they represent on Earth. The National Elevation Dataset (NED), downloaded in individual 1:250 quadrangles, was then map-joined to create one complete layer for each state. The Southwest Regional GAP (SWReGAP) Analysis Landcover Dataset was downloaded as the complete regional dataset including a 300-meter (10 pixel) buffer added to the outer boundary. For these reasons, the NED and SWReGAP

Landcover datasets were clipped to each corresponding state jurisdictional boundary. The final pre-processing step was to derive percent slope from the NED dataset using the algorithm incorporated into ArcGIS 9.0.

The third step in producing the PRM was to separate specific habitat associations from those considered non-appropriate habitat. These associations were based on the literature and known species occurrences. Three input data layers were selected as indicators of potentially appropriate GPD habitat: an elevation range of1500 and 3700 m (4921-12,139 ft), 0 to 20% slope, and 23 land cover classes (Table 1). Land cover classes deemed unsuitable for GPD occupation consisted of forest, woodland, dense shrubland, wetland, and marsh land. Agricultural land and urban areas were included as suitable habitat, but should be considered with caution. Prairie dogs are often not tolerated on these lands; eradication may occur at localized sites. However, because GPDs are often common in these 2 habitat types, they were included as suitable habitat in the PRM.

The fourth step was to calculate the actual PRM, by using the additive overlay technique in which each data layer is added as an equally weighted component in the model. Although the process is referred to as an additive approach, the calculations produce only a combination of the important variables, removing any areas not fitting the appropriate criteria. A model was calculated for each state and then assembled to form one complete, seamless rangewide dataset. Finally, the large mosaic was clipped to the gross range boundary creating the outer extent of the PRM. The gross range map was produced by acquiring state-specific range information from the State Wildlife Agencies then editing and edge matching the specific range maps at state boundaries to portray a smooth, continuous range boundary. The gross range boundary identifies the outer extent of GPD range. Within the boundary, areas exist that do not provide, nor have they ever provided, suitable GPD habitat. The hectares within the PRM were then calculated in ArcGIS 9.0. The gross range boundary, along with the additional data layers, such as landownership, census data, and oil and gas well locations, were used to facilitate analysis. It is important to note these calculations were accomplished using ArcGIS 9.0 software. The use of other software or different map projections might result in slight differences in hectare estimates.

The PRM was produced as a more accurate, spatial depiction of potential range of the GPD. The main constraint of the model was availability of pre-existing GIS data layers at the regional scale. Although the SWReGAP dataset provided a consistent, region-wide land cover data layer, depictions of land cover associations were drawn from NatureServe's Ecological System which did not provide a species-specific level of detail. Additionally, a data layer depicting detailed soil characteristics was not available in digital GIS format. Thus, the PRM overestimates suitable habitat for the GPD, due to critical indicators of GPD occupation that the model could not address. Given these constraints, this model was developed as a first-cut guide to help locate appropriate areas for more intensive field surveys or to identify habitat connections and corridors. This model is not meant to imply the entire area is biologically appropriate for GPD occupation.

Arizona

Distribution. The Biota Information System of New Mexico (Biota Information System of New Mexico 2004) describes the distribution of the GPD in Arizona as follows:

> Gunnison's prairie dogs are found in the desertscrub community of the Tonto Plateau above the Inner Gorge of the Grand Canyon (Hoffmeister 1971).
>
> Gunnison's prairie dogs are found in the plains and desert grassland and to a lesser extent the Great Basin desertscrub north of the Mogollon Plateau but south of the Colorado River; south of and around the west end of the Mogollons to near Wilhoit and also south of the Mogollons in the high prairies of Ash Creek, south of the Nantanes Mountains. Present-day distribution is greatly restricted from near Seligman to Holbrook and northward. In the eastern part of the state, Vernon Bailey's notes of 1908 indicate "these prairie dogs are common all along the Zuni River and Little Colorado River valleys and over the mesas." E. W. Nelson in 1909 found them along the route from Chinle by way of Ganado, Keams Canyon, and the Hopi mesas to Tuba City "in scattered and rather small colonies." In the western part of the state, Walter P. Taylor in 1916 found them to be common on the dry, open fields near the Deming Ranch, 3 mi N Fort Whipple (Hoffmeister 1986).

Survey efforts.

1. In the early 1900s, biologists from the U.S. Department of Agriculture (USDA) recommended that prairie dogs be eliminated due to the damage they caused to crops and rangeland forage (Merriam 1902; Bell 1921). This led to wide-scale poisoning of prairie dogs throughout the western United States (Roemer and Forrest 1996). Unpublished reports of rodent control operations in Arizona from 1916-1933 describe treatment of 1,766,756 ha (4,365,749 ac) of lands inhabited by prairie dogs (Oakes 2000). In 1920, the U.S. Bureau of Biological Survey (BBS) requested that prairie dog inventories be completed and maps produced to showed the distribution and extent of prairie dog occupation in order to plan and fund rodent eradication campaigns. These surveys showed 2,273,070 ha (5,616,878 ac) of occupied GPD habitat on public, private and tribal lands in Apache, Coconino, Navajo, and Yavapai counties (Oakes 2000). Subsequently, the Predator and Rodent Control Agency (PARC) ordered a survey of prairie dog populations in the United States by state and county due to concerns over uncontrolled poisoning (see Oakes 2000). States were given until October 1961 to submit their inventories to PARC. The 1961 reports showed a 92% decline in occupied habitat since the 1921 surveys, with GPDs occupying only 180,235 ha (445,370 ac). Only 4029 ha (9956 ac; <3%) in the 1961 surveys were located on non-tribal lands. An additional 8 ha (20 ac) of occupied habitat was found in Mojave County in

1961. The 1961 surveys also determined that BTPDs had been extirpated from Arizona.

2. In 1979, 88 GPD colonies were located on 5 National Forests in both Arizona and New Mexico (Ruffner 1980). Of these, 32 were visited and 27 were mapped. In the Coconino National Forest, 9 mapped colonies had a mean colony size of 34 ha (84 ac). On the Kaibab National Forest, 5 mapped colonies had an average size of 59 ha (146 ac).

3. In east-central Arizona, AGFD conducted a survey from May 1987 to April 1988, recording 46 colonies, 25 of which were on BLM lands (Yarchin et al. 1988). The colonies on BLM land totaled 1297 ha (3205 ac). BLM has not attempted to remap the colonies and their current status is unknown (T. Cordery, BLM, pers. comm.).

4. In 1990, AGFD initiated an effort to locate and map potential black-footed ferret habitat within Arizona (Van Pelt 1995). It mapped 215 GPD colonies covering 13,846 ha (34,214 ac) in Yavapai, Coconino, and Navajo counties. Eight complexes were identified: Aubrey Valley (7838 ha [19,368 ac]), Seligman (3060 ha [7561 ac]), Farm Dam (1284 ha [3173 ac]), Navajo Army Depot (308 ha [761 ac]), Government Prairie (155 ha [383 ac]), San Francisco Peak (205 ha [507 ac]), Wupatki (216 ha [534 ac]), and Homolovi (494 ha [1221 ac]). The Aubrey Valley Complex (AVC), 3 times as large as the next largest complex, was considered the best reintroduction site for black-footed ferrets because it provided more than half (51%) of Arizona's known carrying capacity for ferrets.

   GPD colonies have been annually mapped in AVC since 1990, with estimates ranging from 6959 to 12,001 ha (17,196-29,655 ac; Van Pelt and Winstead 2003). In 1997, Global Positioning System (GPS) units were first used to map prairie dog colonies in AVC, revealing that the AVC contained 16 separate GPD colonies encompassing 12,001 ha (29,655 ac). Apparent expansion of AVC from 1990 was likely due to a combination of more accurate mapping, actual expansion of colonies, and habitat conditions favoring expansion (Van Pelt and Winstead 2003).

   The AVC GPD has been continuously monitored since 1996 by transect surveys (per Biggins et al. 1989, 1993). Field personnel survey 64 established transect-blocks between May and August. Results are compared to data from prior years to determine if notable changes have occurred in densities. When a notable change is observed, additional surveys are conducted to determine the extent of change. Point-counts from a vehicle may also occur throughout the year.

Estimates of GPD densities from 1996-2001 have shown fluctuations from year-to-year. During this 6-year period, average active burrow densities ranged from 21-33 per ha, with percent of good habitat varying from 33%-61% and ferret family ratings ranging from 24 to 79. Higher prairie dog numbers tended to occur following mild winters and above average rainfall; lower numbers tended to occur during droughts.

Since 1974, the Arizona Department of Health Services Vector and Zoonotic Diseases Division has monitored plague activity in Arizona by documenting human cases, testing carnivore blood samples for titers, and testing flea pools collected from prairie dog burrows. These tests documented the occurrence of plague in Coconino and Yavapai counties, but not within the AVC demonstrating that plague is not responsible for observed population fluctuations in AVC.

5. In 1994 and 1996, GPD colonies were located and mapped in the southwest corner of the Navajo Indian Reservation (Navajo Natural Heritage Program 1996). Ninety colonies were located in 1994 within 4 complexes. The Canyon Diablo complex contained 12 colonies, the Leupp complex contained 5 colonies, the Red Lake complex contained 3 colonies, and the Elephant Butte complex contained 70 colonies. Eighteen colonies covering 2423 ha (5987 ac) were transected to evaluate suitability of the area for black-footed ferrets. The survey determined this area was not suitable for black-footed ferret reintroduction due to a low density of GPDs. However, the total survey area represented only a small portion of what the Navajo Indian Reservation holds in terms of potential black-footed ferret habitat. The eastern section of the study area was not surveyed, but was thought to contain more than 400 ha (988 ac) of active GPD colonies.

6. In 1998, GPD colonies were mapped on the Peaks and Mormon Lake Ranger Districts of the Coconino National Forest (Randazzo 1998). This project began by referencing Ruffner's (1980) work on the Peaks Ranger District. However, not all the colonies mapped by Ruffner were revisited. Ruffner mapped GPD colonies on both private and public lands, but the 1998 survey mapped colonies only on public lands. Twenty-one active colonies and 2 abandoned areas were located in 1998. Total hectares mapped were 1173 (2899 ac). Three of the 4 colonies visited during this survey that were originally mapped by Ruffner in 1979 were active.

7. Wagner and Drickamer (2003) attempted to determine current status of the GPD in Arizona by compiling information from previous surveys (1987-1988 and 1990-1994) and revisiting those sites to evaluate the current status of colonies and map occupied habitat. Locations of more than 400 colonies of GPDs were documented from previous surveys, as well as boundary, size, and status (active or inactive) of the colonies at the time of the surveys. Of the 400

GPDs colonies identified, 293 were visited during the summers of 2000 and 2001. In the previous surveys, 270 (92%) of the 293 colonies were active. In 2000-2001 however, only 86 (29%) of the 293 colonies were active. In addition, Wagner and Drickamer (2003) documented a 66% reduction in total area covered by active colonies. The 270 colonies identified as active in previous surveys covered approximately 13,559 ha (33,505 ac). The 86 colonies identified as active in the 2000/01 surveys covered approximately 4526 ha (11,184 ac).

8. During the surveys conducted by Wagner and Drickamer (2003), 57 of the 293 surveyed GPD colonies experienced die-offs during the summers of 2000 and 2001. Of these 57 colonies, 53 were identified as active during previous surveys. The other 4 colonies apparently became active after the previous surveys but then experienced die-offs shortly before the 2000/01 surveys. Although plague was only confirmed as the causative agent in 15 of the die-offs, it was suspected in most, if not all, of the 57 die-offs. Because so many colonies appeared to be affected by plague, AGFD selected 30 colonies in the vicinity of Flagstaff to monitor recovery rates from these epizootic events (S. MacVean, AGFD, pers. comm.). Some sites selected were discarded before monitoring began, due to private land and access issues. AGFD and Grand Canyon Trust volunteers began monitoring the remaining sites in 2002, with monitoring procedures adapted from Biggins et al. (1993). In 2002, 26 colony sites were surveyed, recording 3 active colonies and a fourth "may be active." In 2003, 23 sites were surveyed and 8 were found active.

9. In May and June 2002, AGFD conducted fixed-wing surveys of all grasslands and areas of low shrubs within Region 2, south of the Grand Canyon (S. MacVean, AGFD, pers. comm.). Aircraft flew 46 to 61 m (151-200 ft) above the ground along grid lines positioned 0.6 km (0.4 mi) apart in rough terrain and 0.8 km (0.5 mi) apart in smoother terrain. Grids and colony locations were recorded with a Trimble Geo Explorer GPS unit. The surveys recorded 353 points within colonies along transects that totaled >3000 km (1864 mi) in length. Wagner's field crew and volunteers from Grand Canyon Trust ground-truthed locations marked as colonies during aerial surveys. Identification of prairie dog colonies from the aircraft was 92% accurate. When corrected for this level of accuracy, a preliminary estimate of 325 points, with 3 GPS points recorded in each colony, resulted in an estimate of 108 prairie dog colonies detected in the survey area.

   Comparing ground (Wagner and Drickamer 2003) to aerial techniques (S. MacVean, AGFD, pers. comm.), determined that approximately 42% of the colonies identified during ground surveys by Wagner and Drickamer (2003) were missed by aerial surveys and 58% of the colonies identified in the fixed-wing surveys were missed by Wagner and Drickamer (2003). The probability that some colonies were missed by both methods was 0.24 (0.42 equals the

> probability of being missed by aerial survey x 0.58 equals the probability of being missed by compiling known colonies) = 0.24. Thus, about 25% of the prairie dog colony locations most likely were missed by both surveys. The best estimate for the number of colonies in the survey area was calculated to be 168. However, this is an underestimate because AGFD was unable to fly all suitable habitat.

Predictive range model. Twenty-five percent of the GPD gross range and 27% of the predicted range occurs in Arizona (Table 2; Fig. 2). Within the state, 71% of the gross range and 76% of the predicted range is located on private or tribal land (Table 3). BLM land comprises 1% of the gross range and 2% of the predicted range in the state, U.S. Forest Service (USFS) land comprises 13% of the gross range and 3% of the predicted range, and state land comprises 13% of the gross and 16% of the predicted range (Table 3). Agricultural development currently impacts <1% of the gross (12,727 ha [31,449 ac]) and predicted (8783 ha [21,703]) ranges. Urban development also impacts < 1% of the gross (31,838 ha [78,673 ac]) and predicted range (17,147 ha [42,371 ac]) (Table 4). The amount of GPD predicted range impacted by oil and gas development could not be determined.

Summary. Historic poisoning campaigns and plague caused declines in GPD occupied habitat in Arizona. In 1921, 2,273,070 ha (5,616,878 ac) of GPD occupied habitat were estimated to occur within 4 counties (Apache, Navajo, Coconino, and Yavapai). In 1961, a 92% decline in occupied habitat was reported. Both the 1921 and 1961 surveys included private and tribal lands within 4 counties. No further mapping of this species took place until the 1980s and 1990s, when surveys were conducted to locate potential black-footed ferret reintroduction sites. This mapping occurred within 3 counties (Navajo, Coconino, and Yavapai); an estimated 13,846 ha (34,214 ac) of occupied habitat was mapped. Many of these sites were revisited in 2000/01 to evaluate population status. During these remapping efforts, only 4526 ha (11,184 ac) of occupied habitat were located. Direct comparisons between these surveys could not be made because different techniques were used to map occupied habitat and additional areas were not searched to determine if new colonies had formed or old colonies had moved. Currently, more than 40,000 ha (100,000 ac) of occupied habitat exists on non-tribal lands (B. Van Pelt, AGFD, pers. comm.). Though a significant decline of occupied habitat on non-tribal lands has occurred since mapping efforts began, there has been a 10-fold increase of occupied habitat since the 1961 surveys.

Determination of population trends for Arizona is impossible, as AVC is the only area where densities of animals have been estimated on a yearly basis. The AVC has been unaffected by plague since at least 1974, therefore population trends for this complex cannot be extrapolated for a statewide projection.

Wagner and Drickamer (2003) stated several conclusions regarding the current status of GPDs within Arizona:

1. In the last 7-15 years, there has been a large reduction in the number of active GPD colonies in Arizona.

2. This reduction in active colonies is primarily due to outbreaks of plague which is the dominant negative impact on Arizona populations.
3. Repeated plague outbreaks, and the subsequent recovery of local populations from these outbreaks, cause a cycle of expansion and contraction in individual prairie dog colonies, or local complexes of colonies.
4. Plague outbreaks occur over relatively discrete areas in both space and time. Thus, GPD populations may be expanding in some areas in Arizona while at the same time populations in other portions of its range may be contracting.
5. There is significant temporal and spatial variation in the size of individual GPD colonies within Arizona.
6. Although the size of individual colonies may be highly variable, at any given time a majority of the active GPD colonies in Arizona are relatively small (<20 ha [<49 ac]).

Agriculture, urbanization, shooting, and plague in Arizona have collectively have played a role in the apparent decline in occupied habitat. Whether oil and gas development might also negatively affect GPDs within the state is unknown; information was not available to adequately evaluate this factor. However, within the state, efforts are being developed to translocate prairie dogs from urban areas to help alleviate urban impacts, a shooting closure has been implemented, and the GPD was included in Arizona's Comprehensive Wildlife Conservation Strategy (CWCS).

Colorado

Distribution. Historically, GPDs in Colorado were found in the San Luis Valley, South Park, along the Arkansas River Valley from Twin Lakes to Pueblo, westward into the upper Gunnison River drainage and the Saguache and the Cochetopa Park areas (Capodice and Harrell 2003). In central Colorado, GPDs typically inhabit mountain parks, occurring at sites ranging in elevation from 1828 to 3657 m (5997-11,998 ft). In southwestern Colorado and adjacent areas, lower, more xeric habitats are used, with sites comparable to those inhabited by WTPDs farther north (Armstrong 1972).

Survey efforts.

1. In 1988, the Saguache BLM Field Office inventoried and mapped GPD colonies in the San Luis Valley Resource Area to evaluate site potential for black-footed ferret reintroduction. These initial inventories covered the Punche Valley (2332 ha [5763 ac]) and Los Mogotes (24,087 ha [59,520 ac]). Two active colonies on 16 ha (40 ac) were mapped in the Punche Valley and 8 colonies on 243 ha (600 ac) were mapped in Los Mogotes. During this survey, numerous prairie dog burrows were visible, but most were filled in with debris or were occupied by other species. This survey found that 0.9% of the San Luis Valley was occupied by GPDs.

2. In 1990, the Colorado Agricultural Statistics Service (1990) surveyed 9046 farmers and ranchers and obtained nearly 3000 responses to estimate the

number of hectares occupied by prairie dogs. The report was designed to provide a non-probability statistical estimate of the total occupied habitat of farm and ranch land inhabited by prairie dogs and other rodents (Capodice and Harrell 2003). The 1990 Colorado Agricultural Statistics Service (1990) estimated that 628,477 ha (1,553,001 ac) were occupied by prairie dogs in Colorado in 1989. This survey estimated hectares occupied by prairie dogs in each county, but it did not differentiate between occupied habitat of WTPDs, GPDs, or BTPDs. To decipher occupancy by the 3 prairie dog species, distribution maps from Fitzgerald et al. (1994) and field surveys conducted by the CDOW during 2003 were used. In counties where WTPDs and GPDs occurred with 1 of the other species of prairie dogs, the relative proportion of the county that was occupied by WTPDs and GPDs was estimated. The proportion was multiplied by the hectares reported occupied by all prairie dogs in a county to obtain an estimate of the occupied habitat by WTPDs and GPDs for that county (Andelt et al. 2003). The hectares of reported WTPDs and GPDs in each county were summed to obtain an estimated 177,607 ha (438,876 ac) of reported GPDs in Colorado during 1989.

In 2002, Knowles primarily summarized CDOW (2002) data for his assessment of the current status of GPDs in Colorado. He criticized the Colorado Agricultural Statistics Service (1990) report of occupied habitat of prairie dogs in Colorado by stating "these estimates clearly greatly inflate the acreage at least in some counties." However, it is worth noting that Knowles (1998) reported there were only 17,806 ha (44,000 ac) of BTPDs in Colorado during 1998, whereas the Colorado Agricultural Statistics Service (1990) estimated about 376,358 ha (930,000 ac; Andelt et al 2003). Aerial surveys conducted by CDOW (following Sidle et al. 2001) estimated that 255,362 ha (631,013 ac) were occupied by BTPDs in Colorado during 2002. Thus, the estimates provided by Colorado Agricultural Statistics Service (1990) were much closer to CDOW estimates than Knowles (2002).

3. In 1990, the USFWS conducted surveys of GPD distribution throughout Colorado (Finley 1991). Surveys were conducted by driving highways and roads and recording observations of prairie dogs. Finley (1991) documented 74 GPD colonies (42 active) within 10 counties. Twenty-eight of the 42 active colonies contained fewer than 60 mounds or fewer than 30 individuals. The largest active colonies were in the Gunnison drainage. Finley noted that South Park was almost devoid of prairie dogs, but found a medium-sized colony (defined as having 21-60 mounds) near Hartsel and other colonies in nearby Teller and Chaffee Counties. He indicated some mammalogists suspected the spread of Wyoming ground squirrels (*Spermophilus elegans*) southward through Colorado after prairie dogs died out from plague might be preventing prairie dogs from repopulating their former colonies east of the Continental Divide and north of the Arkansas River. Finley concluded that populations of GPDs "seem to be far below those reported in the years prior to plague

epizootics", "but I do not feel that the present situation is serious enough to warrant protection by threatened status."

4. Fitzgerald (1991) expressed concern about the status of the GPD in Colorado, indicating that plague and poisoning had eliminated almost all populations in South Park. He also suggested that populations appeared to be in poor condition in the San Luis Valley, and were extirpated from the extreme upper Arkansas River Valley, and Jefferson, Douglas, and Lake Counties. He noted that a large complex still existed on the Curecanti National Recreation Area west of Gunnison.

5. In 2000 to 2002, Capodice and Harrell (2003) revisited previously recorded occupied GPD colonies in Gunnison, Saguache, and Montrose counties on BLM, USFS, CDOW, and private lands. A total of 73 sites were surveyed, with 59 of these sites recorded from 1978-1991 and 14 recorded from recent observations compiled by field staff and others. The Capodice and Harrell surveys were not a comprehensive mapping of occupied habitat in the Gunnison Basin, as the authors only revisited previously-documented sites and did not attempt to locate new colonies. Thus, their results may not be indicative of what has occurred throughout the Basin since 1978, as colonies are known to move, new colonies form, and others are abandoned (Seglund et al. *In press*). More research is needed to adequately document the status of GPD populations within Gunnison Basin. However, results and conclusions are presented here as they were stated by Capodice and Harrell report (2003).

   The Capodice and Harrell (2003) survey documented 36 active colonies, with total occupied habitat equaling 312 ha (771 ac). Of that total, 113 ha (279 ac; 36%) were on BLM land, 2 ha (5 ac; <1%) on USFS land, 10.5 ha (26 ac; 4%) on CDOW land, 68 ha (168 ac; 22%) on private lands, 14.5 ha (36 ac; 4%) on Gunnison city and county lands, and 104 ha (257 ac; 33%) on National Park land. Within the survey area, only 7 of the 16 GPD colonies identified by USFWS (Finley 1991) were still active, representing a decline of more than 45%. In addition, the Colorado Department of Agriculture Statistics (1990) estimated that there were 2347 ha (5800 ac) of occupied GPD habitat on farm and ranch lands within Gunnison County. However, Capodice and Harrell (2003) found only 222 ha (549 ac) of occupied GPD colonies, indicating a 94% decline in occupied habitat over the previous 12 years. In 1979-1980, BLM data reported 6300 ha (15,568 ac) within 19 colonies in the Gunnison Field Office. This figure was based on measuring the different polygons that were mapped in 1979 for the BLM resource management planning effort. Capodice and Harrell (2003) located 113 ha (279 ac) within 5 previously measured colonies in addition to 5 new active colonies on BLM lands, indicating a 50% reduction in active colonies since the 1979-1980 surveys.

Capodice and Harrell (2003) also evaluated the number of active versus inactive burrows at 19 of the 36 colonies mapped. They found that 5 colonies had <10% active burrows and were considered declining; 9 colonies had <50% active burrows and were considered stable to declining; and 5 colonies had >50% active burrows and were considered stable to increasing. Only one of the colonies measured over 40 ha (99 ac); it was on the Curecanti National Recreation Area. Fifty-eight percent (21 of the 36) of the colonies measured 4 ha (10 ac) or less. Capodice and Harrell (2003) found that GPD distribution was fragmented, with most sites no longer within dispersal distance of one another.

5. The Curecanti National Recreation Area west of Gunnison, Colorado contains 101 ha (250 ac) of GPDs (Capodice and Harrell 2003). Colonies within the Recreation Area appear to maintain their boundaries, but prairie dog densities vary year-to-year (K. Stahlnecker, Curecanti National Recreation Area, pers. comm.). Poisoning has not been allowed in the Recreation Area since 1997. Lethal management using gas cartridges is allowed, but only at sites where school children congregate, usually affecting 20 burrows or less (K. Stahlnecker, Curecanti National Recreation Area, pers. comm.). Plague monitoring is done on a yearly basis, and fleas are collected at the beginning of every summer for analysis. Plague has been prevalent in the Recreation Area since 1970 and appears to infect some portion every 10 years (K. Stahlnecker, Curecanti National Recreation Area, pers. comm.).

6. In 2003, the southern half of Montezuma County was surveyed to evaluate occupancy of GPDs (Colyer 2003). Surveys were completed along roads, on foot, and on horseback. From these surveys, 23 colonies on 246 ha (608 ac) were located in Mancos Valley and 28 colonies on 218 ha (539 ac) were located in Montezuma Valley. During the surveys, 2 major negative impacts to prairie dogs populations were noted. The most severe was plague. As described by the biologist in the area, "it appears populations build up, numbers get high per colony, and new colonies are formed up to 5 or more miles from core colonies. Then plague hits and colonies nearly die-off with some completely dying out. Plague travels along drainages with neighboring drainages somewhat protected from epizootics. A few prairie dogs are usually able to survive the epizootic and within 2-3 years the population begins to rebuild. Plague appeared to impact Montezuma County in 1985, 1993, and 1999."

   The second impact of great significance in Montezuma County is irrigation. Farmers can control prairie dogs and keep them from their fields by periodically flooding with irrigation. Much of Montezuma County is devoid of GPDs due to flood irrigation. However, during the last few years of drought, GPDs have been able to expand due to the lack of flood irrigation.

When the drought ends, prairie dogs will likely again be eliminated from these areas.

7. In 2002, the CDOW embarked on a statewide effort to document occupied WTPD and GPD habitat by interviewing field personnel from CDOW, the USFWS, USFS, and BLM (CDOW 2003). Prairie dog colonies were mapped on 1:50,000 USGS county sheets and were designated as active (known to have prairie dogs inhabiting the colony within the last 3 years), inactive, or as unknown (prairie dogs were known to occur historically, but current status was unknown). From this effort, it was estimated that 61,329 ha (151,547 ac) of active, 1824 ha (4507 ac) of inactive, and 79,245 ha (195,819 ac) of unknown occupied habitat occurred within the state. Field verification of identified colonies is planned and budgeted for spring 2005.

Predictive range model. Thirty-one percent of the GPD gross range and 25% of the predicted range occurs in Colorado (Table 2; Fig. 3). Forty-four percent of the gross range and 72% of the predicted range within the state is located on private and tribal land (Table 5). BLM land comprises 14% of the gross range and 15% of the predicted range; the USFS land comprises 37% of the gross range and 6% of the predicted range; and state land comprises 3% of the gross and 5% of the predicted range (Table 5). Agricultural development impacts 652,863 ha (1,613,260 ac) or 2% of the gross range and <7%, or 635,320 ha (1,569,910 ac), of the predicted range. Urban development impacts 78,549 ha (194,099 ac) in the gross range (<1%) and 38,283 ha (94,599 ac) in the predicted range (<1%; Table 4). There are currently 7821 gas and oil wells in the gross range and 1499 wells in the predicted range.

Summary. Over the past 20 years, various efforts have been undertaken to document distribution of GPDs in Colorado. However, surveys have been confounded by differences in effort, timing, and location, making comparisons between surveys difficult. Though direct comparisons between surveys cannot be made, reports during the past 20 years suggest that GPD occupied habitat on public lands has been reduced. This reduction most likely has been due to plague (Ecke and Johnson 1952; Lechleitner et al. 1968; Fitzgerald and Lechleitner 1974; Rayor 1985; Fitzgerald 1993). Poisoning may also have been a contributing factor, by promoting isolation and fragmentation of colonies (Clark 1989). Recent surveys indicate that GPD colonies are small, with fragmented distributions. Increased isolation decreases the likelihood that a colony can be re-colonized following a plague outbreak, as the distance between the infected colony and the nearest neighbor colony may be beyond dispersal capabilities. Isolation can be beneficial by protecting colonies from spread of plague, but can be detrimental to maintaining genetically healthy populations and re-establishing colonies after a die-off.

The cumulative impacts of agriculture, urbanization, shooting, plague, and oil and gas development in Colorado may have further effects over time, and collectively may have played a role in decline of GPD populations within the state. The majority of the GPD gross and predicted range occurs on private and tribal lands, which limits the ability of federal and state agencies to monitor and manage the species. The degree to which oil and gas development is impacting GPD populations is unknown, but development is increasing and the effects of this disturbance on populations should be evaluated. Shooting closures have not been implemented within Colorado, but CDOW does regulate shooting contests, allowing only 5 prairie dogs to be taken. Colorado is actively working on development of a rangewide long-term monitoring plan for the GPD to evaluate populations (Andelt et al. 2003). Pilot surveys using this new monitoring technique will be completed in 2005. In addition, the GPD has been included in Colorado's CWCS.

New Mexico

Distribution. GPDs occur in 16 counties in north-central, northwestern, and west-central New Mexico (Fig 4). They inhabit montane and alluvial valley habitats where grasslands encroach into, or are surrounded by woodland or forest elements (Hubbard and Schmitt 1983). They also occur in openings in brush, juniper, pine, and aspen habitats (Longhurst 1944; Findley et al. 1975). Topography and vegetation vary from arid lowlands to mesic intermountain valleys, benches, plateaus (Pizzimenti and Hoffmann 1973; Knowles 2002), playas, floodplains, croplands, and urban areas (Hubbard and Schmitt 1983). Estimated historical range (including unoccupied habitat) of the GPD in New Mexico is 12,246,934 ha (30,262,833 ac; derived from a GPD range-map in Hubbard and Schmitt [1983]).

Survey efforts.

1. In the early 1900s, biologists from the USDA recommended that prairie dogs be eliminated, due to the damage they caused to crops and rangeland forage (Merriam 1902; Bell 1921). This led to wide-scale poisoning of prairie dogs throughout the West (Roemer and Forrest 1996). Unpublished reports of rodent control operations in New Mexico from 1914-1974 described the treatment of 6,796,104 ha (16,793,539 ac) of lands inhabited by prairie dogs (Oakes 2000). In 1920, the BBS requested that prairie dog inventories be completed and maps produced depicting the distribution and extent of prairie dog occupation in order to plan and fund rodent eradication campaigns. In 1921, 3,129,005 ha (7,731,940 ac) of GPD occupied habitat were estimated to occur in New Mexico (Oakes 2000). Occupied habitat was remapped within the state in 1961, due to concern over the uncontrolled poisoning of prairie dogs that had occurred. In 1961, PARC ordered a survey of prairie dog populations in the U.S. by state and county (Oakes 2000). The results of the 1961 survey showed a 96% decline in occupied habitat as compared to the 1921 surveys, with GPDs occupying only 138,194 ha (341,485 ac) in the state. Based on county distribution, most of the prairie dogs left in the state in 1961 were GPDs, and most of the surviving populations were located on Navajo and other tribal lands. More prairie dog occupied habitat remained on tribal lands, because Native Americans resisted federal poisoning campaigns.

2. In 1971, the USFWS reported that GPDs occupied 14,210 ha (35,114 ac) in Catron County, 8693 ha (21,481) in McKinley County, and 12,607 ha (31,153 ac) in Valencia County (Ruffner 1980). In Catron County, 79 colonies were located, with a mean size of 180 ha (445 ac); 73 colonies were found in

McKinley County, with a mean size of 119 ha (294 ac); and 58 colonies were found in Valencia County, with a mean size of 217 ha (536 ac). These data were gathered on lands under federal, state, private, and tribal jurisdiction prior to cessation of prairie dog poisoning on public lands.

3. In 1979, 88 GPD colonies were located on 5 National Forests in both Arizona and New Mexico (Ruffner 1980). Of these 88 colonies, 32 were visited and 27 were mapped. Four of the mapped colonies were on the Cibola National Forest, which is partially located in Socorro, McKinley, and Catron counties; 6 colonies were on the Gila National Forest, which is partially located in Grant, Catron, and Sierra counties; and 3 colonies were mapped on the Apache-Sitgreaves National Forest, located in Catron County. Mean size of the Cibola colonies was 40 ha (99 ac). Apache-Sitgreaves mean colony size was 10 ha (25 ac). On the Gila National Forest, mean colony size was 127 ha (314 ac). Four additional colonies were selected for studies of prairie dog burrow structure and complexity, vegetation relationships, and population estimates. Three of the selected colonies were in New Mexico. One colony in south-central Catron County within the Gila National Forest had been mapped in 1969, at which time it measured 29 ha (72 ac). Mapping in 1979 in the same colony showed a 13-fold increase in occupied area to 385 ha (951 ac). The second colony mapped in central Catron County had 206 ha (509 ac) of occupied habitat in 1979, indicating a decrease from 254 ha (628 ac) in 1970. The third colony, located in Valencia County, also showed a decline of occupied area, from 162 ha (400 ac) in 1978 to 116 ha (287 ac) in 1979.

4. Bodenchuk (1981) attempted to determine occupied habitat of both BTPDs and GPDs in New Mexico from statewide surveys of 6941 agricultural producers. The results of this survey were dependant on extrapolated values based on the percentage of respondents and non-respondents, and have been criticized as being based on unwarranted assumptions (Hubbard and Schmitt 1983). The study showed that GPDs occurred in Bernalillo, Catron, McKinley, Rio Arriba, San Juan, San Miguel, Sandoval, Santa Fe, Socorro, Taos, Torrance, and Valencia counties and occupied 43,128 ha (106,572 ac) with 28,695 ha (70,907 ac) on private lands (66.2%); 6190 ha (15,296 ac) on state leased lands (14.8%); 4129 ha (10,203 ac) on BLM lands (9.5%); 172 ha (425 ac) on USFS lands (0.4%); and 3942 ha (9741 ac) on tribal lands (9.1%). From these surveys Bodenchuk (1981) estimated that BTPDs and GPDs occupied 201,141 to 209,926 ha (497,030-518,738 ac) statewide.

5. Hubbard and Schmitt (1983), using Bodenchuk's data (1981), calculated the level of prairie dog occupancy on a county-by-county basis was low, ranging from 0 to 0.98%. Based on Bodenchuk's low estimate of 201,141 ha (497,030 ac) of occupied habitat, Hubbard and Schmitt (1983) estimated an occupancy rate of 0.64% for the state. By comparison, in 1919 the area occupied by

BTPDs and GPDs was estimated at 4,836,570 ha (11,951,425 ac), or 15.3% of the state (Shriver 1965).

6. Surveys conducted in 1995 within the Negrito Creek watershed of the Gila National Forest suggested that GPDs had been extirpated, despite presence of suitable habitat (Frey 1995). USFS considered the GPD rare on the Gila National Forest (USDA Forest Service 1995).

7. In 1996, a survey of New Mexico's 4 northeastern counties (Union, Colfax, Mora, and Harding) was conducted to locate and map BTPD colonies (Sager 1996). GPDs were observed at 6 sites in western Colfax and Mora counties. In Colfax County, 3 GPD colonies were located between Angel Fire and Black Lake in the southern extremity of Moreno Valley. Three GPD colonies were also located in western Mora County.

8. A cooperative GPD habitat survey conducted by the BLM and San Juan College was completed in 2002 and 2003 on BLM lands in the Farmington Field Office (Farmington Field Office; Lorance et al. 2002; Yazzie and Sanders 2003). In 2002 and 2003, 7.5 minute topographic quadrangle sections were systematically surveyed for presence of prairie dog colonies (both active and inactive) and potential prairie dog habitat within the boundaries of the BLM/Farmington Field Office. Sections surveyed included Chimney Rock, Waterflow, Young's Lake, La Plata, Farmington North, Adobe Downs Ranch and Flora Vista, Star Lake, Pueblo Alto Trading Post, Cedar Hill, Mount Nebo, Anastacio Spring, Flora Vista, Aztec, Turley, Archuleta, Smouse Mesa, and Gonzales Mesa. All maps were cross referenced with land ownership and BLM land was identified and highlighted to prevent the accidental survey of state, private, or tribal lands that were not included in the study. The 2002 survey located 306 ha (756 ac) of occupied habitat in 16 colonies. The 2003 surveys located 133 ha (329 ac) in 10 colonies of which 4 (14 ha [35 ac]) were inactive.

9. Cook et al. (2003) examined the spatial relationship between nesting ferruginous hawks (*Buteo regalis*) and colonies of GPDs in 2 grassland ecosystems in New Mexico: the Estancia Valley in 1999 and 2000 and the Plains of San Agustin in 2000. Aerial surveys were conducted to locate GPD colonies, and in the spring and late summer colonies were visited on the ground to evaluate activity levels and map colony boundaries. Cook et al. (2003) found a total of 6 colonies within the Plains of San Agustin, with an average colony size of 33 $\pm$ 31 ha (82 $\pm$ 76.5 ac) and total occupied habitat equaling 214 ha (529 ac). The Estancia Valley had 43 active colonies in 1999, but only 27 of these were active in 2000. Reasons for the decline were not determined. One new colony was found in 2000, bringing the total to 28 active colonies. Twenty-five of these 28 colonies were mapped to determine

occupied habitat. The average colony size was 36 $\pm$ 31 ha (89 76.5 ac) and total occupied area was 919 ha (2271 ac).

10. In 2004, the BLM estimated occupied hectares on their lands within the Taos, Albuquerque, Socorro, and Farmington Field Offices (P. Sawyer, BLM, pers. comm.). Within the jurisdiction of the Albuquerque Field Office, 16 colonies encompassing 227 ha (561 ac) were documented, with colony size ranging from 0.4 to121 ha (1-299 ac). The Taos Field Office documented 13 colonies on 33 ha (82 ac), with colony size ranging from <1 to 16 ha (<2-40 ac). The Socorro Field Office documented 18 colonies on 252 ha (623 ac), with colony size ranging from <1 to 79 ha (<2-195 ac). The Farmington Field Office documented 24 colonies on 450 ha (1112 ac), with colony size ranging from <1 to 142 ha (<2-351 ac).

11. In 2001 and 2003/04, GPD colonies were mapped along a 69.4 mile stretch of U.S. Highway 491 (US 491), between milepost 15.3 and 84.7 in McKinley and San Juan counties (P. Knight, Marron Associates, pers. comm.). The entire US 491 survey occurred within the Navajo Indian Reservation. A total of 37 locations of prairie dog colonies were found. Although the prairie dog colonies documented in the area in 2001 were thriving, those encountered in 2003 in the same locations were either abandoned or nearly abandoned. None of the colonies found within or adjacent to US 491 in 2003 had active portions in excess of 2 ha (5 ac). In fact, many of the prairie dog burrows identified in the US 491 right-of-way during spring 2003 were filled in with sediment from storm events or clogged with vegetation by early fall of 2003.

12. In 2004, the New Mexico Department of Game and Fish (NMDGF) and the BLM requested that a feasibility study be completed using Digital Orthophoto Quarter Quadrangles (DOQs) to evaluate the potential of remote sensing to inventory occupied habitat within the range of GPDs in New Mexico (Johnson et al. 2004). This technique could be useful in New Mexico, since much of the GPD occupied habitat there occurs on private and tribal lands that have limited access, which makes accurate mapping difficult. In order to evaluate this potential inventory methodology, spatial data were collected from private consultants, federal, state, and tribal agencies that had completed field surveys for GPDs in New Mexico. The field data were collected from 1973-2004, with the majority coming from 2003 surveys. From these data, 153 points and 380 polygons (4694 ha [11,599 ac]) were compiled, of which 264 were active (3686 ha [9108 ac]), 107 were inactive (990 ha [2446 ac]), and 9 were of unknown status (18 ha [44 ac]). Colony sizes ranged from 0.01 to 398 ha (<0.02-983 ac) with mean colony size of 12 ha (30 ac).

    The 2004 survey indicated that accuracy of DOQ photo interpretation as a survey method for GPDs was lower than for BTPDs. The discrepancy was due to GPD burrows being less clumped and their colonies smaller on average

> than those of BTPDs. GPD habitat also is much more varied, with colonies occurring in various grassland habitats, including grasslands interspersed with woodland (pinyon, juniper, ponderosa pine) or scrubland (sage) habitat. Because of the problems encountered, DOQ surveys for GPDs were determined to be unfeasible at the present time (Johnson et al. 2004).

Predictive range model. Forty percent of the GPD gross and 45% of the predicted range occurs in New Mexico (Table 2; Fig. 4). Within New Mexico, 60% of the gross range and 72% of the predicted range is located on private and tribal land (Table 6). BLM land comprises 14% of the gross range and 15% of the predicted range, USFS land comprises 18% of the gross range and 4% of the predicted range, and state land comprises 6% of the gross and 8% of the predicted range (Table 6). Agricultural conversion impacts 99,786 ha (246,577 ac; <1%) of the gross range and 87,524 ha (216,277 ac; <1%) of the predicted range. Urban development impacts 122,967 ha (303,858 ac; <1%) of the gross range and 90,182 ha (222,845 ac; <1%) of the predicted range (Table 4). Currently there are 27,191 oil and gas wells in the gross range and 12,012 in the predicted range.

Summary. Poisoning of prairie dogs in New Mexico began in the late 1800s, and the U.S. Government entered the campaign in the early 1900s (Merriam 1902). Large scale control programs using strychnine grain were initiated by the BBS in 1914. Strychnine grain continued to be used for prairie dog control in New Mexico until the post-World War II period. Grain treated with compound 1080 was introduced in 1947 as a control measure and remained in use until 1972. Since 1972, different agents have been used to control prairie dogs, including strychnine, zinc phosphide grain, gas cartridges, and phostoxin tablets. Control of prairie dogs in New Mexico continues today but at small, localized scales and is not rangewide (B. Starnes, New Mexico Department of Agriculture, pers. comm.).

Sylvatic plague occurs throughout GPD range in New Mexico and periodic outbreaks devastate GPD populations. Cully (1989, 1993) described a plague outbreak that killed >99% of the GPDs in Moreno Valley, New Mexico between 1984 and 1987. The few prairie dogs that survived the epizootic were initially widely dispersed throughout the 100 km^2 (39 mi^2) valley, but aggregated into several new, small colonies the following spring (Cully et al. 1997). Compared to nearby colonies before the outbreak, juveniles in these new colonies grew at a faster rate, enabling them to better survive the winter and breed at an earlier age. This in turn led to increased growth in colonies; Cully et al. (1997) estimated the population tripled annually. However, as GPD densities recovered, another plague epizootic ensued and the population crashed again (Cully et al. 1997). By 1997, GPDs were present in the Moreno Valley, but colonies were small and scattered and had not recovered to what they had been prior to being impacted by plague in 1984.

There is no information on the current status of occupied habitat or population trends for the GPD in New Mexico. However, based on poison records and historical mapping, it appears that a substantial decline in occupied habitat occurred between the early 1900s and 1980s. Knowles (2002) estimated the former abundance of GPDs in New Mexico from historical records of hectares poisoned during prairie dog control efforts. Knowles (2002) estimated that in the early 1900s, more than 1,821,125 ha (4,500,098 ac) were occupied by GPDs in New Mexico, but by

1982 occupied habitat in New Mexico had declined to approximately 30,352 ha (75,001 ac). Data from 1921 to 1961 also indicated a decline in occupied habitat, from 3,129,005 ha (7,731,940 ac) identified in 1921 to 138,194 ha (341,485 ac) in 1961. Finally, Hubbard and Schmitt (1983) estimated occupancy for both BTPDs and GPDs at 0.64% of the state. By comparison, in 1919 the area occupied by both species of prairie dogs was estimated at 4,836,570 ha (11,951,425 ac) or 15.3% of the state (Shriver 1965).

In the absence of a current rangewide survey, it is unclear how the occupied range of the GPD has changed since the 1981 estimate. Today, GPDs have expanded their range into the Santa Fe area, where historically BTPDs occurred; east of Albuquerque into Torrance County, e.g. Moriarty and south in Estancia Valley; and are also present east of the Rio Grande in the Socorro area (Knowles 2002.). Although there have been documented declines in GPD occupied habitat, GPD populations appear to be stable, at least to the extent that the species' range is being maintained within the state (J. Stuart, NMDGF, pers. comm.; K. Podborny, Wildlife Services, pers. comm.; M. Murphy, USFWS, pers. comm.).

<u>Utah</u>

Distribution. GPDs occur in southeastern Utah in San Juan and Grand counties. They inhabit arid shrub-steppe and grassy lowlands and can be found at high elevations in sagebrush and mountain meadows in the La Sal Mountains. They occur in openings in juniper, aspen, and pine forests.

Survey efforts.

1. The first concerted effort to document prairie dog distribution and abundance throughout Utah occurred in 1968, when the Division of Wildlife, Bureau of Sport Fisheries and Wildlife (later renamed the Utah Division of Wildlife Resources [UDWR]) compiled a map of GPD, UPD, and WTPD colonies using knowledge from professional biologists throughout the state (Bureau of Sport Fisheries and Wildlife 1968). From this collaboration, it was estimated that 40,485 ha (100,041 ac) of prairie dogs existed within Utah, with approximately 8906 ha (22,007 ac) of occupied GPD habitat, 1214 ha (3000 ac) of UPD occupied habitat, and 30,364 ha (75,031 ac) of WTPD occupied habitat.

2. In 1984, a survey of GPD colonies was conducted to evaluate potential for black-footed ferret occupation on BLM administered land in San Juan County (BLM 1984). From this survey, 8 colonies were located on 895 ha (2212 ac). The mean size of the colonies located and mapped was 112 ha (277 ac).

3. In 2002, UDWR attempted to locate and map GPD colonies on public lands in Grand and San Juan counties excluding tribal lands (Seglund 2002). Most colonies located were active and had high densities of prairie dogs. A total of 1534 ha (3791 ac) in 22 colonies were mapped, with 1492 ha (3687 ac) containing active colonies. The mean size of the colonies mapped was 70 ha (173 ac). Sixty-three additional active colonies were located during surveys on private land that

could not be accurately mapped due to trespass restrictions. Most of these colonies were estimated to be <10 ha (<25 ac) in size.

Predictive range model. Four percent of the GPD gross range and 3% of the predicted range occurs in Utah (Table 2; Fig. 5). In Utah, 38% of the gross range and 56% of the predicted range is located on tribal or private land within the state (Table 7). BLM land comprises 42% of the gross range and 34% of the predicted range, USFS land comprises 11% of the gross range and 2% of the predicted range, and state land comprises 7% of the gross and predicted ranges (Table 7). Agricultural conversion impacts <1% of the gross (69,867 ha [172,645 ac]) and predicted (68,956 ha [170,394 ac]) ranges. Urban development impacts 327 ha (808 ac; <1%) of the gross range and 302 ha (746 ac; <1%) of the predicted range (Table 4). Currently, there are 3256 wells in the gross range and 590 in the predicted range.

Summary. Due to lack of information within the state of Utah with regard to population trends and changes in occupied habitat, GPD status in the state could not be determined. Based on the 2002/03 survey data, colonies located on private agricultural areas had high densities of animals, while those located in more natural settings occurred at lower densities. A number of mapped colonies were isolated from other colonies because they were surrounded by unsuitable habitat (e.g. forested habitat, very dense sagebrush, steep sloped areas) or because they were outside dispersal distance from a neighboring colony. If these isolated colonies become impacted by plague or are poisoned out, they may not be re-colonized through natural immigration.

Human disturbances on GPD habitats in Utah are limited mainly to shooting, oil and gas development, and agriculture. Shooting closures during the breeding season (1 April-15 June) were implemented in 2003 on all public lands, but shooting remains unregulated on private lands. Oil and gas development within GPD habitat has accelerated within the past few years. In 2002, Utah ranked 14th in the United States in crude oil production and 12th in natural gas (marketed) production, including federal offshore areas (Utah Department of Natural Resources 2004). How oil and gas exploration and development are impacting GPDs is still unknown, but will need to be determined to better manage this species. Utah, in cooperation with Colorado, is developing a long-term monitoring program for the GPD to evaluate the health of populations (Andelt et al. 2003) and the state has added the GPD to its state "Sensitive Species List" and included it in their CWCS.

CURRENT MANAGEMENT STATUS BY STATE

ARIZONA

The GPD in Arizona is considered a nongame species. The legal definition of nongame wildlife in Arizona includes all wildlife except game mammals, game birds, furbearing animals, predatory animals, and aquatic wildlife. Many nongame species can lawfully be taken under the auspices of Arizona hunting, trapping, or fishing licenses (legal definition based on A.R.S. Title 17.101). In 2002, AGFD established a seasonal shooting closure for GPDs from 1 April to 15 June on public and private lands. There is no bag limit on prairie dogs during the open season, but AGFD monitors take through a small game questionnaire that has been in place since 2000 (B. Van Pelt, AGFD, pers. comm.). AGFD currently has no management plan for the GPD, but includes it in their CWCS as a vulnerable species.

Under the Arizona Department of Agriculture, the GPD has no status and is not actively managed for. Wildlife Services conducts some control of this species when it becomes a concern to human health and safety. Currently, most control work is being conducted in urban areas around Flagstaff and St. Johns, with no control work on BLM or USFS lands. The hectares controlled vary year-to-year, but are usually less than 405 ha/year (1000 ac/year; M. Burrell, Wildlife Services, pers. comm.). AGFD is developing a program to relocate GPDs when colonies are being encroached on by urbanization and has awarded a grant to Habitat Harmony Inc. to help in this effort. No further relocations are planned until additional funding is made available to monitor relocation efforts. To help decrease GPD occupation in urban areas, AGFD also developed a brochure that informs the public on plants to use in urban landscapes that do not attract prairie dogs (M. Burrell, Wildlife Services, pers. comm.).

There are 3 BLM Field Offices within GPD range in Arizona: Phoenix, Arizona Strip, and Safford. The GPD is not on the BLM's "Sensitive Species List" and none of the current Resource Management Plans address conservation measures for this species. The USFS also does not have the GPD on its "Sensitive Species List" and provides no conservation measures for the species.

COLORADO

The GPD is classified as a small game species under Colorado Wildlife Commission Regulation #300 A.2. Colorado includes the GPD in their CWCS as a "Species of Greatest Conservation Need." In addition, their CWCS identifies sagebrush as a habitat type of highest concern in the state for mammals. Colorado is currently working with Colorado State University to develop a long-term monitoring plan for the GPD (Andelt et al. 2003).

Regulation #302.B sets the lawful methods of take of GPDs, which include rifles, handguns, shotguns, handheld bows, crossbows, pellet guns and slingshots, hawking, and toxicants. A small game license is required to take prairie dogs, except for private landowners, whose immediate family members and designees may take prairie dogs causing damage on their lands. The season statewide is year-round, with no bag or possession limits (#308). However, participants in shooting contests can take no more than 5 prairie dogs during an event (Regulation #302-1.a.1). No take is permitted on National Wildlife Refuges.

Colorado collects harvest information on small game species, including prairie dogs. This information can be obtained at:
http://wildlife.state.co.us/hunt/Small_Game/harvest_statistics/02-03/small_game_harvest.pdf

All sportsmen who hunt small game in Colorado are required to sign up for the Harvest Information Program (HIP). HIP or MBHIP (Migratory Bird Harvest Information Program) is a national program originally designed to provide USFWS with a means of improving nationwide harvest estimates of migratory birds. Sportsmen are required to sign up annually and to provide a current address (and in Colorado, a phone number). This enables the resource agency to contact hunters more effectively for post-season harvest surveys. Colorado has piggybacked onto the national program to include all small game hunters, in hopes of improving harvest estimates of resident small game species. A number of small game-related harvest surveys are also conducted by phone. Surveys are conducted each spring, following conclusion of the majority of small game seasons.

Prairie dogs (BTPD, WTPD, and GPD combined) are 1 of 23 species included in Colorado's General Small Game Survey. Each year, a random sample of 10-15% is drawn for the general small game survey from among the hunters signed up for HIP for the current season. In 2002/03, 70,159 hunters signed up for HIP. A sample of 8289 hunters (12%) was drawn. The survey contractor attempts to reach each individual a maximum of 3 times before moving on to the next name. After a reasonable amount of time, the survey is terminated. In general, results from the small game survey provide a fairly precise estimate of harvest for resident small game species. It is more difficult to estimate harvest for prairie dogs, but it is the best available data on harvest for the state.

There are several reasons for the inability to provide good harvest estimates for prairie dogs. First, Colorado regulations do not specify a bag limit for prairie dogs as is found with the majority of small game species. Second, because prairie dogs are not "hunted" in the traditional manner, there are relatively few hunters. Low hunter numbers make it difficult to randomly sample enough hunters to provide the basis for a reasonable estimate of harvest. This is difficult at a statewide level and becomes very problematic at the county level, where 1 or 2 hunters may form the basis for the estimate.

Because Colorado has no bag limit for prairie dogs, the number reported harvested by individual hunters varies considerably. For the 2002/03 survey, individual hunters reported harvesting from 0 to 2000 prairie dogs. The large variation greatly increases variance around the harvest estimate. In comparison, individual pheasant hunters (bag limit of 3, and 9 in possession) reported harvesting 0 to 90 birds, and of those hunters 94% had harvested 1 to 10 birds. The variance around this harvest estimate is much smaller and allows for a much greater level of precision.

The variance in numbers harvested and the relatively small number of hunters contacted through the survey (especially at the county level) make the situation even more difficult. In 2002/03, the survey began with a sample of 8289 hunters, of which 3562 were contacted. Of these, 212 reported hunting prairie dogs and 189 reported harvesting prairie dogs. In comparison, the number of pheasant hunters contacted was 843. The limitations of the survey for prairie dogs are further illustrated by noting the number of hunters contacted for individual counties. Hunters reported hunting prairie dogs in 43 counties. The number of hunters contacted for a given county ranged from 1 (8 counties) to 23 (1 county). The number of counties with 10 or fewer hunters contacted was 37.

Because of the wide variation in numbers harvested as well as the need to estimate harvest based on the response of a small number of individuals, Colorado's prairie dog estimates should always be accompanied with the standard errors and ranges around the estimates that are provided on the

CDOW home page. This information makes it clear that the estimates are not nearly as precise as others generated via the General Small Game Survey.

The CDOW recognizes the limitation of current surveys for accurately estimating prairie dog harvest and has revised hunting survey to improve prairie dog harvest estimates. These improvements are in place for the spring 2005 survey period.

The Colorado Department of Agriculture classifies the GPD as a pest (J. Miller, Colorado Department of Agriculture, pers. comm.). It currently does not practice any control of prairie dogs, due to lack of funding, but provides technical assistance to landowners. Some toxicants, including zinc phosphide and aluminum phosphide, may be used by licensed applicators to control GPDs, under regulation by the Colorado Department of Agriculture or the EPA. Gas cartridges can be used without a license. Relocation of prairie dogs requires a permit that must include a management plan specifically addressing the applicant's long-term plans for maintenance or control of relocated prairie dogs (Regulation #302A.3).

Five BLM Field Offices are within the range of the GPD in Colorado: San Juan, San Luis, Gunnison, Uncompaghre, and Canon City. None of the current BLM Resource Management Plans provide conservation measures for this species which is not on their "Sensitive Species List". However, if oil and gas occur within GPD occupied habitat, development can be relocated 200 m (656 ft) from the original site designation (W. Anderson, BLM State Office, pers. comm.). The USFS also does not include the GPD on their "Sensitive Species List" and they provide no conservation measures for the species.

NEW MEXICO

The GPD is informally considered a "Wildlife Species of Concern" but it is not regulated by the NMDGF and has no special conservation status. NMDGF does include the GPD in their CWCS. The CWCS also identifies the Intermountain Big Sage Community, which is within part of the GPD range, as one of their priority habitat types. In New Mexico, GPDs may be taken throughout the calendar year without a permit by residents. Non-residents require a valid New Mexico hunting license (of any type) to legally take GPDs within the state. Recreational shooting of nongame wildlife, such as the GPD, is prohibited on State Trust Lands and Wildlife Management Areas.

State statutes direct the New Mexico Department of Agriculture to eradicate prairie dogs when they are causing problems. However, the New Mexico Department of Agriculture does not conduct the prairie dog control itself. Rather, it licenses private individuals for application of toxicants that may be used on prairie dogs, and has a contract with Wildlife Services to carry out control efforts as requested by landowners (B. Starnes, New Mexico Department of Agriculture, pers. comm.). The New Mexico Department of Agriculture is developing a protocol to safely relocate GPDs.

Wildlife Services maintains cooperative wildlife damage personnel in areas where occupation of GPDs or other depredating wildlife warrant. Currently, control is occurring in Taos County, with most control occurring on small agricultural farms, urban areas, and airports (K. Podborny, State Director of Wildlife Service in New Mexico, pers. comm.). Very rarely does rangeland control occur. In Santa Fe (by city ordinance) and Albuquerque (by city policy), prairie dogs are relocated when new development threatens occupied habitat or when they occur on city property. Currently, 5 counties have ordinances that do not allow GPDs to be relocated within their boundaries.

In New Mexico, 4 BLM Field Offices are within GPD range: Farmington, Albuquerque, Taos, and Socorro. None of the current BLM Resource Management Plans provide conservation measures for this species. Although conservation measures are not mentioned with regard to oil and gas development, wells can be relocated if they are planned in an active colony (J. Kendall, Farmington Field Office, pers. comm.). The GPD is not considered a "Sensitive Species" by the USFS and there is no management plan for the species.

UTAH

The GPD is designated as a nongame mammal in Utah under Rule R657-19-2. The GPD is on the UDWR "Sensitive Species List" (UDWR 2003), which was prepared pursuant to The State of Utah, Division of Wildlife Resources Administrative Rule R657-48. By rule, wildlife species that are federally listed, candidate for federal listing, or for which a conservation agreement is in place are automatically placed on the list. Additional species on the Utah list are "wildlife species of concern" for which there is credible scientific evidence to substantiate a threat to continued population viability. The list is intended to stimulate development and implementation of management actions sufficient to preclude the need for federal listing of these species under the ESA. Utah has included the GPD in their CWCS as a Tier II species (Utah Species of Concern). They have also identified both shrubsteppe and grasslands as key habitats in the CWCS.

R657-19 provides the standards and requirements for taking and possessing nongame mammals (GPDs) under authority of State Statute (23-13-3, 23-4-18, 23-14-19). The live capture of prairie dogs and other nongame mammals is governed by Rule R657-3; Collection, Importation, Transportation and Subsequent Possession of Zoological Animals. Take of GPDs is prohibited on public lands from 1 April through 15 June, but they may be taken on private lands year-round. No license is required to take GPDs (R657-19-10); they may be taken without bag or possession limits (R657-19-5).

The Utah Department of Agriculture classifies the GPD as a depredating animal (Sec. 4-23-3, definition (5)) and maintains jurisdiction on damage issues. Little control work currently is being done in Utah. Wildlife Services is rarely requested to assist land owners in control efforts and poison grain baits have not been requested for at least 8 years (M. Bodenchuk, State Director for Wildlife Services in Utah, pers. comm.).

The GPD in Utah is considered a "Sensitive Species" by both the BLM and USFS. The BLM in Utah is currently revising its Resource Management Plans. In the new plans, BLM will consider the GPD in special status species alternatives. Within these new plans, the BLM proposes to manage habitat for prairie dogs according to USFWS and UDWR recommendations, develop cooperative agreements with other agencies to inventory prairie dog densities, and provide suitable habitat for expansion, restrict off-highway vehicle (OHV) use to designated roads, protect active colonies, and require buffer zones from new road and oil and gas development, and adjust grazing to allow spring plant growth (livestock off by March 31; P. Riddle, BLM, Moab Field Office pers. comm.; T. Wallace, BLM, Monticello Field Office pers. comm.).

RISK ASSESSMENT

The 23 February 2004 petition to list the GPD under the ESA asserted that all 5 USFWS ESA listing criteria apply to the species (Forest Guardians et al. 2004). In this Risk Assessment, current information regarding threats is summarized, followed by an evaluation based on current understanding of each identified threat. From this evaluation, options to be considered in a conservation strategy, and recommended research needs are discussed.

The threats to the GPD that will be evaluated in the USFWS's 90-day finding are:

1) The present or threatened destruction, modification, or curtailment of its habitat or range
2) Over-utilization for commercial, recreational, scientific, or educational purposes
3) Disease or predation
4) Inadequacy of existing regulatory mechanisms
5) Other natural or man-made factors affecting its continued existence

1) PRESENT OR THREATENED DESTRUCTION, MODIFICATION, OR CURTAILMENT OF HABITAT OR RANGE

<u>Current information</u>

Throughout the 1800s and 1900s, lasting changes in GPD habitat have occurred. They resulted from conversion of rangelands to seeded pastures and croplands, urbanization, oil/gas exploration and extraction, intensive livestock grazing, alteration in fire regimes, and proliferation of non-native plant species. How these changes have affected GPD populations is difficult to quantify, since information is not available regarding populations prior to human induced alterations across the western landscape. Possible consequences of these impacts are presented below.

Agricultural land conversion. Agricultural lands affect less than 3% of GPD gross range. Agricultural land conversions in conjunction with historic eradication efforts have caused population declines on these lands for the GPD (Knowles 2002). Prairie dogs were not tolerated on agricultural croplands and disturbance by them on cultivated lands brought about control or eradication of local populations. Agricultural lands, however, have also benefited GPDs by providing highly-productive forage in place of their native arid landscape. GPD burrows can be found adjacent to agricultural fields in previously unsuitable areas, and in these areas very high population densities can be attained. UPD densities are lower at sites not associated with agriculture (16 prairie dogs/ha [6/ac]), and higher at sites associated with alfalfa fields (36 prairie dogs/ha [15/ac]; Crocker-Bedford 1976). Differences in densities were attributed to differences in quantity and quality of available forage.

Urbanization. Urbanization affects less than 1% of the GPD gross range and less than 2% of the predicted range. Although direct eradication of prairie dogs, habitat fragmentation, and colony isolation occurs in urban landscapes, they affect a very small portion of the GPD range. Irrigation of lawns and pastures, which accompanies urbanization, may somewhat offset the negative impact to GPDs by providing succulent, high quality forage.

Oil/Gas exploration and extraction. Within GPD range, areas have been classified as valuable for oil and gas development. Possible direct negative impacts associated with oil and gas development include clearing and crushing of vegetation, reduction in available habitat due to pad construction, road development and well operation, displacement and killing of animals, alteration of surface water drainage, and increased compaction of soils (USFWS 1990). Vibroseis (seismic exploration) may also affect prairie dogs by collapsing tunnel systems, causing auditory impairment, and disrupting social systems (Clark 1986). Indirect effects include increased access into remote areas by shooters and OHV users. Gordon et al. (2003) found that shooting pressure was greatest at colonies with easy road access as compared to more remote colonies. Conversely, oil and gas development may provide areas with a reduction in shrub cover providing prairie dogs additional habitat to colonize.

Livestock grazing. One of the most significant human-induced changes affecting the western landscape has been widespread introduction of domestic livestock. By 1890, hundreds of thousands of cattle and large numbers of sheep were introduced within the range of the GPD. Evaluating the influence of domestic livestock grazing on GPD habitats and populations is problematic. Non-grazed habitats within the GPD range are rare and clear ecological benchmarks do not exist against which to evaluate changes. Also, determination of rangewide effects is difficult because the impact of grazing on ecological communities inhabited by GPDs has varied depending on site potential, ecological condition, climate, timing, and intensity of grazing. Overall, assessments of livestock grazing throughout the West indicate it has had profound ecological consequences including alteration in species composition within plant communities, disruption of ecosystem function, and alteration of ecosystem structure (Fleischner 1994).

Alteration of plant species composition by grazing occurred due to active selection of preferred species by livestock and differential vulnerability of plants to grazing (Fleischner 1994). Livestock grazing contributed to establishment and proliferation of exotic plant species by destabilizing plant communities, creating microsites conducive to colonization by exotics, and dispersal of exotic seeds in fur and dung. Some of the long-term changes incurred due to grazing were changes in vegetation from predominantly grasslands to browse range (Cottam and Stewart 1940 <u>as interpreted by</u> Collier and Spillett 1975), loss of early cool season forage, and proliferation of non-native annual grasses (Crocker-Bedford 1976; Beck 1994; Young et al. 1972 and 1976 <u>as interpreted by</u> Crawford et al. *In press*). Alteration in plant species composition may have affected habitat suitability for the GPD by decreasing forage availability during critical periods (e.g. as juveniles emerge, prior to hibernation, during the reproductive season), degrading the overall quality and quantity of forage, and reducing biological diversity that had historically allowed GPDs to consume different plant species and parts of plants as plant phenology progressed. Ritchie (1999) found that frequency of extinction at UPD colonies increased dramatically as the number of locally occurring plant species decreased.

Disruption of ecosystem function by livestock grazing in arid environments is partly due to livestock degradation of cryptogamic crusts (Fleischner 1994). These crusts play a major role in nutrient cycling (Rychert et al. 1978), provide favorable sites for germination of vascular plants (St. Clair et al. 1984), and are important to soil hydrology (Fleischner 1994). Research on UPDs indicates these changes could impact GPD by affecting forage availability (Ritchie 1999).

Overgrazing in arid areas causes formation of deep, erosive arroyos (Cottam 1961), increased soil compaction, and decreased water infiltration (Kauffman and Krueger 1984; Abdel-Magid et al. 1987; Ordoho et al. 1990). Because of these impacts, surface runoff has increased and water tables lowered resulting in less water being available for the shallow root zone of grasses and forbs but more accessible for deep rooted shrubs (Walker and Noy-Meir 1981; McAuliffe 1995 as interpreted by Oakes 2000). These impacts have resulted in altered ecosystem structure. There are estimates that over 1,618,800 ha (4,000,142 ac) of western rangeland have undergone this sort of change (Dregne 1983 as interpreted by Fleischner 1994), which could have impacted GPDs by decreasing availability of forage and causing an increase in woody shrubs.

Vegetation in arid areas inhabited by UPDs and GPDs is not adapted to long duration grazing or repeated growing season grazing by large ungulates. Poor rangeland management has caused a decline in occupied habitat and population densities for the UPD (Collier and Spillett 1975). Similar impacts to the closely related GPD are suspected, although unproven at present, due to lack of research. Conversely, well managed grazing has been found to benefit BTPD populations by creating increases in short grass species such as blue grama (*Bouteloua gracili*) and buffalograss (*Buchloe dactyloides*; Osborn 1942; Osborn and Allen 1949; Norris 1950; Smith 1958; Koford 1958).

Altered fire regimes. Beginning in the 1890s, fires decreased in frequency and intensity in the southwestern U.S. (Bahre 1991; Swetnam et al. 1999 as interpreted by Oakes 2000). Settlement resulted in active suppression of wildfires, and grazing reduced biomass on the ranges resulting in less intense fires (McPherson 1995 as interpreted by Oakes 2000). The reduction in fire frequencies and lower fire temperatures over the past century may have contributed to changes in vegetation. The end results of altered fire regimes are fluctuations in herbaceous cover from year-to-year, expansion of woody species, shortened seasonal availability of green plant material, a decrease in high quality perennial forbs, and absence of forage in the late summer (Crawford et al. *In press*).

Alteration of fire regimes is also affected by exotic plant species such as cheatgrass. Cheatgrass seeds germinate in fall and grow during winter, with seed heads maturing in spring and early summer. Unlike native bunchgrasses, cheatgrass is an annual and begins to die in late July. Dead cheatgrass burns easily resulting in early, abundant, and hot wildfires that tend to damage or kill native grasses. After a fire has impacted an area, early-maturing cheatgrass seeds take advantage of the many nutrients the fire releases to out-compete native plant species.

Evaluation

Agricultural land conversion. Within the gross range of the GPD, agriculture impacts 835,243 ha (2,063,930 ac) or less than 3% of the gross range (Table 1). Although GPDs may not be tolerated on these lands, this acreage represents a small amount of habitat within the gross range of the species. Thus, overall habitat loss to agriculture is significant only on a local scale and is not rangewide concern.

Urbanization. In the gross range of the GPD, a number of large metropolitan areas exist including Flagstaff, Albuquerque, and Santa Fe. Within the gross range, 233,681 ha (577,438 ac) are impacted by urbanization, or less than 1% of the total (Table 4). Thus, overall habitat loss due to this type of disturbance is significant only at a local scale and is not a rangewide concern.

Oil/Gas exploration and extraction. Oil and gas development is occurring at an unprecedented rate, particularly on BLM lands, but the long-term effects of oil and gas development on GPDs are unknown. Many BLM Field Offices do not address maintaining habitat for expansion and shifts in occurrence outside of currently mapped colonies, and do not address the impact of road development and the potential for an increase in shooting/direct take of GPDs as a result of oil and gas development.

Livestock grazing. The numbers of sheep and cattle on western rangelands peaked in the early 1900s, with livestock grazing centered on season-long use and stocking rates routinely exceeding carrying capacity of habitats (Cottam and Stewart 1940 as interpreted by Collier and Spillett 1975; Young and Sparks 1985 as interpreted by Crawford et al. *In press*). Within the last 40 years, stocking rates have been reduced by more than 25% (USDI-BLM 1990). Concurrent with these reductions, public rangelands have improved (Box 1990; Laycock et al. 1996 as interpreted by Crawford et al. *In press*). However, intervention may need to be continued to restore the ecological health of western rangelands. Even so, the BLM still considers over 68% of the lands it manages to be in "unsatisfactory" condition (US General Accounting Office 1991 as interpreted by Fleischner 1994).

Significant vegetation changes have occurred on desert grasslands in the West, including an increase in density of woody shrubs, which were present historically but at lower densities. The increase in woody shrubs may not only be due to livestock grazing, but also to fire suppression, climate change, erosion, and removal of prairie dogs from previously occupied areas. In addition, cheatgrass and other nonnative species such as Dalmatian toadflax (*Linaria dalmatica*), leafy spurge (*Euphorbia esula*), and camelthorn (*Alhagi pseudalhagi*, which are primarily spread by livestock grazing and wind, have colonized areas within GPD range. Replacement of native perennial grasses and forbs by nonnatives such as cheatgrass has been extensive in the range of the GPD. Cheatgrass reaches maturity in early summer and then dies, providing little nutrition and moisture either above or below ground for herbivores during the long summer months (Stubbendieck et al. 1997). CDOW currently is involved with several cheatgrass related projects, including experimenting with herbicide applications to control this nonnative grass (J. Garner, CDOW, pers. comm.). In Utah, both UDWR and the BLM are working to control invasive weeds and cheatgrass by spraying herbicides followed by active planting of sagebrush, grasses, and forbs (T. Wallace, BLM, pers. comm.).

Altered fire regimes. Alteration in fire regimes within the range of the GPD has produced changes in structure and function of plant communities. Specific habitat requirements of both UPDs and BTPDs include height and composition of vegetation (Collier 1975; Crocker-Bedford and Spillett 1981; Player and Urness 1982; Clippinger 1989; Reading and Matchett 1997). Habitat associations of GPDs have not been examined over a large number of colonies or across a large geographic area, but vegetation changes associated with altered fire frequency may be affecting the species' distribution. Improvements the BLM is making on rangelands have the potential to improve conditions to restore historical fire frequencies.

Conservation options for a conservation strategy

The ability of resource managers to address the impacts of habitat alteration (conversion and loss) on management of species at a landscape scale has improved significantly, due to advanced technologies. For example, GIS data can be used to discern the spatial pattern and location of suitable habitat. Knowledge of where habitat loss has occurred on both local and landscape scales, in conjunction with graphical depictions of these spatial patterns, is crucial for proper management of GPDs. Identifying habitat patches and corridors between these patches will help determine the long-term viability of local populations, probability of dispersal among populations, and important areas for conservation. Crucial areas identified during these analyses should be incorporated into Resource Management Plans, with conservation actions focused on protecting occupied and potentially occupied habitat, protecting corridors for immigration and emigration, and allowing maintenance and expansion of GPD colonies and complexes. In addition, conservation of GPD habitat on private lands may be addressed by using private landowner incentive programs.

Oil and gas development should be designed to minimize adverse impacts on existing GPD colonies and potential habitat. To assess impacts at proposed sites, GPD occupied and potential habitat should be documented prior to development. A minimal analysis should include mapping of suitable and occupied habitat, use of GIS to determine spatial distribution of these areas, estimates of local population densities, and evaluation of dispersal potential between suitable habitat patches within each complex (e.g. between colonies). Baseline information will help determine whether the loss of occupied and suitable habitat due to resource extraction activities could be mitigated by managing other suitable habitat within a proposed project site and/or avoiding suitable and occupied habitat entirely and allowing development only in habitat not suitable for GPD occupation. In addition, project design of oil and gas facilities in and adjacent to occupied and suitable habitat should include location of wells and roads outside of these areas, consideration of directional drilling when wells are proposed within suitable and occupied habitat, timing restrictions of vehicle travel to periods when GPDs are less active, and regulation of type of vehicle traffic. Guidelines should be developed to aid decision-makers in designating when and where to permit planned resource extraction and what steps must be followed to ensure long-term maintenance of GPD populations. Also, because knowledge of the effects of resource extraction on GPD populations is limited, monitoring should be conducted at sites before, during, and after development. Finally, the enforcement of well reclamation should be improved.

It is beyond the scope of this document to provide a complete review of Resource Management Plans related to livestock grazing, but a reevaluation of management goals and strategies on BLM lands to improve native habitats that benefit GPDs should be considered using additions and/or amendments to Resource Management Plans. In general, based on individual land manager decisions, ecological health could be improved by instituting the following practices in GPD occupied areas:

1. Allow periodic rest or deferment from grazing during times of crucial growth and seed dispersal and establishment. Fencing of high priority areas should be considered.
2. Develop grazing management practices that consider the season, duration, distribution, frequency, and intensity of grazing use on areas to maintain sufficient vegetation on both upland and riparian sites to protect the soil from wind and water erosion, to assist in maintaining appropriate soil infiltration and permeability, and to buffer temperature extremes. Emphasize maintenance of native plant species and natural re-vegetation to support and sustain ecological functions and site integrity. Reseeding of disturbed and burned areas should be done using native, locally adapted, plant species, where appropriate.
3. Incorporate use of mechanical, chemical, and biological methods of weed control to manage noxious weeds, where appropriate.
4. Natural occurrences such as fire, drought, and flooding and prescribed land treatments should be integrated with livestock management practices to move toward sustainability of biological diversity across the landscape, including maintenance, restoration or enhancement of habitat to provide natural vegetation patterns, a mosaic of successional stages, and vegetation corridors.

Conservation actions should be implemented on a rangewide scale and coordinated at a multi-state level. After conservation actions are implemented, continued long-term monitoring of GPD populations should be conducted to evaluate effectiveness of programs. A monitoring protocol has been developed by Colorado State University, CDOW, and UDWR (Andelt et al. 2003) and is currently being implemented in Colorado and tested in Utah. This protocol uses occupancy rate, instead of mapped occupied habitat, to monitor spatial and temporal population changes throughout the range of the GPD. This methodology provides an objective, repeatable estimation technique to measure the response of GPD populations to factors affecting their viability.

Research needs

Studies should be conducted to identify habitat characteristics required to maintain viable GPD populations and to address the direct and indirect effects of land conversions on GPDs. Research needed to better manage GPD populations includes, but is not limited to:

- Determine the effects of timing and intensity of grazing regimes on GPD habitat use
- Determine the effects of agricultural land conversions on population densities, reproductive output, and long-term viability
- Determine the effects of fragmentation and development of barriers due to urbanization and agricultural development on dispersal and maintenance of colonies
- Determine the spatial and temporal effects of fire on GPD colonization rates and re-colonization rates
- Determine differences between non-native annual grasses and native plants in effects on population trends, reproductive output, and viability over the long-term
- Monitor impacts of range restoration treatments, such as green-stripping with forage kochia on GPD populations
- Evaluate changes in distribution and population densities at sites prior to, during, and after oil and gas development
- Evaluate colonization rates after wells are removed
- Monitor vegetation changes after wells are constructed and when they are removed
- Evaluate the effects of Vibroseis on GPDs
- Examine the genetic structure of GPD metapopulations

2) Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Current information

Shooting. Limited research exists on the long-term effects of shooting on prairie dog populations, and research conducted thus far has focused on BTPDs. Extrapolation of the data to GPDs can only be inferred, but in general the data may be relevant. Below is a summary of studies that have been conducted:

- Stockrahm and Seabloom (1988) compared reproductive rates on 2 colonies that experienced intensive recreational shooting to 2 colonies that did not. They found that colonies experiencing heavy recreational shooting pressure had fewer males, smaller litter sizes, and very few females breeding as yearlings. They suggested that shooting disrupted the BTPD social system.
- Knowles (1988) conducted a controlled experiment on 2 colonies subjected to shooting and 1 that was not. The results showed that shooting reduced prairie dog activity levels. By the second year of shooting, the smallest colony had been extirpated.
- Vosburgh and Irby (1998) compared 18 prairie dog colonies in areas protected from recreational shooting in 1994 and 1995 to those open to shooting. Colonies subjected to shooting declined more than colonies not subjected to shooting (15% versus 35%) and prairie dogs were more vigilant in shot

colonies. The authors postulated that recreational shooting might, with additional research, be an effective management tool to limit populations but was not a viable technique to eliminate prairie dogs.

- Vosburgh (1999) compared 4 colonies subjected to shooting to 3 colonies without shooting on Fort Belknap Reservation, Montana. The number of prairie dogs declined by 20% on shot colonies and by 10% on colonies without shooting.
- A review conducted by the CDOW et al. (2002) described the effects of shooting closures on prairie dog populations at black-footed ferret reintroduction sites. The sources of information for this review included black-footed ferret allocation proposals and communication with individuals participating in reintroduction efforts. The non-quantified results of the review showed that shooting restrictions at some sites positively influenced abundance of BTPDs. There were no data to adequately address shooting closures and their effectiveness on WTPD populations. Though shooting closures have been established in some states, there currently are no data to adequately measure their effectiveness at maintaining and/or expanding WTPD populations. In Utah, WTPD population estimates derived from black-footed ferret habitat surveys in Coyote Basin (closed to shooting) do not appear to differ significantly from similar surveys conducted in the Uintah Basin at sites that have not been closed to shooting (Seglund et al. *In press*).
- Gordon et al. (2003) examined the effects of shooting on BTPDs at the Thunder Basin National Grassland, in northeastern Wyoming. They found that shooting did not appear to substantially affect BTPD behavior, short-term population levels, or physiology. High levels of shooting did result in mass emigration from the study plot.
- Pauli (2005) examined the direct and indirect effects of shooting on 10 BTPD colonies on private lands surrounding the Thunder Basin National Grassland. The colonies were paired (one treatment and one control colony), with treatment colonies subjected to a pulse of shooting to reduce prairie dog abundance by 30%. On treatment colonies, survivors exhibited an 8-fold increase in alert behavior and reduced their above-ground activity by 66%, ultimately decreasing the amount of time spent foraging. This change in foraging behavior resulted in decreases in the body condition (by 35%) and increased flea loads (by 30%). Although lowered body condition did not affect overwinter survival, reproduction was reduced. Pregnancy rates declined by 50% and reproductive output fell by 76%. Thus, BTPDs did not exhibit compensatory natality in response to shooting that made them capable of quickly recovering to pre-shooting densities.

Shooting in GPD habitats consists mainly of local shooters as opposed to the large numbers of nonresidents participating in the shooting BTPDs (Knowles 2002). Gordon et al. (2003) found a dichotomy between local and out-of-state shooters, with out-of-state shooters spending more time shooting prairie dogs and using customized guns, rests, and other equipment to improve their accuracy. BTPDs are the preferred target of non-resident hunters because colony boundaries are easily discernible, colonies have higher densities of prairie dogs, mounds are more conspicuous, and the colony is generally more open and devoid of plants that might obscure a shooter's vision.

Today, many shooters use weapons that enable them to be consistently accurate at distances of greater than 366 m (1200 ft) and to take significant numbers of prairie dogs each day. A study conducted by the BLM and Montana Fish, Wildlife and Parks indicated the average shooter hits 60 BTPDs per day during 7 hours of shooting (Knowles and Vosburgh 2001). Additional studies have documented shooters discharging approximately 150 rounds per day, hitting 40-50 BTPDs, while other studies documented shooters spending 2 to 3 days shooting and killing about 200 BTPDs during their visit (Vosburgh and Irby 1998; Vosburgh 1999). The Lower Brule Sioux Reservation in central South Dakota provided 8 years of BTPD harvest data (1993-2000), indicating hunters shot an average of 15,000 BTPDs per year. Each hunter killed an average of 119 BTPDs per year, or 38 per day of hunting (Reeve and Vosburgh 2003). In Arizona, AGFD estimated that in 2002, before implementing a seasonal shooting closure, 75,791 GPDs were shot. In 2003, after the shooting closure was implemented, AGFD estimated only 21,134 GPDs were shot. Whether this decline in animals killed can be attributed solely to the seasonal closure is unknown, but if the reduction in take was partly due to the closure, this new management strategy is beneficial in helping populations maintain densities and recover after die-offs.

Peak shooting pressure on GPD colonies tends to occur in May and June, when the weather is cooler and juveniles are emerging. This timing makes lactating females and young of the year more vulnerable and causes loss of dependent young when females are killed. Significant take of these individuals reduces the yearly reproductive output of a population and may be additive to natural mortality. Both Utah and Arizona have instituted shooting closures during this time to help protect and maintain populations.

<u>Evaluation</u>

Shooting. The effect of shooting on long-term viability of GPD populations is unknown, as shooting can introduce a level of uncertainty in demographics of GPD populations. To minimize shooting impacts, 2 states have implemented seasonal closures, and a third state has placed bag limit restrictions of GPDs during shooting contests. If shooting can be managed to regulate populations and maintain them at a threshold density, it may be a useful management tool for prairie dog conservation.

Shooting has the potential to locally reduce population densities, alter behavior, and slow or preclude recovery rates of colonies reduced by plague or other disturbances (as cited above). However, shooting alone does not appear to have a sufficient effect on populations to move the GPD toward extinction. In addition, states that have both BTPDs and GPDs unanimously believe that hunting pressure is greater on BTPDs. This is important because the USFWS' 2002 BTPD Candidate Assessment concluded that effects due to shooting did not rise to the level of a threat, pursuant to the definitions and constraints of the ESA.

Conservation options for a conservation strategy

Shooting. Shooting, unlike plague, is a manageable impact on prairie dogs. State wildlife agencies should re-evaluate their current regulatory authorities and measures to ensure appropriate regulated take of GPDs. States should consider implementing seasonal closures when females and pups are most vulnerable (1 April-15 July) and requiring shooters to obtain a prairie dog shooting permit. This would give state wildlife agencies, through harvest surveys, the ability to quantify annual harvest. In addition, states should develop monitoring techniques to assess the impacts of shooting and the potential need for regulations to limit take.

Research needs

No research has been conducted on the effects of shooting on GPD distribution and population viability. Therefore, research is needed to provide managers with information needed to regulate the take of GPDs on public lands. Research should be designed to evaluate current recreational shooting, but experimentation may be required for further analyses.

- Studies comparing exploited and non-exploited GPD populations should be conducted. Analysis should include effects on social interactions, foraging, distribution, emigration, population trends, and reproductive output. Studies should be conducted on a large scale over an extended time period to accurately evaluate the effects of recreational shooting.
- Studies should be conducted that evaluate different levels of shooting pressure on GPD populations. This would provide information to help manage harvest levels and timing to protect populations.
- Development of an appropriate monitoring technique to enable managers to adjust harvest quotas to make shooting sustainable over time and avoid extinctions of local populations.

3) DISEASE OR PREDATION

Current information

Disease. The primary factor limiting GPD populations is sylvatic plague, a flea-transmitted disease caused by the bacterium *Yersinia pestis* (Heller 1991; Cully and Williams 2001). Plague is a non-native pathogen that originated in Asia, arriving in North America around 1899. It was first recorded in native mammals in California in 1908 (Barnes 1982). Since then, it has spread from the Pacific Coast east to the 100th meridian, infecting 76 species in 6 mammalian orders (Barnes 1993). The first confirmations of plague in GPDs were in northwestern Arizona in 1932, in eastern Arizona in 1937, and in New Mexico in 1938 (Eskey and Haas 1940). Plague was first recorded in Colorado from 1945 to 1949, when an epizootic occurred in South Park (Ecke and Johnson 1952). Today, plague has spread throughout the entire range of GPD (Barnes 1982).

Prairie dogs are highly susceptible to plague, and this susceptibility is thought to be a function of high population densities, abundant flea vectors, and uniformly low resistance (Biggins and

Kosoy 2001a). WTPD populations, which generally occur in lower densities with dispersed aggregations of animals, have been found to experience less severe population declines (85%-96%; Clark 1977; Anderson and Williams 1997) than BTPDs and GPDs. The latter 2 species experience mortality rates of >99% during epizootics, and eradication of populations can occur within 1 active season (Lechleitner et al. 1962, 1968; Rayor 1985; Cully 1989; Cully and Williams 2001). The specific factors that influence interspecific transmission of plague from reservoir populations into prairie dog populations is unknown, but outbreaks may be triggered by environmental conditions such as mild winters and moist springs (Parmenter et al. 1999; Enscore et al. 2002 as interpreted by Girard et al. 2004). Girard et al. (2004) has postulated that, when plague encounters a susceptible species that is plague naïve and is found at high densities, an epizootic occurs. Rapid dispersal of the pathogen through an area is followed by a slower transmission cycle that occurs in low-densities and resistant hosts, which establishes the disease into stable reservoirs for future emergence. This dynamic balance between amplification of the pathogen and its long-term persistence explains the emergence and subsequent success of plague at global, regional, and localized scales.

Plague has been well documented throughout the range of the GPD (Ecke and Johnson 1952; Lechleitner et al. 1968; Rayor 1985; Cully et al. 1997). In Arizona over the past 7-15 years, there has been a large reduction in the number of active GPD colonies, primarily due to outbreaks of plague (Wagner and Drickamer 2003). However, the AVC has remained unaffected by the disease since at least 1974 (B. Van Pelt, AGFD, pers. comm.).

Wagner and Drickamer (2003) found 57 of the 293 (19%) colonies of GPDs they surveyed experienced die-offs during the summers of 2000 and 2001. Plague was confirmed as the causative agent for 15 of these 57 colonies. During surveys, they also identified the approximate boundaries of 2 previous plague outbreaks. The Dilkon outbreak occurred over approximately 2900 km^2 (1120 mi^2) and was located west of the town of Dilkon, 120 km (75 mi) northeast of Flagstaff on the Navajo Indian Reservation. This outbreak probably occurred in 1995/96; little recovery has occurred since then. Previous surveys in the area identified 45 colonies on 3500 ha (8649 ac). Re-examination of these colonies in 2000 and 2001 found all but 2 were inactive. At most of these inactive colonies, burrow entrances were completely closed and only mounds indicated where they used to occur.

The Seligman outbreak was located east of the town of Seligman, approximately 155 km (96 mi) northwest of Flagstaff. This outbreak occurred over approximately 1100 km^2 (425 mi^2). GPDs are now becoming reestablished in some areas within the boundaries of the Seligman outbreak, despite persistent plague activity. When AGFD conducted surveys in this area between 1990 and 1994, they identified 47 active colonies that covered approximately 3500 ha (8649 ac). In 1996, die-offs were observed in this area and the U.S. Centers for Disease Control and Prevention (CDC) confirmed plague as the cause. Surveys in 2001 found that only 11 of the 47 colonies were active. Thus, it is possible there was another, undocumented plague outbreak in this area in 1999 or 2000.

In 1941, GPDs occupied 370,000 ha (914,290 ac) in South Park, Colorado (Ecke and Johnson 1952). Between 1947 and 1949, plague reduced the occupied habitat of this area to less than 5%

of its former extent (Ecke and Johnson 1952). Lechleitner et al. (1962) observed a colony of 275 GPDs that was eliminated near South Park in 1959, and in 1964 to 1966, he observed 5 of 7 colonies die-out during a plague epizootic in Saguache County, Colorado (Lechleitner et al. 1968). Rayor (1985) described an outbreak of plague that spread through a 60 ha (148 ac) colony in Curecanti National Recreation Area near Gunnison, Colorado in 1981. In less than 2 months, Rayor reported the loss of 1000-1500 animals. A few animals survived the disease and Cully (1989) who visited the area in 1986, noted that GPDs were again abundant in the area.

In New Mexico, an epizootic swept through the Moreno Valley from 1983 to 1987 (Cully et al. 1997). At least 100,000 GPDs were thought to occur in this valley in 1984, but by 1987, plague had reduced the population of GPDs by >99%. Of the prairie dogs that survived, about 50% had antibody titers, indicating they had been exposed to plague and had survived. After the epizootic, surviving GPDs aggregated into new colonies. Within these new colonies, population growth rate tripled annually, due to increased juvenile survivorship and reproduction at an earlier age. However, as GPD densities recovered to 90 animals/ha (36/ac), another plague epizootic occurred and the population crashed once again. By 1997, GPDs were still present in the Moreno Valley, but colonies were small and scattered and had not recovered to what they had been prior to being impacted by plague in 1984.

In Utah, GPD colonies have been known to die-off and recover (e.g. Lisbon Valley), but since no plague testing has been conducted, the reason for the declines cannot be determined.

<u>Evaluation</u>

Disease. Research on plague during the past century has clarified certain aspects of its ecology, but many questions remain unanswered, particularly those related to how plague maintains itself in natural foci and under what conditions epizootics occur. Without answers to these questions, it is impossible to predict the movement, impact, and/or timing of plague epizootics. In addition, information is needed to investigate the effects of changes in population demographics and recovery rates on colonies following a plague epizootic. Repeated plague epizootics, and subsequent recovery of local populations from these outbreaks, can result in a cycle of expansion and contraction in individual prairie dog colonies (Wagner and Drickamer 2003). Pauli (2005) found that plague survivors organized into functional coteries, and exhibited improved body condition after an epizootic. Colonies that were left supporting large healthy individuals grew significantly faster because healthier prairie dogs reached sexual maturity at an earlier age, produced larger litters, and had increased over-winter survival.

When evaluating the overall impacts of plague, both temporal and spatial scales are important to consider. Evaluation on a large scale, examining occupied habitat across hundreds of square-kilometers for extended time periods, would result in a more informative portrayal of plague across the range of GPDs. For example, since recovery rates appear to be quite different among localized populations and shifts in occupied habitat may occur after plague epizootics, investigation of impacts on a small scale may not adequately characterize the effect of the disease on the rangewide status of GPDs. Cully (1997) found that after plague invaded an area, individual GPDs remained widely dispersed. In the following breeding season however, remaining individuals aggregated into new colonies that expanded into suitable habitat. Seery (2004) found that during and after a plague epizootic, the number of BTPD colonies increased while the amount of occupied habitat declined.

The impacts of plague outbreaks, which lead to the loss of prairie dog colonies of all sizes (Roach et al. 2001), are likely magnified by isolation of colonies. Colony growth after an epizootic might be the result of re-colonization by inter-colony dispersers (Antolin et al. 2002). Increased isolation decreases the likelihood the colony can be re-colonized following a plague outbreak if the distance between the infected colony and the nearest neighbor colony are beyond the dispersal capabilities of the species. Lechleitner et al. (1962) documented a plague outbreak in a GPD colony in Colorado in 1959 that killed all members of the colony. Prior to the outbreak, this colony had been continuously occupied for 20 years, despite several poisoning attempts. However, 2 years after the outbreak, the colony still had not been re-colonized, being isolated from other colonies by more than 12 km (7 mi). Recovery rates of GPD and UPD colonies 2 years post-epizootic found GPDs experienced 100% mortality and remained depopulated throughout the study due to lack of available immigrants (Turner 2001). The UPD colony however, had 1 adult female and 11 untagged survivors after infection, enabling the population to rebound to 37% of the pre-plague population of adults 2 years post-epizootic. In addition to immigration being important to colony recovery after a plague epizootic, prairie dog survivors may be crucial in repopulating plague-decimated colonies.

Some mammalian species are evolving a reduced susceptibility to plague (Williams et al. 1979; Thomas et al. 1988 as interpreted by Cully 1993). Resistance to plague might differ among populations of the same species, and might depend on amount of exposure (Biggins and Kosoy 2001b). Antibody titers have been found in UPDs, BTPDs, GPDs, and WTPDs indicating individual exposure to plague and subsequent recovery (Cully and Williams 2001; Biggins 2003b; Pauli 2005). Pauli (2005) found that approximately 5% of BTPDs can survive an epizootic, with more than 50% of the surviving prairie dogs developing antibodies to plague. Long-term, repeated exposure to plague might lead to selection of individuals that are genetically more resistant to the disease and able to maintain plague in an enzootic form in the environment. However, populations of prairie dogs thus far have remained highly susceptible to plague even after being subjected to repeated exposure (Biggins and Kosoy 2001b).

The effects of plague may be amplified and recovery rates slowed when additional stresses such as shooting, poisoning, and habitat loss/conversion occur. All these pressures acting together may also exacerbate isolation of GPD populations and lower overall body conditions of the animal. Weather patterns may also play a part in the effects of plague, as weather can impact flea survival (Gage 2003). In hot, dry years flea survival is reduced, which might translate into lowered transmission rates. Conversely, wet years increase flea survival and reproduction, which may result in increased transmission rates.

Conservation options for a conservation strategy

Disease. The effect of plague on long-term viability of GPDs is unknown. Currently, no techniques are available for effective control or management of plague on large scales, because the ecology of plague differs between habitats, populations, and prairie dog species and because current methods are costly and labor-intensive. Flea control can be successfully used on small scales (D. Biggins, USGS, pers. comm.). An integral part of managing this disease and protecting GPD populations will be to understand the rangewide dynamics of plague. Technologies that may be useful in doing this will include GIS/remote sensing and population and climate modeling.

Research needs

- Model GPD metapopulation dynamics and viability in the presence of plague
- Determine the mechanisms by which the prairie dog colonies in the AVC, Arizona remain free of plague
- Determine what happens to the disease between epizootics (maintenance mechanisms)
- Determine the role of associated mammals in maintenance and transmission of plague
- Determine the mechanisms by which plague is spread between GPD colonies
- Further examine conditions under which plague is likely to flare up (e.g. weather)
- Evaluate ramifications of plague for long-term persistence of GPD populations at a landscape scale
- Examine recovery rates and population dynamics in infected colonies
- Determine whether inbreeding depression occurs in recovering colonies
- Institute a plague monitoring protocol to document plague events annually and maintain a rangewide database similar to that recommended for the BTPD (Luce 2003)
- Continue research to develop an oral plague vaccine that can be economically dispersed over large areas occupied by GPDs
- Continue research on using pesticide dusting for flea control as a management tool. GPD colonies with plague have been found to have both a higher percentage of burrows infested with fleas and a greater number of fleas per infested burrow than plague free colonies, indicating that fleas may drive the cycle (Heller 1991)
- Examine the feasibility of using translocations to augment local prairie dog populations reduced by plague outbreaks

4) INADEQUACY OF EXISTING REGULATORY MECHANISMS

Current information

All states within the range of the GPD allow removal of the species for agricultural and for human health and safety purposes. Seasonal shooting closures have been implemented on all lands except tribal in Arizona, and on public lands in Utah from1 April to 15 July to protect pregnant and lactating females as well as their young. Shooting closures have not been instituted in Colorado or New Mexico, although Colorado has set a bag limit of 5 GPDs per shooter at shooting events. All states include the GPD in their CWCSs, and all will be participating in development and implementation of a rangewide conservation strategy for the species. In addition, Colorado and Utah are working to develop a long-term monitoring protocol for the species (Andelt et al. 2003).

Federal agencies within the range of the GPD manage it to meet multiple use objectives and do not address GPD species-specific needs. Though the GPD currently has no federal protected legal status, the BLM has voluntarily made a policy decision to consider this species within their Resource Management Plans.

Evaluation

All states have specifically included the GPD in their CWCS, which will guide their research and management goals for the next 10 years. In addition, WAFWA has committed to finishing a comprehensive conservation strategy for the species by January 2006. All affected state and federal agencies have reviewed and indicated their intention to sign a 5-year Shortgrass Prairie MOU that supports active research and management of this species. Long-term monitoring protocols are being developed in Colorado and Utah.

Conservation options for a conservation strategy

State and federal agencies should review and evaluate current laws and regulations regarding GPDs. State wildlife agencies and federal agencies should cooperate on development of new Resource Management Plans that address species specific needs of GPDs and their habitat with regard to oil and gas development, livestock grazing, poisoning, shooting, and road development. Standardized rangewide monitoring and management strategies for GPD colonies should be developed and implemented to measure and potentially mitigate the impacts of disturbances. In addition, research addressing many of the issues associated with GPD biology, ecology, and response to disturbances should be funded and attempts should be made to coordinate with private land owners to protect and promote colonization on private properties. Mitigation options for development in areas currently occupied by GPDs and design and implementation of translocation programs should be considered.

Research needs

- Develop a rangewide technique to monitor GPD distribution and rate of occupancy
- Refine habitat suitability models on a state-by-state basis to better manage GPD habitat

5) OTHER NATURAL OR MANMADE FACTORS AFFECTING ITS CONTINUED EXISTENCE

Current information

Poisoning. As early European settlement of the Intermountain West occurred, control of mammalian species considered "vermin" became common practice. Prairie dogs became the focus of widespread eradication efforts, largely as a result of their reputation as range and agricultural pests (Clark 1989). Private initiatives had significant effects on prairie dogs between 1870 to 1915 and may have reduced populations prior to government programs being instituted (Oakes 2000). The USDA BBS implemented a "Westside Plan" that envisioned elimination of prairie dogs, along with predators, across the western rangelands (Oakes 2000). The Agriculture Appropriations Act of 1915 gave statutory authorization for the BBS to conduct large scale eradication programs on National Forests and all other public lands (Oakes 2000).

In Arizona, control measures were extensive, thorough, and well organized, resulting in BTPD extirpation from the state and causing a reduction in GPD populations. Arizona poisoned 384,064 ha (949,043 ac) of BTPDs from 1915-1924 (Oakes 2000). From 1915-1964, 934,906 ha (2,310,203 ac) of GPDs were poisoned, with a peak in 1935, when 143,305 ha (354,114 ac) were poisoned (Forrest 2002). Surveys conducted in 1921 and again in 1961 by BBS and PARC showed a 92% reduction in the amount of GPD occupied habitat of in the state.

Between 1903 and 1912, efforts to exterminate prairie dogs in Colorado were initiated primarily by individual cattlemen (Clark 1989). Organized state-wide efforts began with the Pest Inspection Acts of 1911 and 1915. In 1912, the first systematic efforts of eradication began, with nearly every part of the state of Colorado being treated at one time or another, and most parts being poisoned annually (Clark 1989). Colorado poisoned 9,380,192 ha (23,178,959 ac) of 3 species of prairie dogs from 1915-1964. The peak year was 1947, when 517,356 ha (1,278,415 ac) were poisoned. Unlike many states, Colorado was still poisoning, on the order of 53,000 ha/year (130,966 ac/year) into the 1960s (Forrest 2002).

In New Mexico, 8,296,582 ha (20,501,301 ac) of GPDs and BTPDs were poisoned from 1914 to 1964 (Forrest 2002). Surveys conducted in 1921 and in 1961 by BBS and PARC showed a 96% decline in GPD occupied habitat for the state. Control efforts continue today in New Mexico, but they occur on a small scale and most of the control is to protect health and human safety in urban landscapes and for small agricultural farms.

Utah poisoned 1,099,098 ha (2,715,930 ac) of GPDs, UPDs, and WTPDs from 1914 to 1964 (Forrest 2002). Poisoning to eliminate the UPD began in 1920, and this program was successful at reducing UPDs from approximately 37,232 ha (92,002 ac) in 1920 to 971 ha (2399 ac) in 1971 (Collier and Spillett 1975). Though little poisoning information for the GPD is available for this time frame, similar reductions likely occurred.

Drought. Annual moisture is thought to be one of the most important factors influencing distribution of UPDs (Collier and Spillett 1975). Drought conditions produce negative effects on plant cover and vegetative moisture (Collier and Spillett 1975). Studies have found that both

UPDs and GPDs on productive, wet sites have greater body mass, higher population densities, and faster expansion rates (Crocker-Bedford and Spillett 1981; Collier 1975; Rayor 1985). GPD colonies located on sites lacking sufficient quality and quantity of vegetation may have a difficult time obtaining adequate nutrition and water, resulting in animals spending less time foraging and longer periods in aestivation.

The effects of drought may have been amplified since the late 1800s, due to land use practices that resulted in the invasion by non-native plant species, alterations in plant species composition, and lowering of water tables. Proliferation of exotic annual weeds over native perennial grasses and forbs may impact the ability of GPDs to meet their dietary needs especially during drought years. Invasive species may not provide sufficient above or below ground forage or water stores that GPDs need to subsist. Invasive species also out-compete and eradicate native species with which GPDs have evolved.

Evaluation

Poisoning. Assessing the extent of poisoning on GPDs in the past is difficult because the accounts of poisoning are not usually site or species specific. BTPDs were the main focus of eradication campaigns, but GPDs were targeted directly and indirectly. On public lands, poisoning efforts have led to a reduction in occupied habitat, extirpation from local areas, fragmentation, and isolation of colonies Poisoning in all states became less common after the 1970s, due to federal regulation of poisons. State and federal agencies are currently not involved in large scale control efforts, and are rarely involved in any control unless GPDs are thought to pose a threat to human safety. Translocation as a method of control is becoming more commonly used, while lethal control seems to be declining.

Knowles (1982) and Apa et al. (1990) found that BTPDs were able to recover from poisoning through an increase in intrinsic rate of growth. Colonies reduced by 45% were able to rebound within 10 months, while those completely controlled required 5 years or more to return to pre-control densities. These data provide evidence that BTPDs protected from landscape-scale control efforts can rebound, implying a similar potential for the GPD.

Drought. Though historic levels of livestock grazing throughout the west had profound ecological consequences, including alteration in species composition within plant communities, disruption of ecosystem function, and alteration of ecosystem structure (Fleischner 1994), it is unknown how it interacts with drought. No studies have been conducted to determine the cumulative effects of drought and other impacts on GPDs. However, GPDs evolved in arid environments that experience periodic drought, so the effects of drought alone may not be severe.

Conservation options for a conservation strategy

Poisoning. Ultimately, poisoning must be managed by state wildlife agencies or state departments of agriculture if regulation of GPD take is necessary. Development of incentive programs to motivate private landowners to maintain GPD colonies on their lands should also be explored. Translocation to supplement existing colonies, create new colonies, and/or move individuals from colonies threatened with imminent destruction could be incorporated into management plans to help maintain or recover population densities.

Drought. Climate conditions cannot be managed directly, but other effects that might exacerbate potential drought impacts can be evaluated and managed, if necessary. GIS data layers could be used to rate sites on their ability to sustain GPDs during times of drought, based on composition of vegetation and location of the habitat. For instance, areas composed of native vegetation could be considered less at risk than areas dominated by cheatgrass or other vegetation less suitable to GPDs. This could help land managers focus on high risk areas. This could be accomplished through a variety of strategies, such as evaluating the timing and intensity of grazing to promote forb and perennial grass production, controlling invasive weeds, and restoring the historical density of woody species. Also, managers could work to alleviate other impacts, such as shooting, which might affect the amount of time a GPD spends foraging, to help during times of unfavorable environmental conditions.

<u>Research needs</u>

Information is needed to provide better management decisions regarding land use practices such as grazing, habitat restoration, and resource extraction. These data will aid the design of management strategies to alleviate additive stresses during difficult environmental conditions and provide information on when poisoning may be warranted, and what level of control will be adequate to address the concerns.

- Monitor GPD populations during various environmental conditions over a significant part of the range
- Examine land use practices and their ability to influence GPD responses to environmental changes
- Develop non-lethal options for controlling GPDs
- Examine the ability of GPD populations to rebound after use of poisons on colonies

Recommendation Regarding the Need to List the Gunnison's Prairie-Dog Under the ESA

The White-tailed and Gunnison's Prairie Dog Working Group of WAFWA's 12-state Prairie Dog Conservation Team has examined the data presented in this Conservation Assessment and concluded that the data do not warrant listing at this time for the following reasons:

1) Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Agricultural land conversion

Currently, less than 3% of the gross range is being impacted by agriculture. Thus, the current level of land conversion does not rise to the level of a threat to the continued existence of the species over a significant portion of its range in the foreseeable future, and therefore does not justify listing under the ESA.

Urbanization

Less than 1% of the gross range is impacted by urbanization. Thus, urbanization does not rise to the level of a threat to the continued existence of the species over a significant portion of its range in the foreseeable future, and therefore does not justify listing under the ESA.

Oil/Gas exploration and extraction

Oil and gas exploration is occurring at a rapid rate on public lands. However, BLM lands account for only 12% of the GPD predicted range, thus oil and gas development does not rise to the level of a threat to the continued existence of the species over a significant portion of its range in the foreseeable future, and therefore does not justify listing under the ESA. Although current BLM policies do not address GPD species specific needs, many offices are voluntarily considering them with regard to oil and gas development.

Livestock grazing

This impact does not rise to the level of a threat to the continued existence of the species over a significant portion of its range in the foreseeable future, and therefore does not justify listing under the ESA. Historic levels of livestock grazing impacted GPD range by disrupting the ecosystem and drastically altering the landscape. Many of the changes brought about by this practice will continue to impact this species (i.e. presence of non-native annuals, increased shrub cover, loss of cool season grasses, lowered water tables). However, listing of the species will not help to alleviate this threat, as the BLM and state wildlife agencies are already working to improve rangeland conditions by reducing intensity and timing of grazing, working on controlling invasive weed infestations, and seeding areas to promote grass, forb, and sagebrush growth.

Altered fire regimes

This impact does not rise to the level of a threat to the continued existence of the species over a significant portion of its range in the foreseeable future, and therefore does not justify listing under the ESA. Better rangeland management is occurring and will have a direct effect on fire regimes. In addition, both the BLM and state wildlife agencies are working to improve range conditions after a fire by planting native plants to restore areas and help fight the infiltration of non-natives after a burn.

2) OVERUTILIZATION FOR COMMERCIAL, RECREATIONAL, SCIENTIFIC OR EDUCATIONAL PURPOSES

Shooting

Shooting does not rise to the level of a threat to the continued existence of the species over a significant portion of its range, and therefore does not justify listing under the ESA. Shooting, if managed correctly, will not significantly limit distribution of the GPD, or adversely affect population size and density such that local recovery cannot be achieved in subsequent years.

Further, there are no scientific data suggesting that shooting has a significant impact on viability of GPD populations. Anecdotal information and field observation by state and federal biologists suggest that impacts are not widespread or significant. In addition, in states that have both BTPDs and GPDs, biologists are unanimous in their opinion that shooting is of longer duration and more intense on BTPD colonies than on GPD colonies. Therefore, WAFWA considers it significant that in the 2002 BTPD Candidate Assessment, the USFWS stated: "we are not aware of data that support a conclusion that reductions in density are sufficient to reduce population persistence at a given site," and that "no information is available that demonstrates that any black-tailed prairie dog population has been extirpated or nearly extirpated by this activity." The USFWS' conclusion was that, for the BTPD, the effects due to shooting do not rise to the level of a threat pursuant to the definitions and constraints of the ESA.

3) DISEASE OR PREDATION

Disease

Sylvatic plague is not an imminent threat to continued existence of the species, but could rise to the level of a threat. Biggins (2003a) stated that, though the ecological function of prairie dogs has been impaired by introduction of plague, detection of both population declines and increases seem to suggest they are not in imminent jeopardy of extinction. The role plague has played and will continue to play in the overall decline of GPDs is a crucial question for future management and research. How plague is functioning across the landscape and its overall impact on the viability of GPD populations remain the unknown factor in the equation for GPD conservation. However, listing of the species will not alleviate this threat, as work by both federal and state agencies is already funded and underway to find oral vaccines, conduct plague testing, and research on methods to control the disease.

4) INADEQUACY OF EXISTING REGULATORY MECHANISMS

Current inadequacy of regulatory mechanisms of both state and federal agencies does not rise to the level of a threat to continued existence of the species over a significant portion of its range in the foreseeable future, and therefore does not justify listing under the ESA. As discussed, proactive management for the species will continue and is supported by all affected states and federal agencies. Additionally, all these agencies have favorably reviewed a shortgrass prairie MOU, which includes GPD research and management needs, and have indicated their desires to be signatories. In addition, all states have specifically included the GPD in their CWCS and have committed to finishing a comprehensive conservation strategy for the species by January 2006.

5) OTHER NATURAL OR MAN-MADE FACTORS AFFECTING ITS CONTINUED EXISTENCE

Poisoning

Poisoning does not rise to the level of a threat to continued existence of the species, and therefore does not justify listing under the ESA. Data presented herein indicate poisoning mostly affects GPDs near cultivated or irrigated agricultural lands and urban areas, which together constitute <4% of the gross range. Historically, poisoning reduced occupied habitat and fragmented populations, but it does not occur at the same degree or intensity today.

Drought

Drought does not rise to the level of a threat to continued existence of the species; therefore it does not justify listing under the ESA. Drought may negatively impact GPD populations, but land managers are working to improve range conditions within the range of the GPD to lessen the possible negative effects of drought.

CONCLUSION

After careful analysis of the information presented in this Conservation Assessment, WAFWA believes that justification does not exist for listing the GPD under the ESA at the current time. The main reasons for this finding are 1) lack of quantifiable data to assess the rangewide status of the Gunnison's prairie dog on both public and private lands and lack of adequate data to evaluate threats to the viability of the species; 2) the proactive effort already being put forth by the states to conserve this species; 3) threats to the species that will not be alleviated by listing (e.g. plague) or are already being dealt with by current management practices (e.g. cheatgrass control, relocation efforts, and restoration efforts on rangelands by state, federal, and private agencies); and 4) development of a rangewide conservation strategy for all 3 prairie dog species (BTPD,WTPD, and GPD) that will be completed by January 2006 and adopted by all states.

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Table 1. Landcover classes known to exist within the gross range of the Gunnison's prairie dog. Cover classes with a value of 1 were incorporated into the Gunnison's prairie dog Predictive Range Model.

LAND COVER DESCRIPTION	VALUE	HA
Rocky Mountain Alpine Bedrock and Scree	0	194,544
Rocky Mountain Alpine Fell-Field	0	38,006
Rocky Mountain Cliff and Canyon	0	89,986
Western Great Plains Cliff and Outcrop	0	2,165
Colorado Plateau Mixed Bedrock Canyon and Tableland	0	720,730
Inter-Mountain Basins Shale Badland	0	118,156
Inter-Mountain Basins Active and Stabilized Dune	0	96,402
Inter-Mountain Basins Volcanic Rock and Cinder Land	0	95,276
Inter-Mountain Basins Wash	1	832
Inter-Mountain Basins Playa	1	6,170
North American Warm Desert Bedrock Cliff and Outcrop	0	35,839
North American Warm Desert Active and Stabilized Dune	0	945
North American Warm Desert Wash	1	1,373
North American Warm Desert Playa	1	370
Rocky Mountain Aspen Forest and Woodland	0	658,838
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	0	63,966
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	0	658,936
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	0	533,292
Rocky Mountain Lodgepole Pine Forest	0	195,022
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	0	519,170
Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	0	381,968
Madrean Pine-Oak Forest and Woodland	0	12,530
Rocky Mountain Ponderosa Pine Woodland	0	2,757,082
Southern Rocky Mountain Pinyon-Juniper Woodland	0	1,088,673
Colorado Plateau Pinyon-Juniper Woodland	0	5,227,269
Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Complex	0	136,403
Inter-Mountain Basins Mat Saltbush Shrubland	1	19,990
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	0	616,805
Rocky Mountain Lower Montane-Foothill Shrubland	0	20,579
Western Great Plains Sandhill Shrubland	1	115
Madrean Encinal	0	8
Colorado Plateau Pinyon-Juniper Shrubland	0	174,392
Great Basin Semi-Desert Chaparral	0	1
Inter-Mountain Basins Big Sagebrush Shrubland	1	1,033,294
Colorado Plateau Mixed Low Sagebrush Shrubland	0	75,530
Mogollon Chaparral	0	107,156
Apacherian-Chihuahuan Mesquite Upland Scrub	0	26,135
Colorado Plateau Blackbrush-Mormon-tea Shrubland	0	262,438
Mojave Mid-Elevation Mixed Desert Scrub	0	19,934
Chihuahuan Succulent Desert Scrub	0	1
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	0	6,190
Sonoran Paloverde-Mixed Cacti Desert Scrub	0	996

LAND COVER DESCRIPTION	VALUE	HA
Inter-Mountain Basins Mixed Salt Desert Scrub	1	945,149
Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub	0	3
Sonora-Mojave Creosotebush-White Bursage Desert Scrub	0	5,933
Sonora-Mojave Mixed Salt Desert Scrub	1	12
Inter-Mountain Basins Montane Sagebrush Steppe	1	282,337
Southern Rocky Mountain Juniper Woodland and Savanna	0	205,217
Inter-Mountain Basins Juniper Savanna	0	495,326
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	0	219,193
Inter-Mountain Basins Semi-Desert Shrub Steppe	1	2,699,408
Chihuahuan Gypsophilous Grassland and Steppe	0	75
Rocky Mountain Dry Tundra	0	162,238
Rocky Mountain Subalpine Mesic Meadow	0	110,015
Southern Rocky Mountain Montane-Subalpine Grassland	1	816,880
Western Great Plains Foothill and Piedmont Grassland	1	137,654
Western Great Plains Shortgrass Prairie	1	549,330
Inter-Mountain Basins Semi-Desert Grassland	1	25,88,892
Rocky Mountain Subalpine-Montane Riparian Shrubland	0	174,876
Rocky Mountain Subalpine-Montane Riparian Woodland	0	12,311
Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0	108,941
North American Warm Desert Lower Montane Riparian Woodland and Shrubland	0	1,040
Western Great Plains Riparian Woodland and Shrubland	0	44,098
Inter-Mountain Basins Greasewood Flat	0	484,186
North American Warm Desert Riparian Woodland and Shrubland	0	2
North American Arid West Emergent Marsh	0	4,081
Rocky Mountain Alpine-Montane Wet Meadow	0	110,451
Western Great Plains Saline Depression Wetland	0	1
Chihuahuan-Sonoran Desert Bottomland and Swale Grassland	1	4
Madrean Upper Montane Conifer-Oak Forest and Woodland	0	15
Madrean Pinyon-Juniper Woodland	0	162,011
Chihuahuan Sandy Plains Semi-Desert Grassland	0	7,129
Madrean Juniper Savanna	0	8,092
Chihuahuan Mixed Salt Desert Scrub	0	4,799
Western Great Plains Floodplain Herbaceous Wetland	0	3,142
Wyoming Basins Low Sagebrush Shrubland	1	16
Sonoran Mid-Elevation Desert Scrub	0	1,556
Southern Colorado Plateau Sand Shrubland	0	481,726
Open Water	0	68,071
Developed, Open Space - Low Intensity	1	102,933
Developed, Medium - High Intensity	1	113,771
Barren Lands, Non-specific	0	24,935
Agriculture	1	835,259
Disturbed, Non-specific	0	2
Recently Burned	0	41,436
Recently Mined or Quarried	0	13,805
Invasive Southwest Riparian Woodland and Shrubland	0	29,341

LAND COVER DESCRIPTION	VALUE	HA
Invasive Perennial Grassland	1	35,138
Invasive Perennial Forbland	1	68
Invasive Annual Grassland	1	10,598
Invasive Annual and Biennial Forbland	1	30,529
Recently Logged Areas	0	29,411
Recently Chained Pinyon-Juniper Areas	1	15,647
Disturbed, Oil well	1	129

Table 2. Estimate of Gunnison's prairie dog occupied habitat within the gross and predicted range of each state based on the Predicted Range Model.

STATE	**GPD GROSS RANGE[a] (HA)**	**% OF GROSS RANGE[a]**	**GPD PREDICTED RANGE[b] (HA)**	**% OF PREDICTED RANGE[b]**
Arizona	7,137,700	25	2,580,179	27
Colorado	8,649,893	31	2,409,224	25
New Mexico	11,252,185	40	4,242,717	45
Utah	1,135,529	4	261,613	3
Total	**28,175,307**	**100**	**9,493,733**	**100**

[a] Gross range is the outer boundary identifying GPD distribution and does not imply that all lands contained within the boundary are occupied or have the potential to be occupied by GPDs.
[b] The predicted range was developed from a GIS model to depict a more accurate, spatial range of the GPD. This model does not imply that the area could be or is appropriate for GPD occupation.

Table 3. Landownership within the gross and predicted range of the Gunnison's prairie dog in Arizona.

LANDOWNERSHIP	HA IN GROSS RANGE	PERCENT	HA IN PREDICTED RANGE	PERCENT
BLM	99,223	1.39	54,630	2.12
City/County Lands	968	0.01	568	0.02
DOD	10,441	0.15	5,856	0.23
USFS	914,416	12.79	85,653	3.32
Tribal Lands/BIA	3,506,101	49.05	1,273,034	49.33
NPS	176,355	2.47	35,977	1.39
Private	1,545,512	21.62	700,333	27.14
State	895,638	12.53	424,359	16.45
Total	7,148,654	100.00	2,580,410	100.00

Table 4. Urban areas located within the gross and predicted range of the Gunnison's prairie dog.

NAME OF URBAN AREA	HA IN GROSS RANGE	HA IN PREDICTED RANGE
Alamosa, CO	1,080	649
Albuquerque, NM	58,075	52,480
Belen, NM	3,849	87
Blanding, UT	327	302
Bloomfield, NM	1,902	1397
Buena Vista, CO	449	250
Canon City, CO	4,204	3303
Chinle, AZ	646	309
Chino Valley, AZ	2,081	0
Colorado Springs, CO	50,948	4,20,776
Cortez, CO	1,774	1507
Delta, CO	1,308	1034
Dewey-Humboldt, AZ	861	9
Durango, CO	2,508	1213
Eagar, AZ	760	687
Edgewood, NM	1,933	1056
Eldorado at Santa Fe, NM	1,618	695
Espanola, NM	5,247	3724
Farmington, NM	11,272	8302
Flagstaff, AZ	8,408	4815
Florence, CO	655	490
Fort Defiance, AZ--NM	1,389	614
Gallup, NM	2,494	2058
Grants, NM	1,444	1386
Gunnison, CO	1,339	1091
Holbrook, AZ	466	456
Kayenta, AZ	553	505
Leadville, CO	1,244	537
Los Alamos, NM	1,858	917
Los Lunas, NM	9,251	1327
Meadow Lake, NM	848	848
Monte Vista, CO	869	773
Montrose, CO	2,766	2435
Pagosa Springs, CO	945	724
Pinetop-Lakeside, AZ	2,502	172
Pojoaque, NM	1,205	460
Prescott, AZ	10,059	6728
Pueblo, CO	2,321	94
Salida, CO	970	813
Santa Fe, NM	11,722	9256

NAME OF URBAN AREA	**HA IN GROSS RANGE**	**HA IN PREDICTED RANGE**
Santo Domingo Pueblo, NM	751	508
Shiprock, NM	1,383	735
Show Low, AZ	1,052	773
Snowflake, AZ	912	840
South Florence (Federal Correctional Institution), CO	966	872
St. Johns, AZ	493	466
Taos, NM	3,554	3369
Trinidad, CO	1,679	888
Walsenburg, CO	441	361
White Rock, NM	842	562
Winslow, AZ	1,656	773
Woodland Park, CO	2,083	473
Zuni Pueblo, NM	1,516	401
Total	231,479	145,300

Table 5. Landownership within the gross and predicted range of the Gunnison's prairie dog in Colorado.

LANDOWNERSHIP	HA IN GROSS RANGE	PERCENT	HA IN PREDICTED RANGE	PERCENT
BIA	310,086	3.59	76,523	3.18
BLM	1,247,121	14.43	362,115	15.03
DOD	40,927	0.47	22,330	0.93
USFS	3,229,717	37.36	147,005	6.10
USFWS	10,966	0.13	4061	0.17
NPS	46,454	0.54	6700	0.28
Private	3,490,920	40.39	1,668,001	69.23
State	267,839	3.10	122,628	5.09
Total	8,644,028	100	2,409,363	100

Table 6. Landownership within the gross and predicted range of the Gunnison's prairie dog in New Mexico.

LANDOWNERSHIP	HA IN GROSS RANGE	PERCENT	HA IN PREDICTED RANGE	PERCENT
BIA	3,045,102	27.06	1,439,376	33.93
BLM	1,541,084	13.70	642,158	15.14
DOD	22,512	0.20	9799	0.23
USFS	2,079,817	18.49	175,984	4.15
USFWS	33,106	0.29	5,467	0.13
NPS	69,815	0.62	10,439	0.25
Other Federal	26,235	0.23	3602	0.08
Private	3,758,323	33.40	1,615,227	38.07
State	675,303	6.00	340,692	8.03
Total	11,251,297	100.00	4,242,744	100.00

Table 7. Landownership within the gross and predicted range of the Gunnison's prairie dog in Utah.

LANDOWNERSHIP	HA IN GROSS RANGE	PERCENT	HA IN PREDICTED RANGE	PERCENT
BIA	257,497	22.76	35,689	13.66
BLM	472,628	41.78	88,384	33.83
USFS	119,007	10.52	5734	2.20
NPS	29,936	2.65	2096	0.80
Private	169,426	14.98	110,474	42.29
State	82,810	7.32	18,837	7.21
Water	23	0.00	9	0.00
Total	1,131,326	100.00	261,223	100.00

Figure 1. Gunnison's prairie dog gross range, predicted range and location of identified colonies in Utah and Colorado in 2002.

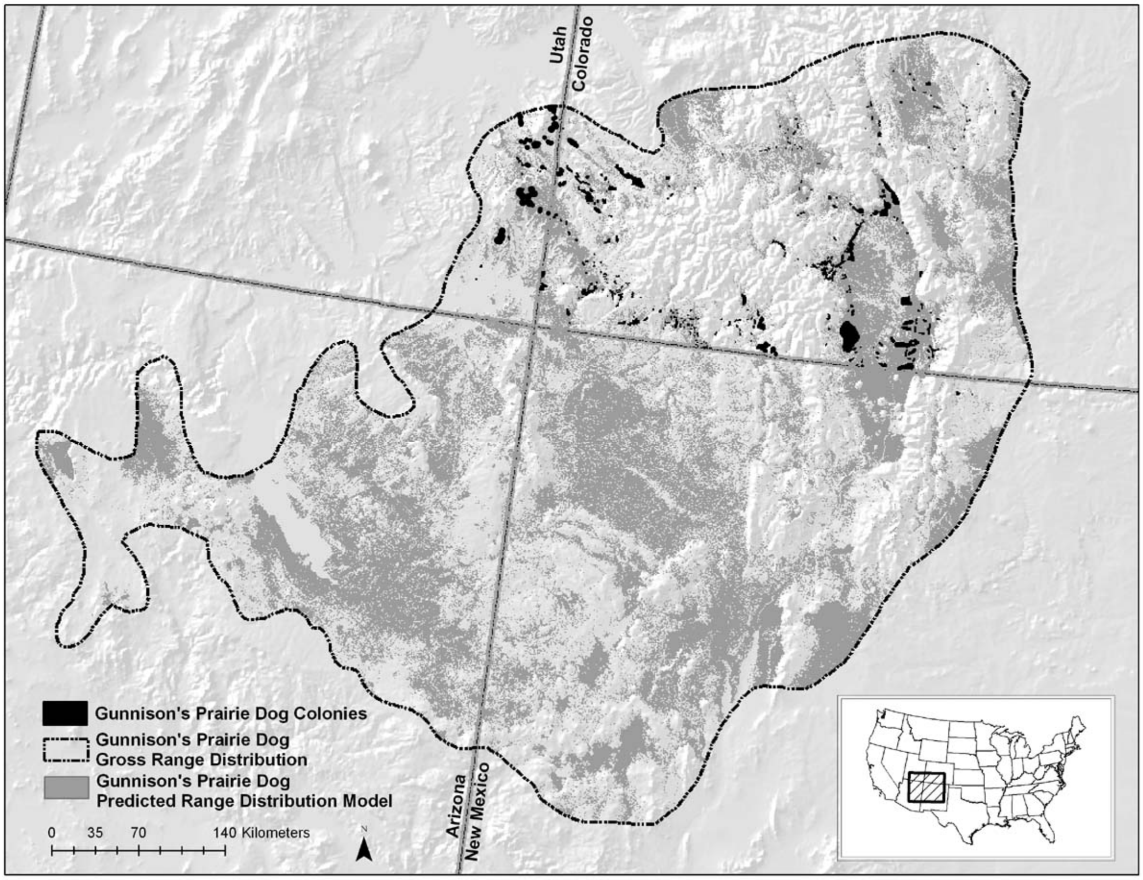


Figure 2. Gunnison's prairie dog gross range and predicted range in Arizona.

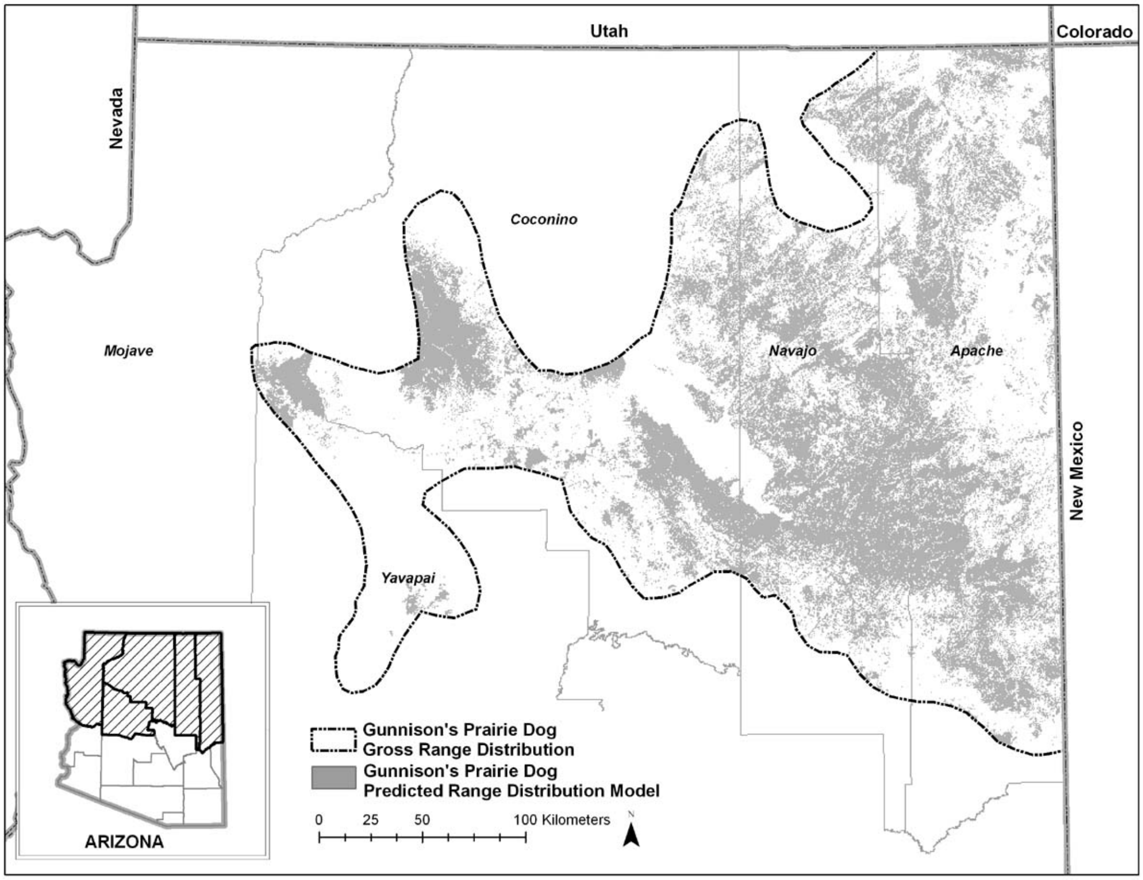


Figure 3. Gunnison's prairie dog gross range, predicted range and location of identified colonies in Colorado in 2002.

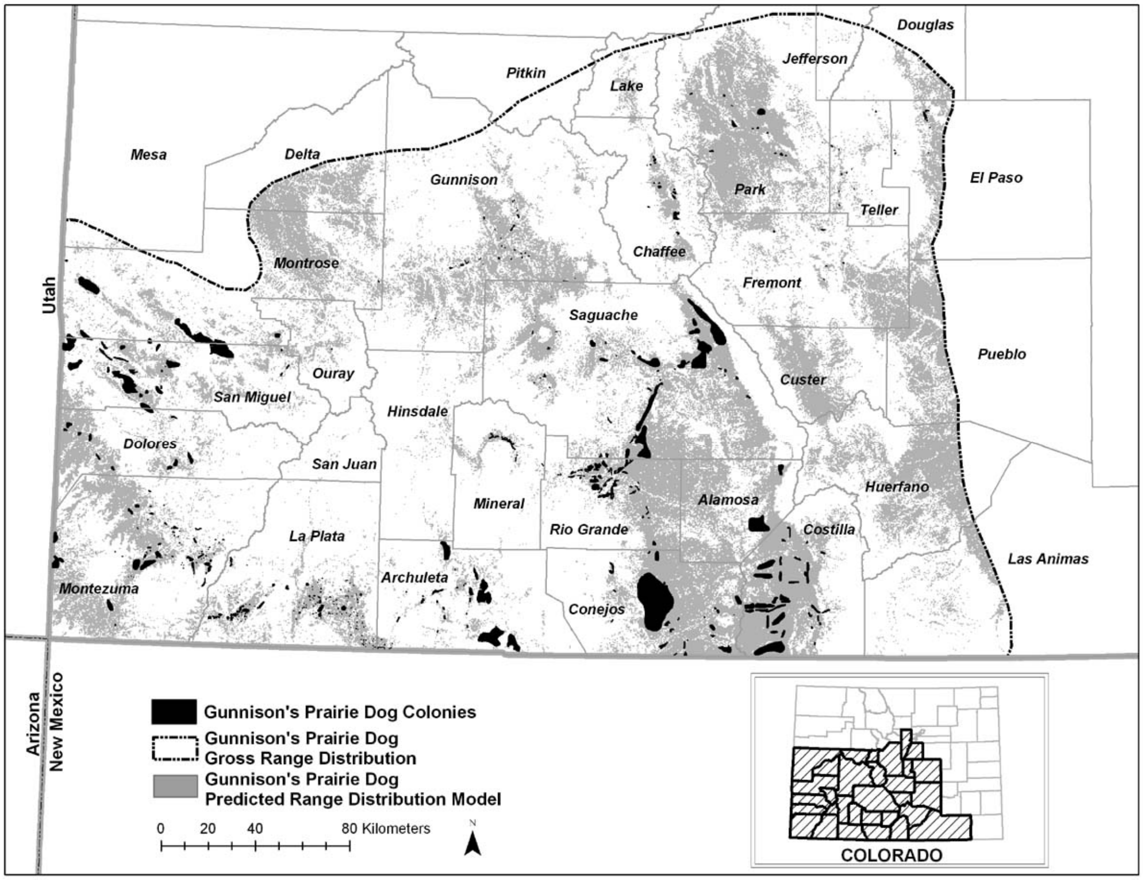


Figure 4. Gunnison's prairie dog gross range and predicted range in New Mexico.

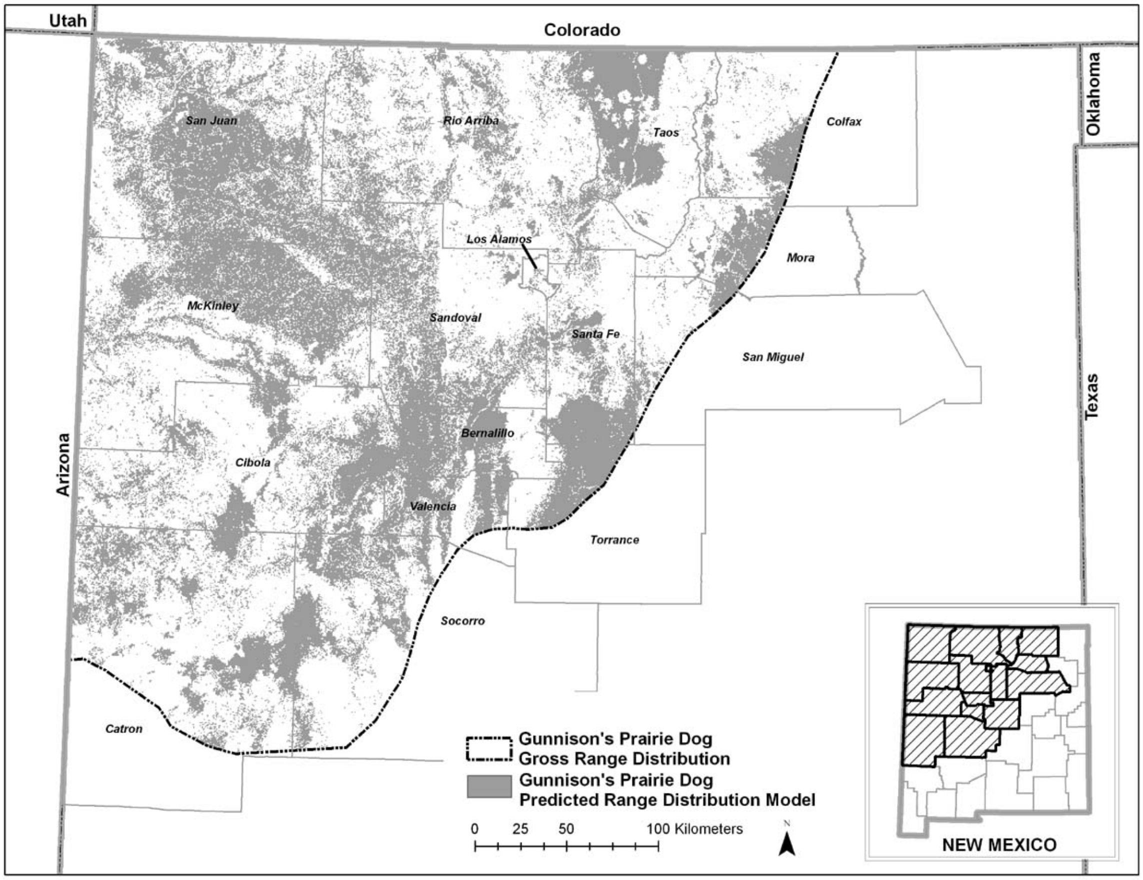
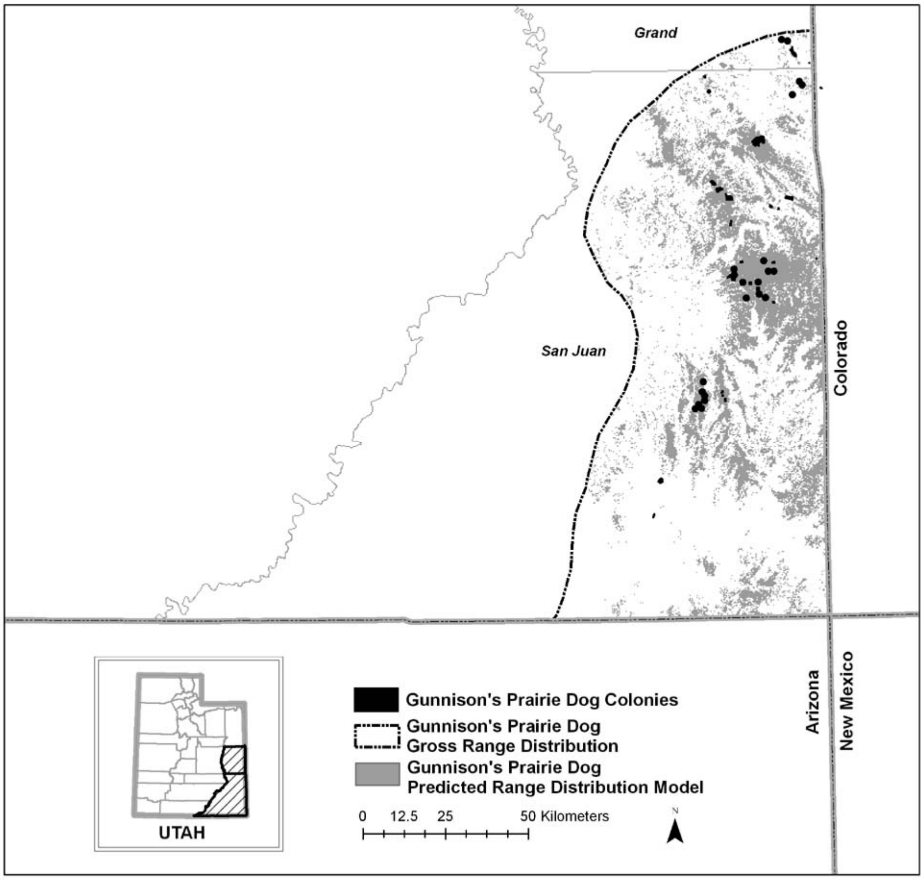


Figure 5. Gunnison's prairie dog gross range, predicted range and colonies identified in 2002 in Utah.



Appendix A. Glossary of terms.

Associated Species- Species that benefit from Gunnison's prairie dogs, either directly or indirectly, but are not dependent on them for survival.

Candidate Species- Plants and animals that the USFWS, through review of available information, has determined should be proposed for addition to the federal threatened or endangered species list.

Colony- A concentration of Gunnison's prairie dogs with a minimum of 20 burrow openings per ha on 5 ha parcels (Biggins et al. 1993).

Complex- A group of Gunnison's prairie dog colonies distributed so that individual black-footed ferrets can migrate between them commonly and frequently. Colonies within a complex are not separated from the nearest adjacent colony by more than 7 km and no impassable barriers exist between colonies that would hinder black-footed ferret movement.

Conservation- (a) From section 3(3) of the federal Endangered Species Act: "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided under {the} Act are no longer necessary;" (b) The retention of natural balance, diversity, and evolutionary change in the environment.

Control Measures- Actions taken to reduce the numbers and/or occupied habitat of Gunnison's prairie dogs, primarily through lethal means.

Coterie- A territorial, harem-polygynous family group of prairie dogs, typically consisting of a breeding adult male, 2 or 3 adult females and several yearlings or juveniles (Hoogland 1995).

Dispersal- The outward spreading of organisms from their point of origin or release; the outward extensions of a species' range.

Ecosystem- Dynamic and interrelating complex of plant and animal communities and their associated nonliving (e.g., physical and chemical) environment.

Endangered Species- A species which is in danger of extinction throughout all or a significant portion of its range [ESA§3(8)].

Extirpated Species- A species no longer occurring in a region that was once part of its range.

Good Black-footed Ferret Habitat – This is equal to habitat capable of supporting black-footed ferret reproduction. It is determined from transect data and is the number of transects with at least 25 active Gunnison's prairie dog burrows per ha divided by the total number of transects.

Gross Range- The outer boundary identifying Gunnison's prairie dog distribution. This does not imply that all lands contained within the boundary are occupied or have the potential to be occupied by Gunnison's prairie dogs.

Habitat- The local environment occupied by an organism and those components required to complete its life cycles, including air, food, cover, water, and spatial requirements.

Historic Range- Those geographic areas the species was known or believed to occupy in the past.

Incentive- Assistance, financial payment or other action which encourages individuals or organizations to participate in an effort or activity, or which offsets any sacrifices an individual or organization may make to participate in an effort or activity.

Listing - The formal process through which the USFWS adds species to the Federal List of Threatened and Endangered Wildlife and Plants.

Mapping – Estimates amount of area occupied by Gunnison's prairie dogs by locating colonies and plotting a line around the outermost burrows within a colony. Most mapping includes both active and inactive burrows.

Petition (for Listing)- A formal request, with the support of adequate biological data, suggesting that a species be listed, reclassified, or delisted, or that critical habitat be revised for a listed species: section 4(b)(3)(A) of ESA.

Predicted Range - The predicted range was determined using a GIS model to produce a more accurate, spatial depiction of the range of the Gunnison's prairie dog. This model is not meant to imply that the entire area could be or is appropriate for Gunnison's prairie dog occupation.

Population - All individuals of one species occupying a defined area and usually isolated to some degree from other similar groups.

Occupied Habitat- Land (hectares) that has Gunnison's prairie dogs in residence.

Obligate Species- Species that, either directly or indirectly, are dependent on black-tailed prairie dogs for survival.

Re-establish- To restore (reintroduce) a species to an area that it historically inhabited.

Species- A group of individuals that can actually or potentially breed with each other and produce fertile offspring under natural conditions, but cannot breed with other such groups.

Sensitive Species- An informal term, conferring no legal status, given to species that are of management concern due to declining numbers and/or loss of habitat. State wildlife agencies maintain a list of species of special concern that identifies species whose occurrence may be in jeopardy.

State Trust lands- Lands entrusted to the state by the Federal government and managed by the State Land Department for revenue for Trust beneficiaries (e.g., public schools, colleges, hospitals, charitable institutions). These are not public lands except in Arizona, Montana, and Wyoming (access permit required) and South Dakota (no access permit required).

Sub-complex - An aggregation of colonies not separated from the nearest adjacent group by more than 7 km, but due to various factors (e.g. state boundaries, land ownership) the whole complex is not surveyed and management occurs on only a portion of the entire complex.

Subspecies- A group of interbreeding natural populations differing morphologically and genetically, and often isolated geographically from other such groups within a biological species but interbreeding successfully with them where their ranges overlap.

Sylvatic Plague- An acute, infectious disease caused by the bacteria *Yersinia pestis* that primarily affects rodents, rabbits, and associated carnivore and scavenger species. The agent is transmitted through the bite of an infected flea or through direct contact with an infected carcass. It is known as bubonic plague in humans and sylvatic plague in the wild.

Threatened Species- A species that is likely to become endangered throughout all or a significant portion of its range.

Tularemia- A pathogen native to North America that can cause disease-related declines in Gunnison's prairie dog populations (Davis 1935).