UTAH GUNNISON'S PRAIRIE DOG AND WHITE-TAILED PRAIRIE DOG CONSERVATION PLAN

FINAL DRAFT

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Gunnison's Prairie Dog and White-tailed Prairie Dog Conservation Strategy

Introduction

The Gunnison's prairie dog (GPD; *Cynomys gunnisoni*) and the white-tailed prairie dog (WTPD; *C. leucurus*) play an important role as keystone species in the maintenance of the sage-steppe and prairie ecosystems. In 2002 (WTPD) and 2004 (GPD), petitions were filed to list both species under the Endangered Species Act (ESA 1973, as amended; Center for Native Ecosystems et al. 2002; Forest Guardians 2004). Both petitions cited habitat loss/conversion, shooting, disease, a history of eradication efforts, and inadequate federal and state regulatory mechanisms as threats to long-term viability of these species. The U.S. Fish and Wildlife Service (USFWS) produced negative 90-day findings for both petitions (USFWS 2004, 2006).

In response to the 2002 WTPD petition, the USFWS issued a negative 90-day finding in November 2004. The USFWS stated that the petition did not contain substantial scientific data to warrant listing. Similarly, the USFWS issued a negative 90-day finding on the GPD listing petition in February 2006. However, in July 2007, the USFWS announced that it would be conducting a review of several listing decisions, including the decision not to list the WTPD, due to concerns about the integrity of scientific information used to make the decision and whether the decision was consistent with appropriate legal standards. In addition, the USFWS agreed, as part of a July 2007 lawsuit settlement, to issue a new determination on ESA protection for the GPD by February 1, 2008.

After the petitions were submitted, through the coordination of the Western Association of Fish and Wildlife Agencies (WAFWA), the states took the lead role in completing multi-state Conservation Assessments that evaluated the status of both species throughout their ranges and impacts to both species. After completion of these documents, a range wide Conservation Strategy was developed for both species to provide management and administrative guidelines to assist state and tribal agencies in managing prairie dogs and their associated ecosystems, and to allow for continued management by these entities (Seglund et al. 2006a, 2006b). Further, in 2006, under the auspices of the Prairie MOU (WAFWA 2006c), states were directed to develop and implement statewide conservation strategies for both species.

The purpose of the Utah GPD and WTPD Conservation Plan is to provide direction for management of GPDs and WTPDs in Utah. This purpose is in accordance with the mission statement of the Utah Division of Wildlife Resources:

> The mission of the Division of Wildlife Resources is to assure the future of protected wildlife for its intrinsic, scientific, educational and recreational values through protection, propagation, management, conservation and distribution throughout the State of Utah.

The Utah GPD and WTPD Conservation Plan will direct GPD and WTPD management statewide for a period of 10 years (2008-2017). Prior to 2017, this document will be reviewed, management progress will be evaluated, and an updated management plan will be written and implemented.

UTAH GUNNISON'S AND WHITE-TAILED PRAIRIE DOG PLANNING TEAM

The first step in developing the Utah Gunnison's and White-tailed Prairie Dog Conservation Plan (Utah Plan) was to establish a multi-stakeholder Gunnison's and White-tailed Prairie Dog Planning Team (Planning Team) with representation from state and federal agencies, non-governmental organizations, and academia. The purpose of the Planning Team is to assist with and coordinate the activities of all potential stakeholder and partners in the development and implementation of the Utah Plan. Specifically, this coordination will include: 1) developing and implementing protocols for compiling information from partners in categories that can be aggregated to depict conservation measures occurring throughout the species' range in Utah, 2) encouraging review and dialogue regarding means for balancing legitimate needs for both protection and control, and 3) identifying research needs, helping to obtain funds, and coordinating project implementation. Planning Team members may be assigned to various technical committees as information or other needs (e.g. review of materials) arise.

Subsequent development and implementation of conservation planning, management proposals, and actions will be coordinated, at a minimum, among the states and federal agencies. The involvement of tribes, other governmental agencies, and private entities will be encouraged and their participation welcomed. The UDWR will implement the Utah Plan and will seek new funds to enhance implementation of the Utah Plan. Effective conservation of WTPDs and GPDs and their habitat under the Utah Plan will necessarily depend on cooperation of all groups, thus, all potential partners must be aware of the importance of involving private landowners to the extent they wish to be included. Partners also recognized the importance of compatible rural livelihoods and activities (e.g. ranching, farming, outdoor recreation, etc.) and voluntary participation by private landowners in habitat identification, enhancement, and conservation, as key to the Utah Plan. As such, any member of the public was welcome to provide comments on documents and proposed actions, and attend statewide and regional Planning Team meetings.

This effort is being led by the Utah Division of Wildlife Resources (UDWR) and Utah State University Extension (USU Extension), in partnership with the Utah Gunnison's and White-tailed Prairie Dog Planning Teams (Planning Team, Appendix A). The actions under this Strategy are designed to:

- Prevent the need for WTPDs or GPDs to be listed under the Endangered Species Act.
- Promote conservation of WTPDs, GPDs, associated species, and their habitats in Utah.
- Reduce the risk of overutilization of these prairie dog species for commercial, recreational, scientific, or educational purposes in Utah.
- Identify research needs for WTPDs, GPDs, habitats, and species associations in Utah.
- Focus use of Utah's existing regulatory mechanisms to maintain species and habitat viability.
- Reduce the risk of other factors affecting the continued existence of these prairie dog species in Utah.
- Increase landowner participation in prairie dog conservation efforts.

- Maintain and/or increase partner participation on Planning Team, as necessary.

The Utah Plan recognizes that circumstances exist where population control is appropriate and needed to address private property rights and human health and safety concerns. This Plan identifies both short and long-term objectives, and sets various time frames for completing activities. It incorporates a rangewide view for long-term species persistence and an ecosystem management approach for habitat conservation. Although this Plan focuses on WTPD and GPD conservation, Planning Team members recognize that because these prairie dogs are keystone species, the risks identified for them also may affect associated sage-steppe and prairie species. Initially, Planning Team members agree to direct their conservation actions toward WTPDs and GPDs, but when applicable, will work toward the conservation of sage-steppe and prairie associates.

BACKGROUND

LIFE HISTORY

Gunnison's Prairie Dog

The GPD is the smallest species within the subgenus *Leucocrossuromys* (Pizzimenti 1975). Its weight varies seasonally, ranging from 250-1350 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 300-390 mm (11.8-15.4 in), and tail length measures 40-64 mm (1.6-2.5 in; Fitzgerald et al. 1994; Hoogland 1996). The GPD overall coloration is darker than *WTPD* and Utah prairie dog *(C. parvidens)*. The top of the head, cheeks, and superciliary line are darker than the rest of the body, but they do not exhibit the striking facial pattern found in WTPDs and UPDs (Fitzgerald et al. 1994).

A few studies have described GPD life history, but most studies were limited to a small number of colonies and did not quantify vegetation and substrate requirements (Longhurst 1944; Fitzgerald and Lechleitner 1974). Common plant species noted to occur in GPD colonies included 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, Bouteloua 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).

Utah's CWCS identifies grassland and high desert scrub as the primary and secondary habitat, respectively, for GPDs (UDWR 2005). The CWCS characterizes grassland habitats in Utah as:

> Perennial and annual Grasslands; or herbaceous dry meadows, including mostly forbs and grasses occurring at 640-2,740 m (2,200-9,000 ft) elevation. Principal perennial grass species include: bluebunch wheatgrass, sandburg bluegrass (*Poa secunda*), crested wheatgrass (*Agropyron cristatum*), basin wildrye (*Elymus cinereus*), galleta, needlegrass, sand dropseed, blue gramma, Thurbers needlegrass, western wheatgrass, squirreltail (*Sitanion hystrix*), timothy (*Phleum spp*.), poa (*Poa* spp.), spike (*Trisetum spicatum*), Indian ricegrass, and some sedges. Principle annual grass species is cheatgrass. Principal forb species include: yarrow (*Achillea millefolium*), dandelion (*Taraxacum officinale*), Richardson's geranium (*Geranium richardsonii*), penstemon (*Penstemon* spp.), mulesears (*Wyethia amplexicaulis*), golden aster (*Chrysopsis villosa*), arrowleaf balsamroot (*Balsamorhiza sagittata*), hawkbit (*Agoseris pumila*), larkspur (*Delphinium* spp.), and scarlet gilia (*Gilia pulchella*). Primary associated shrub species include: sagebrush, shadscale, greasewood, creosote, rabbit brush, cinquefoil, snowberry, and elderberry. Primary associated tree species is juniper.

The CWCS characterizes high desert scrub habitats in Utah as:

> Shrublands at 670-3,150 m (2,200-10,300 ft) elevation principally dominated by greasewood (*Sarcobatus vermiculatus*), shadscale, graymolly (*Kochia vestita*), mat-atriplex (*Atriplex corrugata*), Castle Valley clover (*Atriplex cuneata*), winterfat, budsage (*Artemisia spinescens*), four-wing saltbush (*Atriplex canescens*), halogeton (*Halogeton glomeratus*), Mormon tea (*Ephedra* spp.), horsebrush (*Tetradymia canescens*), snakeweed and rabbitbrush; or low elevation perennial grassland co-dominate with shrubland. Principal grassland species include: galleta, indian ricegrass, three-awn grass (*Aristida glauca*) and sand dropseed. Primary associated forb species include: desert trumpet (*Eriogonum inflatum*). Primary associated shrub species include: sagebrush, and black brush (*Coleogyne ramosissima*); other associated species include seepweed (*Suaeda torreyana*).

GPDs are semi-fossorial animals and require well drained, deep soils for burrow construction (Wagner and Drickamer 2003, 2004). Because GPDs hibernate and many colonies occur at high elevations, these burrowing animals rely on placement of hibernacula below the frost line. 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, 2004).

GPDs feed predominantly 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 GPDs fed mainly on grasses and forbs when available and switched to seeds as the grasses and forbs became dormant. Prairie dogs 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).

GPDs 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. Adults emerge from hibernation 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) and latitude. Juvenile emergence in late May to July (dependent on elevation and latitude) 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, especially overwinter when relying on fat reserves, and percentage of 1-year old breeders (Rayor 1985; Menkens and Anderson 1989).

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; Slobodchikoff et al. 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. Territories are used and defended by social groups and agonistic behavior 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 are 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).

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 (Travis et al. 1995, 1996). 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.

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).

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).

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 38-221 m (125-725 ft), and 56% percent of dispersing males went to an adjacent territory, a distance of 34-575 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 0.07-0.08 ha (0.17-0.2ac).

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. Density of GPD colonies reported in the literature ranges from 2.3 prairie dogs/ha (1/ac) (Crocker-Bedford 1976) to 70/ha (28/ac; Longhurst 1944).

<u>White-tailed Prairie Dog</u>

The WTPD can be distinguished by the presence of a short, white-tipped tail and distinct facial markings of dark black or brown cheek patches that extend above the eye (Fitzgerald et al. 1994). The WTPD weighs between 650-1700 g (1.4-3.8 lb; Fitzgerald et al. 1994). The total body length of the WTPD is 315-400 mm (12.4-15.8 in) with a tail length of 40-65 mm (1.6-2.6 in; Fitzgerald et al. 1994). Male WTPDs are typically larger than females (Fitzgerald et al. 1994).

WTPDs occur at elevations ranging from 1150 m (3772 ft) in Montana (Flath 1979) to 3200 m (10,498 ft) in Colorado (Tileston and Lechleitner 1966; Fitzgerald et al. 1994). In Utah, WTPDs have been found at elevations from 1280-2438 m (4199-7999 ft; Boschen 1986; Cranney and Day 1994; Intermountain Ecosystems 1994).

WTPDs require deep, well-drained soils for development of burrows. Soils commonly found on WTPD colonies are derived from sandstone or shale parent rocks and are described as clay-loam, silty clay, or sandy loam (Forrest et al. 1985; Clark et al. 1986; Boschen 1986; Patton 1989; Wolf

Creek Work Group 2001). Topography of inhabited areas is flat to gently rolling with slopes of less than 30% (Forrest et al. 1985; Collins and Lichvar 1986).

Common vegetation associations on WTPD habitats are saltbush (*Atriplex* spp.) and sagebrush (*Artemisia* spp.) shrub communities that contain an understory of grasses and forbs (Kelso 1939; Gilbert 1977; Flath 1979; Forrest et al. 1985; Boschen 1986; Beck 1994; Cranny and Day 1994; Wolf Creek Work Group 2001; Knowles 2002). Saltbush associations commonly are found in areas with fine-textured soils and are characterized by low growing, widely spaced plants (Wolf Creek Work Group 2001). WTPD habitats in northwestern Colorado and Utah are dominated by shadscale (*Atriplex confertifolia*), mat (*A. corrugata*), and Gardner's saltbush (*A. gardneri*); and to a lesser extent, Wyoming big sagebrush (*Artemisia tridentata*), black greasewood (*Sarcobatus vermiculatus*), and rabbitbrush (*Chrysothamnus* spp.; Gilbert 1977; Boschen 1986; Cranney and Day 1994; E. Hollowed, BLM, personnel communication). Annual grasses (e.g. cheatgrass [*Bromus tectorum*]) and forbs dominate the herbaceous communities comprising much of the WTPD habitat in both Colorado and Utah (Boschen 1986; Wolf Creek Work Group 2001). In Montana, some colonies are dominated by saltbush mixed with a variety of perennial forbs and limited sagebrush cover (*Artemisia tridentata*; Flath 1979). Others sites are dominated by winterfat (*Eurotia lanata*) and poverty sump weed (*Iva axillaris*; Flath 1979).

Utah's CWCS identifies grassland and high desert scrub as the primary and secondary habitat for WTPDs, respectively. Grassland and high desert scrub habitats were described in the previous section under GPDs.

WTPDs, like other prairie dog species, are primarily found in relatively open plant communities with short-stature vegetation (Tileston and Lechleitner 1966; Clark 1977; Collins and Lichvar 1986; Menkens 1987; Orabona-Cerovski 1991). Preference for open areas is probably due to their use of visual surveillance for predators and for social interactions (Fitzgerald and Lechleitner 1974). Menkens (1987) found near Laramie and Meeteetse, Wyoming, that median shrub densities varied from slightly greater than 0-0.3 shrubs/m^2 (0-3.2 shrubs/ft^2). Collins and Lichvar (1986) found shrub densities to range from 0.1-2.5 stems/m^2 (1.1-27 stems/ft^2) and shrub heights to be generally less than 66 cm (26 in) at occupied habitats in Meeteetse, Wyoming. Total vegetative cover on WTPD colonies is highly variablewith reported averages ranging from 10-83 % (Tileston and Lechleitner 1966, Collins and Lichvar 1986; Menkens 1987).

WTPDs are primarily herbivorous with grasses making up the majority of their diet. Cool season grasses dominate the diet in spring and early summer, and additional plants are used during other seasons. Sagebrush and saltbush are used by WTPDs during late winter, forbs are used in early spring before other green food is available, and as grasses and sedges flower, seed heads become dominant in their diet (Tileston and Lechleitner 1966). Rabbitbrush flowers are consumed in fall prior to hibernation (Tileston and Lechleitner 1966).

WTPDs 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. WTPDs can become water stressed during their active season if sufficient succulent vegetation is not available. The presence of moist vegetation may be crucial to maintaining WTPD populations because without it, they can not remain active long enough to gain sufficient weight to guarantee winter survival (Beck 1994).

WTPDs cease above ground activity during periods when they are unable to meet metabolic needs (Michener 1977; Bakko and Nahorniak 1986; Harlow and Menkens 1986; Rayor et al. 1987). Lack of precipitation, extreme daily temperatures and/or lack of forage and water appear to be the ultimate factors in induced dormancy (Hudson and Bartholomew 1946 in Collier and Spillett 1975). WTPDs generally hibernate for 4 to 5 months during the winter and may aestivate during mid- to late summer, however timing of these patterns varies with latitude and elevation (Hollister 1916; Tileston and Lechleitner 1966; Bakko and Brown 1967; Pizzimenti 1976b; Harlow and Menkens 1986).

Adult males are the first to emerge in mid-February to early March, about 2 to 3 weeks before adult females (Tileston and Lechleitner 1966; Clark 1977; Cooke 1993). After emergence of females, the breeding season begins and lasts for about 2 to 3 weeks (Bakko and Brown 1967). Pups emerge in mid- May to June at about 5 to 7 weeks of age, at which time the colony experiences a dramatic increase in above ground densities of 150-400% (Tileston and Lechleitner 1966; Clark 1977). The first week after emergence pups remain very close to their natal burrows, but by week 3 they become entirely independent of both their mothers and natal burrows (Clark 1977). Surface activity begins to cease for adult males in late July to mid-August and for adult females about 2 to 4 weeks later (Bakko and Nahorniak 1986). Juveniles remain active above ground until late fall.

Both male and female WTPDs are reproductively mature at 1 year of age (Cooke 1993). Females are reproductively active once a year. Mean litter size at birth cannot be determined because pups are in burrows; however, based on uterine swellings, females show an average of 5.64 + 0.74 embryos per litter (Bakko and Brown 1967) and Flath (1979) found an average of 4.58 pups per litter at 7 weeks based on a sample size of 7 litters.

WTPDs are one of the least colonial prairie dog species and often colonize in an irregular pattern over the landscape. WTPD colonies are extremely difficult to characterize (Tileston and Lechleitner 1966; Forrest et. al. 1985; Mariah Associates, Inc. 1986, 1987, 1988; Bio/West Inc. 1988; Patton 1989). In addition, densities of adults and yearlings within a colony are usually significantly lower than those found in other prairie dog species (Lechleitner 1969; Clark 1977; Hoogland 1979, 1981).

The social system of the WTPD has been classified as a single-family female kin cluster (Tileston and Lechleitner 1966; Michener 1983) comprised of several reproductive females, occasionally 1 or 2 males of reproductive age, and dependent young (Cooke 1993). Females within a cluster are generally members of the same matriline (Cooke 1993). Within the cluster, WTPDs spend little time in social maintenance and most of their active time feeding (approximately 60%; Tileston and Lechleitner 1966; Clark 1977; Orabona-Cerovski 1991; Grant 1995). Overt defense of individual WTPD cluster territories does not occur except during the breeding season when individual males defend plots around burrows allowing only receptive females to enter for copulation (Clark 1977; Cooke 1993). Clark (1977) also found that females showed a weak defense around nest burrows just prior to the emergence of young (Tileston and Lechleitner 1966; Clark 1977).

Little work has been done examining home range sizes in different habitats and for different sex and age classes with regard to WTPDs. In southeastern Wyoming, WTPD home ranges have been found to range from 0.5-1.9 ha (1.2-4.7 ac; Clark 1977) and in north-central Colorado, home range sizes range from 0.15-0.2 ha (0.37-0.49 ac; Cooke 1993).

Emigration and immigration occur in early spring during the reproductive period, and again in late summer and early fall as young disperse (Clark 1977). Clark (1977) found that young of the year began to disperse when the population densities within colonies was greatest (late June to early July). Competition and changes in social climate probably initiated dispersal. Dispersal distance reported in the literature ranges from 50m (164 ft) to 300 m (984 ft). Oraboba-Cerovski (1991), based on a sample of 29 radio-collared prairie dogs, described apparently limited dispersal of male WTPDs in the Shirley Basin. In addition, Grant (1995), with a sample of 22 WTPDs, found that none of his radio-collared individuals dispersed; although they did make long-distance movements of up to 225m.

WTPDs are capable of relatively long movements as illustrated by two translocated animals that traveled 767 m (2,516 ft) and 823 m (2,700 ft) back to their original trap location. In addition, dispersal distances reported for juvenile males and females in north-central Colorado ranged from 0.4-2.4 km (0.1-1.4 mi) with one female dispersing 8.0 km (4.8 mi) (Cooke 1993). Dispersal

WTPD activity is greatest between ambient temperature of 18-28ºC (64-82ºF; Grant 1995). Individual animals within colonies can be seen throughout the day however, there are peak activity periods in the morning and late afternoon in the summer, and in the afternoon during spring and fall (Tileston and Lechleitner 1966). WTPDs are not active in heavy rain, high wind, snow, or hail storms.

WTPD populations have been reported to fluctuate by more than 50% between consecutive years (Menkens 1987; Menkens and Anderson 1989). In most cases, adult variation in density (27-167%) was less than that reported for juveniles (124-348%; Menkens 1987). Variation in densities between years and among habitats likely is due to disease cycles and vegetation quantity and quality. It is important to note that population fluctuation caused by disease outbreaks likely does not represent natural variability of prairie dog populations, as plague is an introduced pathogen in prairie dog populations. Reports of burrow densities vary greatly from location-to-location, ranging from 0.8-291/ha, (0.3-118/ac) with a mean of 2.1-41.7/ha (0.8-16.8/ac; Tileston and Lechleitner 1966; Clark et al. 1986; Menkens 1987; Orabona-Cerovski 1991). Collins and Lichvar (1986) found that burrows were widely distributed and equidistant from one another in WTPD colonies located in contiguous, homogeneous suitable habitat. However, if colonies occurred within a mosaic of habitat types with not all areas suitable for prairie dogs, burrows were arranged in a clumped pattern.

KEYSTONE SPECIES STATUS

Kotliar et al. (1999) found sufficient evidence demonstrating that all 5 prairie dog species are crucial to the structure and function of native systems, and concluded that keystone status was appropriate. Meffe and Carroll (1994) as "…one that makes an unusually strong contribution to community structure or processes."

Specifically, grazing and burrowing activities of the GPD and WTPD 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 (Bangert and Slobodchikoff 2000) and their burrows provide structural habitat for burrowing owls (*Athene cunicularia*) and various small mammals (Miller et al. 1994). Measuring vertebrate species diversity, Clark et al. (1982) recorded 16 reptile, 23 bird, and 16 mammal species on GPD towns. WTPD colonies provide habitat for many other organisms (Martin and Schroeder 1979, Clark et al. 1982), including the endangered black-footed ferret (*Mustela nigripes*) (Martin and Schroeder 1979, Biggins et al. 1999), the mountain plover (*Charadrius montanus*) (Manning and White 2001), the burrowing owl (Martin and Schroeder 1979), and the tiger salamander (*Abystoma tigrinum*) (Clark 1971).

GPDs and WTPDs also serve as prey for a number of predators. GPDs are food for ferruginous hawk (*Buteo regalis*), red-tailed hawk (*Buteo jamaciensis*), golden eagle (*Aquila chrysaetos*), and bald eagle (*Haliaeetus leucocephalus*) Cully (1991). WTPDs serve as prey for badger (*Taxidea taxus*) (Tileston and Lechleitner 1966, Hoogland 1981, Goodrich and Buskirk 1998), golden eagle (Flath 1979, Campbell and Clark 1981; Hoogland 1981), ferruginous hawk (Cully 1991), bobcat (*Felis rufus*) (Flath 1979; Hoogland 1981), coyote (*Canis latrans*) (Flath 1979; Hoogland 1981), long-tailed weasel (*Mustela frenata*) (Hoogland 1981), prairie falcon (*Falco mexicanus*) (Hoogland 1981), kit fox (*Vulpes macrotis*)(List and Macdonald 2003), and black-footed ferret (Forrest et al. 1985).

Given this high degree of association between GPDs and WTPDs and other species, and the impacts of GPD and WTPD burrowing activity on the areas they inhabit, the status of GPDs and WTPDs may serve as one indication of the overall health of shrub-steppe and prairie/grassland ecosystems.

Associated Species

Black-footed ferret. Historically, the black-footed ferret ranged throughout the western United States and western Canada. Ferrets depend almost exclusively on prairie dog colonies for food and denning habitat (Forrest et al. 1985) and the historic range of the ferret included the ranges of both the white-tailed prairie dog and Gunnison's prairie dog (Anderson et al. 1986). Reductions in prairie dog populations in addition to other factors, such as secondary poisoning and canine distemper, resulted in near extinction of wild black-footed ferrets in the 1960s (USFWS 1998). The black-footed ferret was listed as an endangered species under the ESA in 1967. In 1999, the USFWS established a nonessential experimental population in northwestern Colorado/northeastern Utah in accordance with section 10(j) of the ESA (USFWS 1998) and has since established several additional reintroduction sites throughout the historic range of this species.

The black-footed ferret is a Tier I species in Utah's CWCS. The Utah DWR published the Northeast Region Black-footed Ferret Management Plan in 2007 which is designed to facilitate the recovery and delisting of the species, primarily by supporting reintroduction efforts in Uintah County, Utah in a way that is compatible with existing and future economic values of the area. The Northeast Region Black-footed Ferret Management Plan (UDWR 2007) and the Utah CWCS (UDWR 2005) identify disease (plague, canine distemper, and tularemia), habitat loss, energy development, and limited distribution as issues/threats to black-footed ferrets in the state. The Utah CWCS also identifies prairie dog control in agricultural areas as being a threat to persistence of black-footed ferrets (UDWR 2005). As disease, pesticide use, habitat loss, and energy development have also been identified as threats to WTPDs, strategies to address these threats are anticipated to help maintain populations of both species.

Kit fox. The kit fox is closely associated with desert and semi-arid regions throughout the west. Kit foxes use prairie dog towns for both foraging and denning habitat (List and Macdonald 2003). The species historically has lived in areas devoid of free water (Egoscue 1956) and it is well adapted to arid conditions with specialized behavior and physiological functions that conserve water (Golightly and Ohmart 1984). However, the increased distribution of artificial water sources has led to range expansion in species that both compete with and prey on kit foxes (e.g. coyote) and has limited the kit fox to suboptimal habitat (Kozlowski 2005, List and Macdonald 2003). In addition, conversion of cold desert habitats to invasive annual grasslands has forced the species to consume suboptimal prey (AGEISS 2001). Several authors have suggested conservation initiatives for kit foxes should be closely aligned with efforts to save declining prairie dog ecosystems (Ceballos et al. 1993, List and Macdonald 2003). *Vulpes macrotis* has been historically split into several subspecies, one of which is classified as endangered under the ESA (San Joaquin kit fox, *V. m. mutica*).

The kit fox in Utah (primarily *V. m. nevadensis*) is currently a Tier II species in Utah's CWCS and is legally trapped as a furbearer, but is rarely targeted by trappers and most harvest is incidental to trapping other furbearers. Harvest is identified as a threat to kit foxes in Utah's CWCS, as are bioaccumulation of pesticides, and expansion of other predators (primarily coyotes) into kit fox range. It is expected that management actions directed at reducing pesticide use to control prairie dogs may also help to maintain populations of kit foxes by potentially reducing the threat of pesticide bioaccumulation.

Ferruginous Hawk. The ferruginous hawk is dependent on native prairie/shrubsteppe ecosystems throughout the western United States and much of this habitat type has been lost through exotic plant invasions, conversion to agricultural uses, energy extraction activities and incompatible range management actions. In addition to habitat loss, ferruginous hawks are threatened by poisoning of prey species, especially prairie dogs, directly through consumption of bioaccumulated poisons and indirectly through the reduction in available prey (Dechant et al. 1999). Ferruginous hawks are often associated with prairie dogs (Kotliar et al. 1999) and local declines in hawk abundance have occurred following prairie dog declines in New Mexico (Cully 1991) and Colorado (Jones 1989). In addition, Gilmer and Stewart (1983) suggested that grazing by prairie dogs reduce plant cover and make prey more visible to ferruginous hawks. The degree of dependence of ferruginous hawks on prairie dogs in Utah is unknown. A petition to list the ferruginous hawk under the ESA was rejected in 1992 (USFWS 1992).

The ferruginous hawk is listed as a species of concern on the Utah State Sensitive Species List (Tier II in the Utah CWCS) and is a Utah Partners in Flight Priority Species. In addition, it is a focus species in several Nature Conservancy (TNC) Ecoregional Conservation Plans and is listed as a Bird of Conservation Concern by the USFWS. The ferruginous hawk is protected under the Migratory Bird Treaty Act. The Utah CWCS identifies human disturbance to nest sites, lack of information on population status, energy development on breeding grounds, and habitat loss from number of sources as threats to ferruginous hawks in Utah. Strategies in this Plan that address energy development and livestock grazing may help abate threats to ferruginous hawks where they co-exist with GPD and WTPDs.

Burrowing Owl. The burrowing owl is dependent on prairie dogs and other small mammals to excavate burrows that the owl uses for nesting and roosting. The species is suffering dramatic declines and range contraction in states throughout the West, including Utah (James and Espie 1997). Population declines are due to habitat loss, fragmentation, and degradation associated with widespread control of prairie dogs and ground squirrels, as well as conversion of open prairie, grasslands, and agricultural land to development (Paige 1998). In Utah, burrowing owls occur statewide but the species is rare, and rapid urbanization has contributed to habitat loss throughout the state.

Though the burrowing owl has not been petitioned for listing under the ESA, it is listed as a species of concern in Utah (Tier II in the Utah CWCS). It is protected by the Migratory Bird Treaty Act and is a focus species in several TNC Ecoregional Conservation Plans. The Utah CWCS identifies urbanization, a lack of information on genetic distribution, and a lack of information on population productivity and its relationship to prairie dog colonies as threats to burrowing owl populations in Utah. It is anticipated that research aimed at addressing questions related to density and distribution of GPDs and WTPDs needed to assure their functionality in the ecosystem and evaluations of keystone role of GPDs and WTPDs.

Mountain Plover. The mountain plover was historically associated with herbivorous grassland mammals, such as large ungulates and prairie dogs, which created open habitat suitable for plover nesting (Knowles et al. 1982, Olson-Edge and Edge 1987). Mountain plovers are closely associated with black-tailed prairie dogs, but have been confirmed breeding in colonies of other prairie dog species (Mexican prairie dogs, Desmond and Chavez-Ramirez 2002; white-tailed prairie dogs, Manning and White 2001). The global population of mountain plovers has declined by 50 percent since 1966 and the current population is estimated between 5,000 and 11,000 (Wunder and Knopf 2003). Once widely distributed through the Great Plains region, the species now breeds primarily in Colorado, Wyoming, and Montana, and winters in southern California. In Utah, the only known historical breeding site is in Duchesne County, south of Myton, in the Uinta Basin (Day 1994, Manning and White 2001), and eastern Utah is likely the periphery of the breeding range (Manning and White 2001). A proposal to list the mountain plover under the ESA was issued in 1999 and again in 2002 citing habitat loss and significant population declines. In 2003, that proposal was withdrawn because new data indicated that threats to the species were not significant (USFWS 2003). The mountain plover is protected by the Migratory Bird Treaty

Act and by policies of individual federal agencies (e.g. Bureau of Land Management, Forest Service).

The mountain plover is a tier III species in Utah's CWCS, a Utah Partners in Flight Priority Species, and it is listed in the U.S. Shorebird Conservation Plan, the Intermountain West Regional Shorebird Plan, and the Wyoming Basins Ecoregional Conservation Plan (TNC). Utah's CWCS identifies threats to mountain plovers: road construction related to energy development, disturbance of nesting area from oil and gas development, and a lack of information about population status in the state. It is anticipated that implementing Plan strategies that address oil and gas development may also benefit mountain plovers where they coexist with WTPDs in Utah.

DISTRIBUTION AND ABUNDANCE

Gunnison's Prairie Dog

The Gunnison's prairie dogs historic range included large portions of New Mexico, Colorado, Utah, and Arizona; that range has contracted and the species is now largely restricted to the Four Corners region (USFWS 2006). In 1961, it is estimated that approximately 100,000 acres were occupied by GPDs (Knowles 2002). In 1968, the Utah Division of Wildlife, Bureau of Sport Fisheries and Wildlife (later renamed the Utah Division of Wildlife Resources) estimated that there was 22,007 acres of occupied GPD habitat in the state. In 1984, 8 GPD colonies were mapped on BLM lands, totaling 2,212 acres, in San Juan County, as part of an evaluation of habitat for black-footed ferrets (Wright 2006, Seglund et al. 2006). In 2002, the UDWR mapped 22 GPD colonies, with 3,687 acres of active colonies in Grand and San Juan County (Wright 2006, Seglund et al. 2006). Colonies were classified as active if ≥25% of burrows were active. Sixty-three additional active GPD colonies located on private land were not included in this mapping due to trespass restrictions. Most of these colonies were estimated to be <25 acres in size (Seglund et al. 2006a).

A predicted range model developed for the GPD Conservation Assessment estimates that 3% of the GPD predicted range model (PRM) occurs in Utah (Seglund et al. 2006a). The GPD PRM was developed from a GIS model to depict a more accurate, spatial range of the GPD and does not imply that the area could be or is appropriate for use by GPDs.

During 2005 the Utah DWR explored known GPD habitat on public land in southeastern Utah looking for active colonies. When a distinct colony was located (as opposed to widely scattered individuals) a burrow transect was established. Transects were oriented along the long-axis of prairie dog colonies as determined during a preliminary inspection from an elevated point or the top of the truck cab. Methodology and definitions followed Biggins et al. (1993).

Most GPD complexes were characterized by high burrow densities. Total burrow densities ranged from 195/ha to 527/ha. However, one complex, Butler Wash had 0 active burrows out of 195 total burrows/ha. The total active burrow density for GPD transects was 74.5/ha and the ratio of active burrows/total burrows was 0.25. All complexes maintained good densities of burrows compared to literature reports (Campbell and Clark 1981) (Table 1). In the Butler Wash complex where none were active, there may have been a recent plague outbreak (Wright 2006).

Also in 2005, the Utah DWR developed a GIS layer of soils considered suitable for GPD habitat in southeastern Grand County and San Juan County. Based on previous mapping, interviews, and road reconnaissance, a 180 record point file of potential GPD locations was assembled. Three soil surveys using different soil map unit keys and soil map unit names cover the range of the GPD in Utah. Each GPD point location was assigned to the soil map unit in which it was located. In the northern area "Soil Survey of Canyonlands Area, Utah", any soil map units with two or more GPD points assigned to it was tentatively added to the layer of GPD suitable soil layer. Soil map unit descriptions determined to be inappropriate because of shallow profile or high rock content were edited out of the layer. The same procedure was followed in the "Soil Survey of San Juan Co., Utah Central Part" and "Soil Survey of San Juan Area, Utah" with one exception. Because there was more private land and fewer GPD points in these areas, a single point was sufficient to have a soil map unit tentatively included in the layer.

The GPD suitable soil layer comprised 2,549 square kilometers. Out of 180 GPD potential locations, 155 (86%) fell within the GPD suitable soil layer, and most that did not were close to the edge of the layer. Not all locations in the point file have been verified as suitable for GPD's by site visits. The Utah DWR has used this soil layer to enhance and refine the existing PRM for GPDs in the state. The resulting map is considered the revised predicted range model (RPRM) for GPDs in Utah and will be used to develop occupancy surveys, as described in the MONITORING STRATEGY section of this document. The RPRM for GPDs in Utah encompasses approximately 839,500 acres (Figure 2), primarily falling on federal land (56%) with lesser amounts on private and state lands (Figure 2, Table 2).

In 2007, the Utah DWR conducted occupancy surveys (as described in the Monitoring Strategy section of this document) for GPDs in Utah; 29 of 142 plots surveyed were occupied (A. Wright, Utah Division of Wildlife Resources, personal communication). This survey will be repeated in 2010 to determine trends in occupancy in Utah and will contribute to determining occupancy trends across the range of the species (WAFWA 2007).

White-tailed Prairie Dog

The distribution of white-tailed prairie dogs includes Wyoming, Colorado, Utah, and Montana (Knowles 2002). Though the species' current range is similar to its historic range, there is evidence that species abundance has declined as a result of control efforts and plague (Seglund et al. 2004). There is no range-wide population estimate for white-tailed prairie dogs. A predicted range model developed for the WTPD Conservation Assessment estimates that there are 340,470 occupied acres throughout the species range (Seglund et al. 2006b). The predicted range model was developed from a GIS model to depict a more accurate, spatial range of the WTPD and does not imply that the area could be or is appropriate for WTPD occupation.

In Utah, white-tailed prairie dogs occur in Rich, Summit, Daggett, Uintah, Duchesne, Carbon, Emery, and Grand Counties (Seglund et al. 2004). In Utah, WTPDs have been found at elevations from 1,280-2,438 m (4,199-7,999 ft; Boschen 1986; Cranney and Day 1994; Intermountain Ecosystems 1994).

The predicted range model (PRM) developed for the WTPD Conservation Assessment estimates that 13% of the WTPD predicted range occurs in Utah (Seglund et al. 2006b). In Utah, the PRM for the WTPD encompasses 8,583,526 acres (Figure 1), most of which is located on federal land (59%) (Figure 2, Table 2).

A statewide evaluation of the distribution and population status of WTPDs in Utah is confounded by a history of incomplete and inconsistent surveys, and variable time periods between estimates at specific sites. Efforts have been made to determine both population trends and changes in distribution over time. These efforts were detailed in the WTPD Conservation Assessment (Seglund et al. 2006b) and information presented in this document has largely been drawn directly from that effort.

The only comprehensive effort to quantify prairie dog distribution was conducted by Utah UDWR in 2002 to 2003. Previous efforts to account for the statewide distribution of WTPDs were incomplete. Therefore, trends in the predicted range of WTPDs in Utah over time must be inferred from evaluation of quantitative data collected on a limited number of sites. In addition, many WTPD colonies occur on private lands, and trespass restrictions prevent foot access for field surveys. Consequently, the data presented below represent minimum estimates of both WTPD distribution and abundance.

- 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 UDWR) compiled a map of UPD, GPD, and WTPD colonies using knowledge from professional biologists throughout the state (Bureau of Sport Fisheries and Wildlife 1968). The effort produced a rough map of species' distribution, but did not attempt to quantify occupied habitat by each species. This collaboration identified both the Uintah Basin in northeastern Utah and Castle Valley in eastern Utah (south of Price and west and east of U.S. State Highway 10) as areas supporting the greatest amount of habitat occupied by WTPDs.. In far eastern Utah, the Cisco Desert along Interstate 70 and Rich County near Evanston, Wyoming were thought to contain the lowest concentrations of WTPDs.

- The next major effort to document WTPD distribution and abundance in Utah occurred in 1985 (Boschen 1986, Cedar Creek Associates 1986). Since 1985, state and federal agencies, and occasionally private consultants, have sporadically surveyed portions of the species' range. In addition to surveys to document occupied habitat, a handful of WTPD sites have been intensively monitored to evaluate their suitability as black-footed ferret habitat.

Surveys of WTPD populations have been conducted in several prairie dog complexes and sub-complexes in the Uinta Basin of northeastern Utah from 1997 to 2007 (Figure 3, Table 3). These surveys have been conducted primarily in support of black-footed ferret reintroduction efforts. Coyote Basin (including Kennedy Wash) and Snake John Reef are sub-complexes located within the larger Raven Complex in Uintah County, Utah, and Moffat County, CO. Coyote Basin, the primary release site for black-footed ferrets, is located along the Colorado/Utah border 11 miles south of US 40. Snake John Reef, the secondary release site for black-footed ferrets, is located along US 40 near the Colorado/Utah border and near Dinosaur, CO. Shiner Basin Complex is located northeast of Vernal and south of Diamond Mountain. Shiner Basin is not located within the current black-footed ferret management area but is within the 10(j) designated area. Within these areas, WTPD colonies were mapped, evaluated for their potential as black-footed ferret reintroduction sites, and monitored annually to track continued habitat suitability for black-footed ferrets (Biggins et al. 1989, 1993) (Figure 3).

- Coyote Basin – Little was known about the Coyote Basin sub-complex before initiation of black-footed ferret habitat surveys, but it was thought that a die-off had occurred here in 1990 (Boschen 1993). Windshield surveys from 1992 to 1993 showed an increase in WTPD numbers throughout the sub-complex (Boschen 1993). Intensive black-footed ferret habitat surveys (Biggins et al. 1989, 1993) were conducted in Coyote Basin from 1997 to 2006. Surveys from 1997 to 2000 showed the Coyote Basin population declining slightly. In 2001, the population began to increase and in 2002, the population of WTPDs was the highest recorded since transecting began in 1997. Subsequent surveys in 2003 and 2004 showed a significant decline in the number of WTPDs. Surveys in 2005 and 2006 have shown a increase in WTPD numbers although they have not reached 2002 levels. The rapid drop in prairie dog numbers from 2002-2004 is likely attributable to extreme drought conditions. A plague epizootic is not suspected. The coefficient of variation for Coyote Basin was 33% (Table 3).

Kennedy Wash – From 1982 to 1988 a ferruginous hawk mitigation study was conducted in the Kennedy Wash area of the Uintah Basin (Stalmaster 1985, 1988). During this research project, WTPD densities were determined by counting WTPDs seen along established transects in April and June. Numbers of WTPDs observed varied from a high of 242 WTPDs/km^2 (629/mi^2) in 1983 to a low in 1987 of 13 WTPDs/km^2 (33.8/mi^2). In 1988, the WTPD population increased and was estimated at 65 WTPDs/km^2 (169/mi^2). Black-footed ferret habitat surveys were conducted in the Kennedy Wash sub-complex from 1998 to 2003. The Kennedy Wash sub-complex showed a trend similar to that documented in Coyote Basin: the population declined slightly from 1998 to 2001, increased sharply in 2002, and declined significantly in 2003. The coefficient of variation for Kennedy Wash was 48% (Table 3). Prairie dog colonies within Kennedy Wash are considered part of the Coyote Basin sub-complex.

- Snake John Reef– Black-footed ferret habitat surveys were completed in the Snake John sub-complex from 2001 to 2006. WTPD population estimates were similar in 2001 and 2002, but like Coyote Basin, populations declined significantly in 2003. The level of decrease in Snake John Reef was not as dramatic as in Coyote Basin. The coefficient of variation for Snake John was 25% (Table 3).

- Shiner Basin – Basin was surveyed from 1997 to 2000. WTPD populations declined from a high of 47,551 in 1998 to an estimated low of 5,383 in 1999. Due to this significant decline, Shiner Basin was removed from consideration as a black-footed ferret release site even though transecting in 2000 documented an increase in the WTPD population estimate. For the 4 years of surveys, Shiner Basin had a coefficient of variation of 91% (Table 3). In 2002 and 2003, a low intensity survey effort (~60% of the area was sampled) was conducted within the Shiner Basin Management Area in order to evaluate WTPD population recovery (B. Zwetzig, BLM, personal communication). Survey results showed presence of WTPDs but at extremely low densities. However, prairie dog numbers have continued to increase since 2003 but transecting still has not be resumed in this area.

Averaging WTPD population estimates over all transected colonies surveyed in Utah from 1997-2003 showed a pattern of populations reaching high densities with subsequent declines in both 1999 and in 2003 (Seglund et al. 2006b). WTPD populations over all transected colonies within the Uinta Basin fluctuated despite the short term duration in monitoring (3-7 years/site) with coefficients of variation ranging from 25% to 91% (Table 3). Population estimates demonstrated dramatic increases and decreases in numbers of WTPDs within a one-year period (e.g. Kennedy Wash increased from an estimated 3,670 WTPDs [3/ha; 7.4/ac] in 2001 to 10,282 WTPDs [8.6/ha; 21.2/ac] in 2002 and Shiner Basin saw a decline in WTPDs from 47,551 [11/ha; 27.2/ac] in 1998 to 5,383 in 1999 [1.8/ha; 4.4/ac]). Because WTPDs reproduce only once per year and juvenile emergence ranges from 2.94-3.83 per litter (Tileston and Lechleitner 1966; Bakko and Brown 1967), these oscillations in population estimates may be biologically significant. However, whether these fluctuations are normal can not be determined with the short-term duration in sampling.

In addition to the above survey efforts, during 2002 and 2003, the UDWR began a statewide mapping effort to quantify the current area occupied by white-tailed prairie dog colonies on public lands. Methods of data collection varied slightly among UDWR administrative regions, but all relied upon site visits to describe colony size and activity. The 2002 to 2003 surveys estimated that white-tailed prairie dog colonies occupied 57,463 ha (141,808 ac) in Utah (Figure 2, Figure 3). Colonies in Grand, Emery and Carbon Counties in south central Utah occupied 10,869 ha (26,856 ac) on public lands (Seglund 2002). Within the Uinta Basin of northeastern Utah, 46,521 ha (114,951 ac) of occupied habitat were recorded (Maxfield 2002). In northern Utah, five colonies consisting of 73 ha (180 ac) were mapped in 2003 (A. Kozlowski, UDWR, personal communication).

LEGAL STATUS

In Utah GPDs and WTPDs are protected by both State Code and administrative rule. Utah law and administrative rules protect GPDs and WTPD from unlawful possession, transportation, destruction, and harm. The relevant sections of Utah Code are:

i. Definitions (23-13-2) of "Wildlife" (49), "Protected Wildlife" (35) and of "Take" (43): http://www.le.state.ut.us/~code/TITLE23/htm/23_01003.htm

ii. Captivity of protected wildlife unlawful (23-13-4): http://www.le.state.ut.us/~code/TITLE23/htm/23_01005.htm

iii. Importation or exportation and release unlawful (23-15-5): http://www.le.state.ut.us/~code/TITLE23/htm/23_01006.htm

iv. Taking, transportation, selling, or purchasing protected wildlife illegal except as authorized (23-20-3): http://www.le.state.ut.us/~code/TITLE23/htm/23_08005.htm

v. Wanton destruction of protected wildlife (23-20-4): http://www.le.state.ut.us/~code/TITLE23/htm/23_08007.htm

The relevant administrative rules are:

i. Rule R657-3. Collection, Importation, Transportation, and Possession of Zoological Animals: http://www.rules.utah.gov/publicat/code/r657/r657-003.htm

- R675-3-11 Certificate of Registration Required: http://www.rules.utah.gov/publicat/code/r657/r657-003.htm#T11

- R657-3-24 Classification and Specific Rules for Mammals: http://www.rules.utah.gov/publicat/code/r657/r657-003.htm#T24

Gunnison's Prairie Dog

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. 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 GPD was petitioned for listing under the ESA in February 2004, but that petition was rejected in January, 2006 citing lack of scientific evidence (USFWS 2006). However, USFWS is currently in litigation relative to this decision.

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. Hunting or shooting 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).

Utah State Statutes (4-23-3, UCA) classify prairie dogs as "depredating animals". This section of law is administered by the Utah Department of Agriculture and Food. 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, former State Director for Wildlife Services in Utah, personal communication).

The GPD in Utah is considered a "State Sensitive Species" by the BLM. The BLM in Utah is currently revising Resource Management Plans in the Moab and Monticello Field Offices, covering the entire range of the GPD in Utah. In the revised land use plans, BLM will recognize the GPD as a State Sensitive Species, and will address GPD habitat conservation measures through a range of alternatives. Because the GPD is considered a State Sensitive Species, the Bureau's 6840 Policy requires that the Bureau "*…ensure that actions authorized, funded, or carried out by the BLM do not contribute to the need for the species to become listed."* Within these new plans, the BLM may propose to manage habitat for prairie dogs according to UDWR recommendations, by developing cooperative agreements with UDWR or other agencies to inventory GPD habitat, consider suitable unoccupied habitat for population expansion, develop conservation measures to protect active GPD colonies, mitigate impacts from new roads, oil and gas developments, and rights-of-way, adjust livestock grazing to favor spring plant growth where feasible, limit OHV use to existing roads and trails, and/or propose establishment of Areas of Critical Environmental Concern (ACEC) where GPD habitat would receive management priority over other resource uses.

White-tailed Prairie Dog

The WTPD is a species of concern on the Utah Sensitive Species List (Tier II species in the Utah CWCS). The USFWS was petitioned in July 2002 to list the white-tailed prairie dog as threatened or endangered under the ESA, but the USFWS found that listing was unwarranted in November 2004, citing lack of scientific evidence (USFWS 2004). USFWS is anticipating litigation relative to this decision.

No license is required to take WTPDs (R657-19-10); they may be taken 24-hours-a-day, without bag or possession limits (R657-19-5). Take of WTPDs is prohibited on public lands from 1 April through 15 June, but they may be taken on private lands year-round. WTPDs may be taken in the following counties, which describe the limits of their gross range in Utah: Carbon, Daggett, Duchesne, Emery, Morgan, Rich, Summit, Uintah, and all areas west and north of the Colorado River in Grand County. No take of WTPDs is permitted within the Primary Management Zone for black-footed ferret recovery bordering Colorado in eastern Uintah County (R657-19-2(b)). This year-round shooting closure was imposed in 1999 [Subsection (2)(b)(i)]. The closed area boundary begins at the Utah-Colorado state line and Uintah County Road 403, also known as Stanton Road, northeast of Bonanza, southwest along this road to SR 45 at Bonanza, north along this highway to Uintah County Road 328, also known as Old Bonanza Highway, north along this road to Raven Ridge, just south of US 40, southeast along Raven Ridge to the Utah-Colorado state line, and south along this state line to point of beginning.

The Utah Administrative Code classifies the WTPD 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 occasionally requested to assist land owners in control efforts with a focus on providing technical assistance (M. Bodenchuk, former State Director for Wildlife Services in Utah, personal communication).

The WTPD in Utah is also considered a "State Sensitive Species" by the BLM. The BLM in Utah is currently revising land use plans in the Moab, Vernal, Price and Salt Lake Field Offices, covering the entire range of the WTPD in Utah. In the revised land use plans, BLM will recognize the WTPD as a State Sensitive Species, and will address WTPD habitat conservation measures through a range of alternatives. Because the WTPD is considered a State Sensitive Species, the Bureau's 6840 Policy requires that the Bureau "*…ensure that actions authorized, funded, or carried out by the BLM do not contribute to the need for the species to become listed."* Within these new plans, the BLM may propose to manage habitat for WTPDs according to UDWR recommendations, by; developing cooperative agreements with UDWR or other agencies to inventory WTPD habitat, consider suitable unoccupied habitat for population expansion, develop conservation measures to protect active WTPD colonies, mitigate impacts from new roads, oil and gas developments, and rights-of-way, adjust livestock grazing to favor spring plant growth where feasible, limit OHV use to existing roads and trails, and/or propose establishment of Areas of Critical Environmental Concern (ACECs) where WTPD habitat would receive management priority over other resource uses.

MONITORING STRATEGY

The most commonly used technique to evaluate prairie dog habitat has relied on delineating colony boundaries based on burrow distribution to determine amount of acreage inhabited by the species. However, WTPD and GPD colony boundaries are difficult to discern and their distribution and activity levels within these boundaries are extremely variable. This results in an investigator relying on their best estimate by using topographic features or breaks in habitats to delineate boundaries. In addition, individual burrow activity is not always assessed, which results in both active and inactive areas included in estimates of occupied habitat. Little information is available on the length of time a burrow persists on the landscape and it is likely that the rate of deterioration varies with activity of other burrowing mammals (e.g. badgers, ground squirrels), and weather conditions (e.g. precipitation, wind). The consequence of mapping both active and inactive areas is an overestimation of occupied habitat, with trends not accurately documented.

In general, four primary techniques, including mail surveys, ground surveys, interpretation of satellite imagery (Sidle et al. 2002), and line intercept aerial surveys (Sidle et al. 2001) have been used for estimating distribution and abundance of prairie dog species (Andelt et al. 2003). These efforts required significant resources, and often failed to provide accurate, reliable information.

In 2002, Utah DWR and Colorado Division of Wildlife (DOW) initiated a cooperative effort to develop an objective technique for monitoring GPD and WTPD populations. Aerial surveys using the line intercept methodology, which had been developed to estimate the area occupied by black-tailed prairie dogs, was evaluated to determine if it could be successfully applied to GPDs and WTPDs. This methodology had several problems. The use of line intercept methodology significantly overestimated the lengths of WTPD and GPD colonies compared to lengths measured on the ground, proportions of lengths of prairie dog colonies detected by the 2 aerial survey crews were only weakly correlated, and the 2 crews did not consistently report finding prairie dogs in the same areas along the same transects. The conclusion from this pilot study was that line intercept methodology is not a viable technique for monitoring GPDs and WTPDs (Andelt et al. 2003).

As a result of the aforementioned pilot study, Colorado DOW investigated the use of occupancy modeling (MacKenzie et al. 2002) to monitor GPDs and WTPDs. The population of sites (sampling frame) is defined based on UTM coordinates, so that the total number of sites (*N*) divided into the number of occupied sites is the proportion of sites occupied (*O*), or the occupancy rate. Occupancy modeling is useful because it eliminates the subjectivity associated with defining colony boundaries, appears to be more cost effective (A. Seglund, biologist, Colorado Division of Wildlife, personal communication), and, unlike acreage estimates, allows for correction for "false negatives" (i.e. when quadrats are occupied but prairie dogs are not observed), estimates of statistical precision, and calculation of confidence intervals. Based on initial trials, occupancy modeling will be a useful tool for establishing baseline occupancy rates for WTPDs and GPDs in order to monitor changes in occupancy through time (Andelt et al. 2005a, 2005b).

Based on the results of pilot studies conducted by Colorado DOW and Utah DWR in 2005 (Andelt et al. 2005a, 2005b), all states within the range of these species, including Utah, have agreed to implement an occupancy approach to evaluate the health of WTPD and GPD populations rangewide (WAFWA 2007).

Occupancy Modeling Methodology

Long-term monitoring of GPDs and WTPDs in Utah will be achieved using occupancy modeling. Occupancy modeling is being conducted as part of an effort to establish baseline occupancy rates and future trends for GPDs and WTPDs rangewide.

Occupancy for prairie dogs is defined as the proportion of sites occupied by the species. To determine occupancy, the predicted range of the species is divided into specific sites (0.25 km^2 quadrats). A random sample of sites is selected and surveyed to detect presence of prairie dogs. The occupancy rate is equal to the total number of sites (*N*) divided into the number of occupied sites is the proportion of sites occupied (*O*).

A pilot study conducted by the Colorado DOW at prairie dog colonies with high, medium, and low levels of activity resulted in a probability of detection of >0.9. Unlike acreage estimates, measures of statistical precision and guidance for sampling design can be developed from occupancy estimation methods, and confidence intervals can be calculated for occupancy estimates. Current results from the sampling strategy are promising for both species to allow managers to detect reasonable declines. Declines would then trigger the initiation of management actions to restore occupancy rates to within the natural biological variation of the species.

Across the range of GPDs and WTPDs a total of 700 plots for each species will be surveyed. Plots were allocated to each state in each species range based on a minimum plot allowance (100 per state) and the percentage of potential habitat (based on the rangewide predicted range model, Seglund et al. 2006a, 2006b) in each state. Because of difficulty in securing access to sample plots, areas under Tribal ownership were excluded from the survey; all other landownership types could be surveyed. Occupancy surveys for GPDs and WTPDs will be conducted every 3 years starting in 2007 and 2008, respectively. States are required to follow minimum guidelines for conducting occupancy surveys which are described in the Rangewide Protocol (Andelt and Seglund 2006, Appendix B). At the close of the sampling period, all states will turn over copies of their occupancy data sets to the Colorado DOW who will be responsible for data archiving, analysis, and summary rangewide reporting.

Under the rangewide occupancy sampling program, each state is responsible for developing a state-specific "area of inference", selecting plots, and monitoring a minimum number of plots. In Utah, the DWR developed a revised predicted range model (RPRM) for GPDs by factoring in suitable soils and known distribution (Figure 1) as described in DISTRIBUTION AND ABUNDANCE. A spatially balanced design (Stevens and Olsen 2004) was used to select occupancy sample plots from the GPD area of inference (i.e. RPRM).

For WTPD the area of inference will be based on 2002/2003 surveys of WTPD habitat, and the rangewide PRM for WTPDs (Figure 1) (described in DISTRIBUTION AND ABUNDANCE, above) possibly refined by a GIS layer of soils considered suitable for WTPDs.

In addition, states are responsible for establishing specific survey periods within which to sample. Survey periods will be chosen to maximize the probability of detecting prairie dogs and may vary between sampling periods, specific areas, and species.

Utah will implement occupancy modeling to monitor GPDs and WTPDs in the state, beginning in 2007 and 2008, respectively. Based on the rangewide allocation, Utah will survey 142 GPD (116 plots were required based on rangewide allocation) and at least 140 WTPD plots. Utah will follow the protocol outlined in the Rangewide Protocol (Andelt and Seglund 2006, Appendix B).

MANAGEMENT TRIGGERS

Occupancy surveys will provide an estimate of occupied habitat, rangewide, for each species, every three years. The initial sampling period will serve as a baseline upon which to compare rates of occupancy, colonization, and extinction, and will help to refine current estimates of detection probability. As of this writing, management triggers (i.e. declines) will be established and responded to on a rangewide basis because the rangewide occupancy survey design minimum standards are only robust enough, in many cases, to allow for rangewide detection of trends. In many states, only plots needed for the rangewide estimate are being monitored and it will not be possible to confidently detect statewide trends.

Subsequent sampling periods will allow for rangewide estimates of local trends in occupancy, extinction, and colonization probability. Based on a detection probability of 0.9 and with a sample size of 700 plots, there is 95% chance of detecting a 40% change in the occupancy rate, rangewide. Should a 40% decline be detected after the second sampling period (i.e. after the 2010 and 2011 sample for GPDs and WTPDs, respectively), the GPD and WTPD Interagency

Team will meet to evaluate the trend and to determine potential causes. At that point, states will have one year to implement corrective management actions and occupancy sampling will occur annually until a reversal in the trend is detected, rangewide. Management actions implemented will vary by state, but will collectively be targeted at abating and mitigating for the impacts potentially responsible for the decline. Issues potentially impacting GPDs and WTPDs in Utah are described below in CONSERVATION AND MANAGEMENT ISSUES; potential management actions are described below in CONSERVATION AND MANAGEMENT STRATEGIES.

Once occupancy surveys have been conducted for at least 3 sampling periods (i.e. 9 years), estimates of process variation will be available to help determine long-term management triggers. Process variation is defined as the variation in number of plots detected from year to year that is affected by factors such as plague. For example, a large decline in occupancy rates may occur one year from plague, but within a few years, occupancy rates may rebound. GPD and WTPD occupancy rates will fluctuate "normally" with changes in distribution and population size. Long-term trends in occupancy will be influenced by this "normal variation" and management triggers, in order to be most effective, will need to incorporate this variation so that, should long-term trends in occupancy be detected, they will reflect actual changes in occupancy rates, rather than being driven by normal fluctuations. Therefore a long-term rangewide management trigger will be reevaluated by the Interagency Team in 2009, after 2 additional occupancy surveys have been conducted in Colorado, at which point there will be sufficient data to begin estimating process variation for GPDs and WTPDs in that state.

2007 GUNNISON PRAIRIE DOG SURVEY

Methods

During 2007, as part of a multistate, range-wide effort, the Utah DWR carried out an occupancy survey for GPD's in southeastern Utah. During 2006, a model or "sampling universe" of potential habitat (630,114 acres) based on soil surveys was developed. For sampling, this area was approximated with an area of 500 m by 500 m plots (524,065 acres). To assess how well the model worked, suitability for providing GPD habitat in each plot was categorized when we located it in the field. Suitability categories can be found in Table 4. Using a spatially-balanced, random sampling design (Stevens and Olsen 2004) 125 plots were selected to be surveyed. Two surveys were completed on each of 124 plots (access was denied to 1 plot). A detailed description of the survey protocol used in all states is found in Appendix B. Surveys began on April 1, 2007 and were completed on August 8, 2007.

To address concerns that the 125 plots would not provide sufficient data to implement a state management plan (due to poor model performance or low observed occupancy, an additional sampling stratum, "stratum 2", was established within the original sampling universe. Stratum 2 would be the subject of more intensive sampling. Stratum 2 was an intersection of points (buffered by 500m) representing locations where active colonies had been reported between 1990 and 2007 (Figure 4) with the "sample universe" (Figure 1, Figure 2, Figure 4). Two surveys were completed on 18 additional plots within stratum 2. Because 14 of the original 124 plots already fell within stratum 2, sampling efforts within 500 m of GPD colonies known to be active in the last 17 years was doubled.

Range-wide true occupancy (versus observed occupancy) and detectability will be computed by statisticians at the Colorado Division of Wildlife. Repeating 2 surveys at each plot makes it possible to estimate the number of false negatives (places where prairie-dogs are present but not detected) using Program Mark. The Utah DWR intends to format Utah data for Program Mark and compute state specific estimates for these parameters, but this task is not yet accomplished (Wright 2007).

Results

Observed occupancy on the original 124 plots was 14.5% (Table 5). When plots were added within previously know GPD areas (stratum 2, n = 32, i.e. 'historic' records), the total n for all strata = 142 plots, observed occupancy was 11.8% in potential habitat without 'historic' records and 46.9% in habitat with 'historic' records.

Parametric values for occupancy were computed by Paul Lukacs of the Colorado Division of Wildlife (Table 6). When only the original 124 were considered, occupancy is estimated at 0.157 (SE=0.033); this estimate had the lowest standard error. Estimated occupancy is higher than observed occupancy because it corrects for false negatives (i.e. surveys were GPD's were present, but not detected). There is a 95% probability the true value of occupancy lay between 9.2% and 22.2%. Based on this range of values and the assumption that 50% of an occupied plot had burrows, it is reasonable to assume that the area inhabited by GPD's in southeastern Utah totals between 26,157 and 63,119 acres (Wright 2007).

CONSERVATION AND MANAGEMENT ISSUES

Issues facing GPDs and WTPDs in Utah can be grouped into the following categories, which correspond to the 5 USFWS Listing Factors:

- The present or threatened destruction, modification, or curtailment of its habitat or range
  - Agricultural land conversion
  - Urbanization
  - Oil/gas exploration and development
  - Livestock grazing
  - Altered fire regimes
- Over-utilization for commercial, recreational, scientific, or educational purposes
  - Shooting
  - Poisoning
- Disease or predation
  - Sylvatic plague
  - Tularemia
  - Predation
- Inadequacy of existing regulatory mechanisms

- Other natural or man-made factors affecting its continued existence
    - Poisoning
    - Drought
    - Climate change

A detailed evaluation of each issue category listed above was prepared for the GPD and WTPD Conservation Assessments, respectively (Seglund et al. 2006a, Seglund et al. 2006b). Here, we provide an evaluation of the impacts of each issue in Utah on both GPDs and WTPDs.

THE PRESENT OR THREATENED DESTRUCTION, MODIFICATION, OR CURTAILMENT OF ITS HABITAT OR RANGE

Agricultural Land Conversion

Conversion of native rangeland to cropland has both positively and negatively impacted GPDs and WTPDs. Prairie dog species typically are not tolerated in areas under agricultural production and populations were controlled or removed in these areas. Agricultural lands have also provided highly productive forage for GPDs and WTPDs. Colonies found adjacent to agricultural lands (i.e. alfalfa fields) can have higher densities than those found on native rangelands.

Gunnison's Prairie Dog. Conversion of native habitat to agriculture has the potential to occur on private and tribal land in Utah. In Utah, 37% of GPD habitat is located on land that could potentially be converted to or may currently be in agricultural production. Rangewide, agricultural lands affect < 3% of GPD predicted range (Utah comprises 3% of the rangewide predicted range). Although direct eradication of prairie dogs, habitat fragmentation, and colony isolation occurs in agricultural landscapes, they affect a very small portion of the GPD range, rangewide. Although agricultural conversion was not cited as a direct threat to GPDs in Utah's CWCS, expansion of agriculture may indirectly impact GPDs by increasing the likelihood that rodenticides (covered in greater detail, below) will be used to control localized populations. Utah's CWCS identifies the need for research on the impacts of using pesticides to control GPD populations in the state as a high priority.

White-tailed Prairie Dog. Conversion of native habitat to agriculture has the potential to occur on private and tribal land in Utah. Agriculture currently effects 3% of WTPD rangewide predicted range in Utah and 29% of the predicted range within the state. Although direct eradication of prairie dogs, habitat fragmentation, and colony isolation occurs in agricultural landscapes, they affect a relatively small portion of the WTPD range both in Utah and across the range. Utah's CWCS does not identify agricultural conversion as a specific threat to WTPDs in the state; however, increases in the co-occurrence of agriculture and WTPDs may increase the use of pesticides for WTPD population control in localized areas. Utah's CWCS does identify the need for research on the effects of poisoning on WTPD populations in the state as a high priority conservation action.

Urbanization

The direct impact of urbanization on GPDs and WTPDs has not been evaluated. However, urbanization of native rangelands has historically eliminated habitat for both species. The presence of urban areas increases the chances for negative human-wildlife interactions. Further, urbanization may fragment and isolate some GPD and WTPD populations, making dispersal in or out highly improbable. Irrigation of lawns and pastures may provide succulent forage for both species.

Gunnison Prairie Dog. 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 in Utah. Irrigation of lawns and pastures, which accompanies urbanization, may somewhat offset the negative impact to GPDs by providing succulent, high quality forage. Utah's CWCS does not identify urbanization as a threat to GPDs in the state.

White-tailed Prairie Dog. In urban areas direct eradication of prairie dogs occurs, habitats become fragmented, dispersal corridors are removed, and colony isolation can occur. However, irrigation of lawns and pastures may offset some of these losses. Although urbanization effects a relatively small portion of the WTPD range in Utah, it is identified as a threat to WTPDs in Utah's CWCS.

<u>Oil/gas exploration and development</u>

A large portion of the range of GPDs and WTPDs in Utah is classified as valuable for oil and gas development. There is a lack of scientific research regarding the immediate and long-term landscape level effects of energy development on GPDs and WTPDs. 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). Individual oil and gas wells affect an area averaging less than 0.8 ha (2 ac), but with close spacing of wells, significantly more wells proposed in the WTPD's range, and increasing road densities, this development has the potential to significantly decrease the amount of available WTPD habitat. States have reclamation rules that require impacted lands to be restored to their original condition after a well is abandoned, however effective restoration may be a difficult, long-term process. More research is needed to determine and implement effective remediation technologies. Indirect effects of oil development include increased access into remote areas by shooters and OHV users, and spread of noxious and invasive plant species.

Vibroseis (seismic exploration) may also affect prairie dogs by collapsing tunnel systems, causing auditory impairment, and disrupting social systems (Clark 1986). Additional scientific research the direct and indirect effects of vibroseis is warranted as existing studies are inconclusive and limited in scope (Menkens and Anderson 1985).

Coalbed methane wells are a relatively new technology that relies on the extraction of methane gas from coal 61-1666 m (200-5500 ft) below the surface. Potential problems associated with coalbed methane development are increased human disturbance and habitat losses or fragmentation due to well development, pipelines, roads, and compressor sites; increased potential for shooting due to additional road development; and direct project-induced mortality. In addition, water disposal from methane extraction activities may have negative impacts on sagebrush-steppe habitats due to the high alkalinity of the water released.

Gunnison's Prairie Dog. Utah has extensive oil, gas, and coal resources that fall within the range of GPDs. Development of oil and gas resources is recognized as a threat to GPDs on both a rangewide and state level (Seglund et al. 2006a, UDWR 2005). Assuming that there is the potential for oil and gas development to occur on all private, federal, and State Institutional Trust Lands Administration managed land within the range of GPDs in Utah, most of the RPRM (based on landownership) may currently be impacted or has the potential to be impacted by oil and gas development. The GPD range occurs within the jurisdiction of the BLM's Monticello and Moab Field Offices, which do not have species-specific conservation measures within their existing land use plans. However, both of these field offices are currently revising their Land Use Plans and will consider the GPD as a State Sensitive Species and propose habitat conservation measures to ensure that the species will not need to be listed in the future as a result of BLM authorized actions. In addition, Utah's CWCS (UDWR 2005) recommends providing appropriate buffers against the construction of well pads, roads, and other structures to help prevent direct impacts to individual prairie dogs or colonies.

White-tailed Prairie Dog. Utah has extensive oil and gas resources that fall within the range of WTPDs and development of these resources has been identified as a threat to WTPDs in Utah (UDWR 2005). Utah has extensive coal deposits with untapped resources of coalbed methane in the Price Field Office. Oil and gas development within the Price, Vernal, and Moab field offices has the potential to occur or may be occurring on private, federal, and State Institutional Trust Lands Administration managed land. Assuming that the potential for oil and gas development is uniform across the aforementioned land ownerships, most of the PRM of the WTPD in Utah has the potential to be impacted by oil and gas development. In Utah, a large portion of the WTPD range occurs within the jurisdiction of the BLM's Vernal Field Office which includes the Coyote Basin Black-footed Ferret Reintroduction Area which has limited protective measures for black-footed ferret habitat protection, but does not specifically address WTPD conservation (Seglund et al. 2006b). The WTPD range also occurs within the jurisdiction of the BLM's Price, Salt Lake and Moab Field Offices, which do not have directives with regard to WTPD management. However, these field offices are currently revising their Land Use Plans and the new plans will consider the WTPD as a State Sensitive Species and propose habitat conservation measures to ensure that the species will not need to be listed in the future as a result of BLM authorized actions.

In the 2006 WTPD Conservation Assessment, the WTPD Working Group recommended that the BLM add the WTPD to their list of sensitive species to insure long-term, effective management of this species (Seglund et al. 2006b). In addition, the WTPD Working Group recommended that the BLM should clearly designate where WTPD habitat protection will be a priority (Seglund et al. 2006b). Finally, the WTPD Working Group also recommended that BLM WTPD management emphasis be shifted from black-footed ferret management to management of WTPDs as a sensitive species (Seglund et al. 2006b). In addition, the Utah CWCS (UDWR 2005) recommends providing appropriate buffers against the construction of well pads, roads, and other structures to help minimize direct impacts to individuals and habitats.

Livestock Grazing

Domestic livestock (i.e. cattle and sheep) were introduced to the western U.S. and thus the range of both GPDs and WTPDs in the 1800s. Though grazing by ungulates occurred prior to the introduction of domestic livestock, it differed with respect to species composition, timing, and selective pressure (Miller et al. 1994 in Crawford et al. in press). Evaluating the influence of domestic livestock on WTPD populations is difficult because ungrazed habitats within WTPD range are rare or nonexistent. Ecological site descriptions provide a benchmark for the historic climax plant community that existed at the time of European immigration and settlement (Butler et al. 2003).

Poorly managed livestock grazing can alter plant species composition on rangelands (Fleischner 1994), which could negatively affect habitat suitability for the GPD or the WTPD by decreasing availability of forage during critical periods (e.g. as juveniles emerge, prior to hibernation, during the reproductive season). Poorly managed livestock grazing can also impact cryptogrammic crusts, nutrient cycling, compact soils, and increase runoff, all of which can combine to alter the structure and function of shrub-steppe systems (Kauffman and Krueger 1984; Abdel-Magid et al. 1987; Ordoho et al. 1990, Fleischner 1994). 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 and WTPDs by decreasing availability of forage and causing an increase in woody shrubs. In addition, poorly managed livestock grazing can cause a loss of early cool season forage and an increase in non-native annual grasses (Crocker-Bedford 1976, Beck 1994, Young et al. 1972).

While certain characteristics of livestock grazing can be detrimental to prairie dogs, there may be instances where properly managed livestock grazing can have no effect or be beneficial. For example, a stable, healthy colony of WTPDs co-exist on Deseret Land and Livestock in Rich County, where livestock are managed on a short duration, high intensity rotation.

Gunnison's Prairie Dog. Within the predicted range for GPDs in Utah, National Parks and National Recreation Areas are the only places where livestock grazing is prohibited. For the purposes of this analysis, all other lands were considered to have the potential to be impacted by livestock grazing during the life of this plan. Based on this classification, a total of 619,397 acres within the GPD RPRM (99%) could be or is currently influenced by livestock grazing.

Livestock numbers in San Juan and Grand Counties decreased slightly in the past 10 years from 25,000 in 1996 to 19,000 in 2006 (Figure 5). It is likely that in some parts of the GPD range in Utah, livestock grazing has had detrimental effects on GPDs and their habitat. However, initiatives such as the Grazing Improvement Program (GIP) and Utah's Watershed Restoration Initiative are working, in part, to improve grazing systems on private and public land. Although these programs do not specifically target GPDs, the GIP program does address indirect impacts such as elimination of invasive species and the Watershed Restoration Initiative aims to restore native wildlife and biological diversity in the state. In addition, as the BLM renews grazing permits, they develop EAs that address the need for spring plant growth and consider the needs of GPDs, where appropriate (P. Riddle, BLM Moab Field Office, personal communication). In addition, the BLM is working to develop grazing systems with multiple pastures that allow for rotation and spring or complete rest in some pastures. Further, in Utah, both the UDWR and the BLM are working to control invasive weeds and non-native annual grasses by spraying herbicides followed by active planting of grasses and forbs (Seglund et al. 2006a).

White-tailed Prairie Dog. Within the predicted range for WTPDs in Utah, National Parks, National Recreation Areas, and Wilderness Areas are the only places where livestock grazing is prohibited. For the purposes of this analysis, all other lands were considered to have the potential for livestock grazing during the life of this plan. Based on this classification, a total of 8,408,243 acres within the WTPD PRM (98%) could be or is currently impacted by livestock grazing.

Livestock numbers in Carbon, Dagget, Duchesne, Emery, Grand, Rich, Uintah, and Utah Counties have remained relatively stable throughout the last 10 years, fluctuating around 250,000 head (Figure 6). It is likely that in some parts of the WTPD range in Utah, livestock grazing has had detrimental effects on WTPDs and their habitat. However, initiatives such as the Grazing Improvement Program (GIP) and Utah's Watershed Restoration Initiative are working, in part, to improve grazing systems on private and public land. Although these programs do not specifically target GPDs, the GIP program does address indirect impacts such as elimination of invasive species and the Watershed Restoration Initiative aims to restore native wildlife and biological diversity in the state. Further BLM has been directed to comply with Standards for Rangeland Health and Guidelines for Grazing Management for BLM Lands in Utah (BLM 1997) and work to develop implementation and monitoring plans for individual allotments. However, none of the alternatives in the draft Vernal RMP prohibit grazing in special status species habitat (BLM 2005).

<u>Altered Fire Regimes</u>

Since the 1860s, the ecological role of fire has changed within sagebrush-steppe and grassland systems. Altered fire regimes have increased the persistence of non-native Eurasian annual grasses such as cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-medusae*), and caused a loss of native shrubs (Ferry et al. 1995). Because these species, cheatgrass in particular, mature and die by late summer, they fail to provide adequate forage for GPDs and WTPDs in critical periods of fat storage in preparation for overwinter survival. Much of the research on fire in sagebrush and grassland systems has been conducted in the Great Basin and may not be applicable to southeastern and northeastern Utah where GPDs and WTPDs, respectively are found. Similar research efforts are needed to adequately assess the effects of altered fire regimes on GPD and WTPD habitat.

Gunnison's Prairie Dog. Altered fire regimes have changed the structure and function of grassland and sagebrush steppe systems in southeastern Utah; however, the specific effects on GPDs are not known. The UDWR, SITLA, the BLM, and the USFS all actively work to prevent catastrophic wildfires and to rehabilitate burned sites when fires to occur to prevent the spread of invasive and non-native plant species.

White-tailed Prairie Dog. Altered fire regimes have changed the structure and function of grassland and sagebrush steppe systems in northern and northeastern Utah; however, the specific effects on WTPDs are not known. The UDWR, SITLA, the BLM, and the USFS all actively work to prevent catastrophic wildfires and to rehabilitate burned sites when fires to occur to prevent the spread of invasive and non-native plant species.

OVER-UTILIZATION FOR COMMERCIAL, RECREATIONAL, SCIENTIFIC, OR EDUCATIONAL PURPOSES

<u>Shooting</u>

No research is available regarding the effects of shooting on GPDs or WTPDs. To date, all research has been conducted on black-tailed prairie dogs (BTPD) and inference to GPDs and WTPDs may not be valid because the lower densities of animals and more dispersed nature of GPD and WTPD colonies. These studies have demonstrated that shooting can cause disruption in BTPD social systems, local declines, local extirpation, emigration, altered behavior, and reduced reproduction (Stockrahm and Seabloom 1988, Knowles 1988, Vosburgh 1999, Gordon et al. 2003, and Pauli 2003). Shooting has been identified as a potential threat to GPDs and WTPDs (UDWR 2005, Seglund et al. 2006a, Seglund et al. 2006b, WAFWA 2007).

Lead poisoning is an indirect consequence of shooting and a source of mortality for mammal and bird species associated with prairie dog colonies. In their recent paper, Pauli and Buskirk (2007) concluded that expanding lead alloy bullets pose a considerable risk to scavenging raptors and mammals. In their study, 47% of BTPDs shot with expanding lead bullets contained quantities of lead sufficient to be acutely lethal to nestling raptors and potentially lethal to adult birds (Pauli and Buskirk 2007).

Today, many shooters use weapons that enable them to be consistently accurate at distances of greater than 366 m (1,200 ft) and to take significant numbers of prairie dogs each day. 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.

Gunnison's Prairie Dog. 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. Shooting also increases the risk of death and/or harmful effects from lead poisoning on associated scavenging mammals and/or raptors. Although shooting has the potential to produce local, short-term reductions in population densities, alter behavior, and slow or preclude recovery rates of colonies reduced by plague or other disturbances (as cited above), this activity alone does not appear to have a sufficient effect on populations to move the GPD toward extinction (USFWS 2006). To minimize shooting impacts on GPDs, Utah has implemented seasonal (April 1 to June 15) closure on all public lands throughout the state. Further research on the impact of recreational shooting has been called for and states have been encouraged to monitor harvest rates (WAFWA 2007).

White-tailed Prairie Dog. Shooting closures for WTPDs have been impleented year-round in Coyote Basin, Utah to improve black-footed ferret habitat (Figure 9). In 2003, a seasonal shooting closure from April 1 to June 15 was implemented on all public lands throughout the state of Utah. The effect of shooting on the long-term viability of WTPD populations is unknown because shooting can introduce a level of uncertainty in the demographics of WTPD populations. Further, shooting may introduce lead into the food chain and increase the risk of death or harm to scavenging raptors and mammals. Although shooting has the potential to produce local, short-term reductions in WTPD population densities, alter behavior, and slow or preclude recovery rates of colonies reduced by plague or other disturbances (as cited above), the long-term effects of this activity on WTPDs is not known.

DISEASE OR PREDATION

Sylvatic plague

Sylvatic plague is widely recognized to be the primary factor limiting GPD and WTPD populations and distribution (Knowles 2002, Seglund 2006a, Seglund 2006b). Sylvatic plague is flea-transmitted disease caused by the bacterium *Yersinia pestis* (Heller 1991; Cully and Williams 2001). Plague is a non-native pathogen that was first recorded in native mammals in California in 1908 (Barnes 1982). Since then the disease has spread from the Pacific Coast, at least 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). The first confirmation of plague in WTPDs was in Wyoming in 1936 (Eskey and Haas 1940). Today, plague exists throughout the range of GPD and WTPD populations and non-infected populations do not exist (Barnes 1982, Biggins and Kosoy 2001).

Plague is either enzootic or epizootic. Enzootic infection is characteristic of a stable rodent-flea infectious cycle where host rodents are relatively resistant to the disease. In this state, the mortality rate of infected rodents is usually low. In epizootic states, plague is highly lethal to its rodent host. Because of the susceptibility of prairie-dog species to this disease, plague typically exists in epizootic state in prairie-dog populations.

GPDs are highly susceptible to plague, with nearly 99% mortality during epizootic events and localized extinctions within 1 active season (Lechleitner et al. 1962, 1968; Rayor 1985; Cully 1989; Cully and Williams 2001). WTPDs, because they are typically more dispersed on the landscape and occur in lower densities, generally experience lower population declines (85%-96%) and lower transmission rates (Clark 1977; Anderson and Williams 1997).

Little is known about how plague is maintained in the environment and under what conditions it will manifest as an epizootic (Gage 2004). There is no way to predict the movement, impact, or timing of plague events in prairie dog populations. In addition, little is known about how plague impacts population demographics, movement of individuals, or how colonies recover and/or re-colonize areas after plague epizootics (Seglund 2006a, Seglund 2006b).

Oral plague vaccines are being developed for prairie dogs. Laboratory experiments on BTPDs using sweet potato gelatin vaccine-laden baits have demonstrated a relatively high level of success (56% survived challenge with *Y. pestis* vs. control) (Mencher et al. 2004). Baits are being refined through experimental trials in laboratory and field settings to determine optimal delivery of vaccines (Creekmore et al. 2002).

Gunnison's Prairie Dog. Plague cycles have been observed in GPDs in Utah and populations have been known to die-off and recover (e.g. Lisbon Valley). Plague is known to occur in the range of GPDs in Utah; however, plague testing has not occurred specifically on GPDs in Utah, so the cause of declines cannot definitively be attributed to the disease (Seglund et al 2006a). Plague is anticipated to be an on-going, serious threat to GPD populations in Utah at both a localized and wide-spread scale. Utah's CWCS lists plague testing and population monitoring as potential conservation actions for addressing plague in GPDs in Utah (UDWR 2005).

White-tailed Prairie Dog. Plague cycles have been documented in northeastern Utah (Knowles 2002, Seglund et al. 2006b). Plague will likely be an on-going, serious threat to WTPD populations in Utah at both a localized (i.e. individual colony) and more widespread scale. Utah's CWCS lists plague testing and population monitoring as potential conservation actions for addressing plague in WTPD populations in Utah (UDWR 2005).

Predation

GPDs and WTPDs are prey for many predators including black-footed ferrets, hawks, eagles, badgers, and canids (i.e. coyotes, foxes). Avian predation may be magnified in localized areas by the presence of artificial perches such as oil and gas infrastructure, power lines, and fences. Further, predator populations can be artificially high in localized areas due to the presence of human refuse (i.e. dumps), or can be driven by populations of other prey species (i.e. rabbits and other small mammals).

Gunnison's Prairie Dog. Predation alone does not appear to control or limit density of GPDs (King 1955, Tileston and Lechleitner 1966, Clark 1977). In fact, associated species addressed in this Plan utilize GPDs for food (i.e. ferruginous hawks).

White-tailed Prairie Dog. Predation has not been identified as having a notable impact on populations of WTPDs. In parts of northeastern Utah, WTPD populations are managed to provide habitat for their primary predator, the black-footed ferret. In those areas, there is greater concern about the effects of fluctuating WTPD populations on black-footed ferrets than the effects of the predator on the prey. In addition, other associated species addressed in this Plan utilize WTPDs for food (i.e. ferruginous hawk, kit fox).

INADEQUACY OF EXISTING REGULATORY MECHANISMS

As previously mentioned, both the GPD and WTPD are considered State Sensitive Species in Utah and are protected by both State Code and Administrative Rule in addition to this conservation strategy. There is a seasonal closure on shooting of both species during the crucial breeding season and, as previously described, shooting is prohibited within the Primary

Management Zone for black-footed ferret recovery bordering Colorado in eastern Uintah County, Utah.

In Utah, GPDs and WTPDs are also classified as "depredating animals" (Rule 4-23-3). Under this rule, the Agricultural and Wildlife Damage Prevention Board is responsible for developing programs designed to prevent damage to livestock, poultry, and agricultural crops. Programs can include, but are not limited to, hunting, trapping, chemical toxicants, and the use of aircraft. GPDs and WTPDs causing agricultural damage or creating a nuisance on private land may be taken at any time. Due to potential issues related to human health and safety, control of GPDs and WTPDs is sometimes necessary and appropriate.

Gunnison's Prairie Dog. In Utah, GPDs are listed on the State Sensitive Species list, which is in place to help stimulate development and implementation of management actions to precluded Federal listing of these species under the ESA. Conservation actions for GPDs are described in Utah's CWCS (UDWR 2005). As previously described, shooting of GPD on public land is prohibited during the breeding season in Utah. In 2007, a Rangewide Conservation Strategy was developed to provide states with guidance about specific activities to include in individual state plans to improve prairie dog conservation and management (WAFWA 2007). Further, the WAFWA directors signed an MOU in 2005 in which they agreed to cooperate to collect and analyze data for prairie species (including GPDs and several associated species) and their habitats, and on implementation of conservation actions. This MOU demonstrates a clear intention to conserve GPDs throughout the range. In Utah, GPDs are also classified as a depredating animal and may be taken at any time on private land.

Strategies and actions described in this Plan will provide additional guidance within the state to help conserve GPDs, abate or reduce adverse impacts from factors contributing to declines, and involve multiple partners (e.g. state and federal agencies, NGOs, private industry, and private landowners) in conservation efforts to help minimize impacts from possible lost management options.

White-tailed Prairie Dog. In Utah, WTPDs are listed on the State Sensitive Species list, which is in place to help stimulate development and implementation of management actions to precluded Federal listing of these species under the ESA. Utah's CWCS includes conservation actions to help maintain populations of WTPDs and address threats. As previously described, a shooting closure is in place for WTPDs on public land during the crucial breeding season and shooting is prohibited within the Primary Management Zone for black-footed ferret recovery bordering Colorado in eastern Uintah County. In 2007, a Rangewide Conservation Strategy was to provide states with guidance about specific activities to include in individual state plans to improve prairie dog conservation and management (WAFWA 2007). Further, the WAFWA directors signed an MOU in 2005 in which they agreed to cooperate to collect and analyze data for prairie species (including WTPDs and several associated species) and their habitats, and on implementation of conservation actions. This MOU demonstrates a clear intention to conserve WTPDs throughout the range. In Utah, WTPDs are also classified as a depredating animal and may be taken at any time on private land.

Strategies and actions described in this Plan will provide additional guidance within the state to help conserve WTPDs, abate or reduce adverse impacts from factors contributing to declines, and involve multiple partners (e.g. state and federal agencies, NGOs, private industry, and private landowners) in conservation efforts to help minimize impacts from possible lost management options.

OTHER NATURAL OR MAN-MADE FACTORS

Poisoning

GPDs and WTPDs have been the target of eradication campaigns for over 100 years and have been inadvertently impacted by poisoning of BTPDs and ground squirrels (Clark 1989, Seglund et al. 2006). In Utah, poisoning of 1,099,098 ha (2,715,930 ac) of Gunnison's, Utah, and white-tailed prairie dogs occurred from 1914 – 1964 (Forrest 2002). After the 1970s some toxicants (e.g. strychnine and 1080) previously used for prairie dog control were banned, and although prairie dog control continues today, it occurs at a reduced rate with less effective toxicants.

Poisoning impacts GPD and WTPD populations at both a localized and landscape scale. At a localized scale, poisoning has been used to eliminate prairie dogs from specific areas and may be an appropriate tool for addressing some human health and safety concerns (i.e. prairie dogs on airports, school playgrounds, etc.). At a landscape level, indirect impacts of localized efforts include changes in population size and distribution resulting from removal of immigration sources, obstruction of genetic exchange, and increased susceptibility to stochastic events (Seglund et al. 2006).

Zinc phosphide and aluminum phosphide are the primary pesticides used on GPDs and WTPDs in Utah. These substances are considered Restricted Use Pesticides by both the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Utah Pesticide Control Act (Rule R68-7). As such, only licensed applicators are permitted to use them. In Utah, certification consists of a written exam (H. Deer, USU Extension, personal communication). Commercial and non-commercial applicators are required to keep written records for 2 years of any application of a restricted-use pesticide, including the purpose for which it was used. Private applicators are also required to maintain records of pesticide application events for 2 years. GPDs and WTPDs causing agricultural damage or creating a nuisance on private land may be taken at any time. The number of vertebrate pesticide application licenses (commercial, non-commercial, and private) issued in counties where GPDs and WTPDs occur is listed in Table 4.

Gunnison Prairie Dog. Assessing the extent of poisoning on GPDs in Utah is difficult because historical accounts of poisoning were not species-specific. On public lands, poisoning efforts prior to the 1970s led to a reduction in occupied habitat and extirpation from local areas. Poisoning in all states became less common after the 1970s due to federal regulation of poisons. Currently, state and federal agencies in Utah are 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. Only toxicants registered by the EPA may be legally used to control prairie dogs. As previously stated, there are licensed applicators in counties where GPDs occur (Table 4). Although it is know that poisoning is used to control GPDs on private land, the extent of these activities is cannot be specified. Utah’s CWCS calls for additional research on the impacts of poisoning on GPD populations in the state as a high priority conservation action (WAFWA 2005).

White-tailed Prairie Dog. Assessing the extent of poisoning on WTPDs in Utah is difficult because historical accounts of poisoning were not species specific. On public lands, poisoning efforts prior to the 1970s led to a reduction in occupied habitat and extirpation from local areas. Poisoning in all states became less common after the 1970s due to federal regulation of poisons. Currently, state and federal agencies in Utah are not involved in large scale control efforts, and are rarely involved in any control unless WTPDs are thought to pose a threat to human safety. Only toxicants registered by the EPA may be legally used to control prairie dogs. As previously stated, there are licensed applicators in counties where WTPDs occur (Table 4). Poisoning is known to occur on private land to control WTPDs; however, the extent of this practice cannot be specified. Utah’s CWCS calls for research on impacts of poisoning on WTPD populations as part of an effort to better understand factors that may limit populations (UDWR 2005).

Drought

GPDs and WPTDs have evolved in arid environments with periodic drought conditions. However, because of the cumulative effects of other factors influencing viability of these species, the impact of drought on populations may be more pronounced and lasting. In addition, global warming may produce drought events at a greater frequency and duration, further compounding its effects.

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). The same is likely true for WTPDs. Drought decreases the amount of available forage for GPDs and WTPDs, promotes the spread of invasive and noxious plant species, and stresses other prey species, possibly making GPDs and WTPD more susceptible to predation.

Gunnison Prairie Dog. 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. However, there may be a need to further understand potential cumulative effects of drought and other factors on GPD populations and habitats in Utah. Additional information would allow for greater strategic planning on the part of managers to address cumulative impacts over which they have greater influence.

White-tailed Prairie Dog. No studies have been conducted to determine the cumulative effects of drought and other impacts on WTPDs. However, WTPDs evolved in arid environments that experience periodic drought, so the effects of drought alone may not be severe. However, there may be a need to further understand potential cumulative effects of drought and other factors on WTPD populations and habitats in Utah. Additional information would allow for greater strategic planning on the part of managers to address cumulative impacts over which they have greater influence.

MANAGEMENT GOAL, OBJECTIVES, AND STRATEGIES

The goal of this Conservation Plan is to maintain or increase the viability of GPD and WTPD populations and sage-steppe and prairie scrub ecosystems they inhabit in the state of Utah to contribute to precluding the need to list these species. Although this Conservation Plan focuses on GPD and WTPD conservation, it is recognized that, because of their keystone species status, factors impacting GPDs and WTPDs likely also impact associated species; conservation actions, when applicable, will also be designed to benefit associated species.

In February, 2007, the Utah GPD/WTPD Statewide Planning Team (Appendix A) met in Salt Lake City Utah to develop draft objectives and strategies for this Conservation Plan. The following objectives and strategies were developed based on the results of that meeting and incorporate objectives and strategies from existing conservation and management plans for GPDs and WTPDs, rangewide, and associated species in the Utah. Strategies are ranked in order of their importance for meeting the goal of this Conservation Plan (VH=Very high, H=High, M=Medium, L=Low). In order to facilitate implementation of this Plan, we have also included action steps, responsible parties, estimated cost, potential funding sources, and an estimated timeline.

Objective	Strategy	Priority	Action Steps	Responsible Parties	Cost Estimate	Potential Funding Sources	Timeline
Maintain occupancy rates above 60% of the baseline rate (determined by the 2007/2008 surveys), to preclude Utah from contributing to the activation of rangewide management triggers.	By 2008, estimate current rate of occupancy of GPDs and WTPDs in Utah.	VH	Conduct occupancy modeling for GPD in 2007 and WTPD in 2008, and every three years thereafter according to the Rangewide Protocol (Andelt and Seglund 2006, Appendix B).	UDWR, UFBF	$30,000 per survey	ESMF, BLM, WAFWA	Every 3 years starting in 2007 for GPDs and 2008 for WTPDs.
			Assist with the development of standardized reporting methodologies and contribute occupancy modeling data to the rangewide database.	UDWR, CDOW, WTGWG			Completed by 2008
			Evaluate the feasibility of establishing Utah-specific thresholds/triggers based on existing occupancy sampling scheme for GPDs and WTPDs (TBD).	UDWR, USU			Starting in 2009
			Identify process variation for long-term trends, as data becomes available.	WTGWG			Starting in 2009
	As necessary, take action to halt and reverse declines in occupancy rates.	H	Rank conservation actions (Appendix C) based on several key 'capacity factors' including, but not limited to, leadership capacity, multidisciplinary team resources, legal framework, funding, community and constituency support.	Statewide Planning Team; UDWR, BLM			2008 and ongoing
			Implement actions (Appendix C) in accordance with this Conservation Plan, the WAFWA Conservation Assessments and Strategies (Seglund et al. 2006a, 2006b; WAFWA 2007), and the 2007 Northeastern Region Black-footed Ferret Management Plan (UDWR 2007) when/if a 40% decline (95% CI) range-wide occupancy decline is detected from the baseline survey; short-term trigger) or ongoing as appropriate.	UDWR, NRCS, BLM, USFS	Varies		Ongoing
			Following a 40% decline (95% CI) in range-wide occupancy, conduct annual occupancy modeling surveys to assess success of management actions in halting and reversing declining trends.	UDWR, WTGWG	$30,000 per survey	ESMF, BLM, WAFWA	As necessary

Objective	Strategy	Priority*	Action Steps	Responsible Parties	Cost Estimate	Potential Funding Sources	Timeline
(Continued)	Continue prairie dog monitoring in black-footed ferret management areas in accordance with the 2007 Northeastern Region Black-footed Ferret Management Plan (UDWR 2007).	H	Conduct annual transect surveys to estimate the number of prairie dogs per colony and to obtain a ferret family rating for each subcomplex.	UDWR, BLM		BLM	Ongoing
			Map prairie dog colonies within the black-footed ferret management area to determine complex connectivity and total occupied acreage.	UDWR, BLM			Ongoing
	Monitor distribution and/or abundance of associated species.	M	Contribute to the development of a cohesive, comprehensive WAFWA prairie conservation strategy that addresses associated species.	WTGWG, UDWR, BLM			June 30, 2010
			Document occurrences of associated species during occupancy surveys for GPDs and WTPDs in accordance with WAFWA occupancy monitoring protocol.	UDWR	$30,000 per annual survey	ESMF, BLM	Ongoing
			Support existing monitoring programs. Programs may include efforts by the UDWR, Natural Heritage Program, Audubon Breeding Bird Surveys, BLM, and USFS.	UDWR	Varies		Ongoing

Objective	Strategy	Priority*	Action Steps	Responsible Parties	Cost Estimate	Potential Funding Sources	Timeline
Address priority threats to maintain occupancy across at least 60% of the geographic range (i.e. sampling frame) of GPDs and WTPDs, rangewide.	Implement at management actions to address high priority threats, ongoing or as necessary.	VH	Evaluate potential actions (Appendix C) and rank them based on their benefits, feasibility, costs. Criteria to include (but not limited to): contribution to increasing species viability, contribution to abating threat(s), duration of benefit, scope of benefit, leverage, individual/institutional capacity for implementation, ease of implementation, ability to motivate constituents, total costs.	Statewide PD Planning Team, UDWR, USU Extension			By 2009
			Pursue funding for high ranking actions including funding to evaluate action effectiveness.	UDWR			Ongoing
			Track implementation progress using action ranking/tracking sheet (Appendix E).	USU Extension, UDWR			Annually
			Monitor individual actions to ensure that associated objectives were met.	USU Extension, UDWR			Ongoing
Address research needs identified in this Plan.	Initiates at least one research project during the life of this plan to fill knowledge gaps identified in this Plan.	VH	Develop project proposals that address information gaps related to: effectiveness of habitat management practices, disease management tools (i.e. disease testing, flea dusting, translocation), impacts of oil and gas development, effectiveness of oil and gas mitigation guidelines/recommendations, density and distribution of GPDs and WTPDs needed to assure their functionality in the ecosystem, evaluation of keystone role of GPDs and WTPDs, evaluate cumulative effects of recreation (i.e. shooting, OHV recreation) on GPDs and WTPDs.	USU, BYU, UDWR			Develop 2 proposals by March 2008.
			Acquire funding to implement project proposals.	UDWR, USU, BYU			Ongoing
			Implement proposed projects, analyze and evaluate results, publish results in appropriate scientific, peer-reviewed and popular publications.	UDWR, USU, BYU			By 2017

Objective	Strategy	Priority*	Action Steps	Responsible Parties	Cost Estimate	Potential Funding Sources	Timeline
By 2017, increase awareness of Utah wildlife professionals, ranchers and farmers, and lay people working/living in the range of GPDs and WTPDs about GPD and WTPD biology/ecology, threats facing populations and their habitats, conservation planning efforts, and potential conservation actions.	Develop outreach/education tools to enhance communication, information dissemination, and community involvement in conservation.	H	Develop survey tools to assess current level of awareness of Utah wildlife professionals, ranchers and farmers, and lay people working/living in the range of GPDs and WTPDs about the biology/ecology of the two species, threats facing populations and habitats, conservation planning efforts, and potential conservation actions.	UDWR, USU, BYU, UofU, USU Extension, private contractors.			Complete survey by January 2009
			Based on survey results, design 1-3 diverse outreach/communication tools (i.e. brochures, web pages, PSA, etc.) that focus on increasing awareness where it is most critical and targeted at audiences specifically in need of information.				Roll-out the 1st by June 2009
			Conduct follow-up surveys of the aforementioned population to determine effectiveness of communications/outreach materials on reaching target audience and changing awareness levels.	UDWR, USU, BYU, USU Extension, private contractors.			2015

Objective	Strategy	Priority*	Action Steps	Responsible Parties	Cost Estimate	Potential Funding Sources	Timeline
Maintain or increase partner participation in conservation planning, plan implementation, and plan evaluation to achieve the goal of this Conservation Plan.	Have partner state, federal, and non-governmental agencies be signatories to this Plan as a sign of commitment to implementation of the strategies in this plan.	VH	Distribute completed Plan to all state, federal, and non-governmental partner agencies and provide example template for signature page.	USU Extension, UDWR			2008
			Encourage through face-to-face meetings, phone calls, and other forms of contact, the completion and submission of signature pages for major cooperating partners.	USU Extension, UDWR			Ongoing
			Encourage incorporation of this Plan and the objectives, strategies, and actions therein into other planning efforts.	UDWR, UPCD			Ongoing
			As appropriate, review project proposals and planning documents developed by partner agencies and organization to ensure that they are consistent with this Plan.	UDWR			Ongoing

PLAN DELIVERABLES

Several products or deliverables will be produced over the life of this Plan (2007-2016). These products will enable the UDWR and the Statewide GPD/WTPD Planning Team to adaptively evaluate the effectiveness of strategies and actions outlined in this Plan and to determine if objectives are being met.

Monitoring Data

Data collected during regular occupancy monitoring, colony mapping, or other surveys will be compiled and analyzed in the regions. Copies of the data will be sent to the Mammals Program Coordinator for analysis, by species, at the statewide level. Occupancy monitoring data will also be sent to the Colorado Division of Wildlife for rangewide analysis and data archiving.

Annual Reports

At the end of each calendar year an Annual Report will be written by the Mammals Program Coordinator or his/her designee summarizing management activities for the past year. Annual reports will be completed and distributed to relevant federal agencies and public groups by January 31 of each year. This time period will allow for surveys to be conducted in spring and/or fall and still leave adequate time to summarize the data before the report is due. Topics addressed in the annual report should include the following:

A. Summary of prairie dog occupancy surveys and modeling efforts.
   1. Location where monitoring surveys were conducted.
   2. Type of monitoring activities conducted.
   3. Statewide trends in occupancy, local colonization, and local extinctions.
   4. Rangewide trends and status of management triggers.

B. Summary of Plan implementation activities.
   1. Description of strategies implemented by UDWR with evaluation of success.
   2. Description of strategies implemented by state and federal agency and private partners with evaluation of success.

C. Description of additional Objectives and Strategies developed through the adaptive management process.

Final Report

In addition to the annual reports, a final report will be required at the end of the 10-year period (2007-2017) covered by this Plan. The final report should address the same topics covered in annual reports, and should also summarize the entire management period. In addition, the status and distribution of GPDs and WTPDs as of 2017 should also be discussed. This report will be written by the UDWR Mammals Program Coordinator or his/her designee and distributed by June 30, 2017. The Final Report will be distributed to relevant state and federal agency and private partners.

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Table 1. Densities of active and inactive Gunnison's prairie-dog burrows at new transects established in southeastern Utah during 2005. Each transect went roughly down the long axis of a colony. Clustered transects were aggregated into complexes. Definitions and procedures followed Biggins et al. 1993.

Complex Name	Active	Inactive	Length (km)	Area (ha)	Active Burrows/ha	Inactive Burrow/ha
Dry Valley	25	148	2.04	0.61	40.8	241.6
Deadman Canyon	25	23	0.45	0.13	187.1	172.2
La Sal Junction	28	182	1.96	0.59	47.4	308.4
Ken's Lake	10	89	0.63	0.19	53.2	473.5
Squaw Canyon	11	23	0.51	0.15	73.3	153.3
Navajo Canyon	3	28	0.17	0.05	60.0	560.0
Behind the Rocks	10	16	0.34	0.10	100.0	160.0
Spanish Valley	39	58	1.20	0.36	108.3	161.1
Bluff Bench	61	44	1.55	0.46	131.3	94.7
Butler Wash	0	39	0.67	0.20	0.0	195.3
Sugar Loaf Rock	8	16	0.33	0.10	81.2	162.4
	Total Transect Length		9.83			
	Area of Transects		2.95			
	Total active/ha		74.5			
	Average inactive/ha		225.7			

Table 2. Landownership in Gunnison's and white-tailed prairie dog predicted range in Utah.

	GPD Revised Predicted Range		**WTPD Predicted Range**	
Landownership	Acres	Percent	Acres	Percent
Federal	298,052	48	5,099,820	59
Private	267,305	43	2,479,181	28
State	55,777	9	1,003,958	12
Water	22	<1	567	<1
TOTAL	621,156		8,583,526	

Table 3. White-tailed prairie dog population analysis and summary statistics determined from surveys evaluating suitability of habitat for black-footed ferrets at 4 white-tailed prairie dog complexes in the Uinta Basin, Utah, 1997-2003 (Seglund et al. 2006b).

White-tailed Prairie Dog Complex	Year	Size (ha)	% of Good Habitat[b]	White-tailed Prairie Dog/ha Good Habitat[c]	Population Estimate for Good Habitat	White-tailed Prairie Dog/ha Entire Area Sampled	Population Estimate for Entire Area Sampled	Mean Population Estimate	Standard Deviation	Coefficient of Variation (%)	Monitoring Period (number of years)
Coyote Basin	1997	4,075[a]	91.2	11.45	42,541	10.60	43,205	37,184	12,185.871	33	7
	1998	4,539[a]	91.4	9.30	38,605	8.72	39,565				
	1999	4,544	77.8	10.12	35,783	8.40	38,180				
	2000	4,527[a]	74.7	9.47	32,035	7.39	33,438				
	2001	4,544	74.8	10.33	35,108	8.24	37,424				
	2002	4,544	91.5	12.86	53,451	11.98	54,444				
	2003	4,544	30.4	6.73	9,300	3.09	14,031				
Kennedy Wash[d]	1998	1,196	82.2	10.41	10,240	8.94	10,697	6,683	3,177.792	48	6
	1999	1,196	52.6	8.13	5,118	5.36	6,411				
	2000	1,196	47.9	8.65	4,949	4.79	5,725				
	2001	1,196	30.7	7.73	2,840	3.07	3,670				
	2002	1,196	73.6	10.80	9,504	8.60	10,282				
	2003	1,196	33.0	5.76	2,272	2.77	3,313				
Shiner Basin	1997	1,774[a]	95.7	8.76	14,877	8.49	15,065	20,427	18,582.633	91	4
	1998	4,327[a]	99.3	11.04	47,447	10.99	47,551				
	1999	3,057[a]	10.3	7.03	2,221	1.76	5,383				
	2000	4,332[a]	40.4	6.24	10,915	3.16	13,707				
Snake John	2001	5,020	89.9	10.71	48,319	9.83	49,346	43,633	10,852.600	25	3
	2002	5,020	81.3	11.93	48,680	10.05	50,437				
	2003	5,020	61.1	9.06	27,803	6.20	31,118				

a. Differences in ha surveyed from year-to-year are due to small colonies being either surveyed or not surveyed in a given year.

b. Estimated area of good habitat was determined by multiplying proportion of good habitat by colony size.

c. Good Habitat (equal to habitat capable of supporting black-footed ferret reproduction) is the number of transects with at least 25 active white-tailed prairie dog burrows per ha divided by the total number of transects.

d The Kennedy Wash sub-complex is now monitored as part of the Coyote Basin complex.

Table 4. Definitions of GPD habitat suitability. Based on previous survey experience, areas with rocky or very sandy soils, soil profiles less than 24 inches, pinyon-juniper dwarf forest, or more than gently sloping were considered permanently unsuitable for prairie-dogs; low brush cover greater than 15% was considered unsuitable, but potentially suitable with disturbance (Wright 2007).

Suitability Category	Description
Suitable	More than 5 acres in plot appears suitable prairie-dogs in current condition.
Marginal	Less than 5 acres in plot appears suitable for prairie-dogs in current condition, but fire or other disturbance to sagebrush could create suitable habitat in greater than a 5 acre area.
Unsuitable	P/J woodland, hilly, stony, thin soil, extremely sandy, or otherwise unsuitable for prairie-dogs.

Table 5. Summary of occupancy survey results for Gunnison's prairie-dog in southeastern Utah during spring and summer of 2007 (Wright 2007).

	No. of Plots	Acreage	Plot Density (plots/10,000 acres)	Observed Occupancy (%)*	Crude Ballpark Estimate of Occupied Area (acres)**
Stratum 1 (suitable soil)	110	524,065	2.10	13 (11.8%)	30,919
Stratum 2 (historic locations)	32	44,577	7.18	15 (46.9%)	10,453
Total (using stratification)	142				41,372
Original Plots (no strata)	124	568,642	2.18	18(14.5%)	41,226

*True occupancy estimate with confidence limits see table 3.
**Assumes 50% of the area of an occupied plots contains prairie-dogs. Confidence intervals not available.

Table 5. Estimates of occupancy for Gunnison's prairie dogs in southeastern Utah based on surveys conducted in Spring and Summer of 2007 (Wright 2007).

					95% Confidence Interval	
Stratum	**Total Plots**	**Sampled Plots**	**Occupancy**	**SE**	**Lower Bound**	**Upper Bound**
1	8253	110	0.119	0.031	0.058	0.180
2	702	32	0.461	0.088	0.288	0.634
Total	8955	142	0.146	0.060	0.027	0.264

					95% Confidence Interval	
Stratum	**Total Plots**	**Sampled Plots**	**Occupancy**	**SE**	**Lower Bound**	**Upper Bound**
1	8955	124	0.157	0.033	0.092	0.222

Table 6. Number of commercial, non-commercial, and private licensed vertebrate pesticide applicators within the range of Gunnison's prairie dog and white-tailed prairie dog in Utah (data obtained from the Utah Department of Agriculture & Food), 2007.

	Licensed Vertebrate Pesticide Applicators		
County	**Commercial**	**Non-commercial**	**Private**
Rich	5	9	2
Summit	20	48	3
Daggett	1	11	0
Uintah	13	54	14
Duchesne	13	27	6
Carbon	22	14	6
Emery	5	22	27
Grand	13	17	2
San Juan	6	10	12

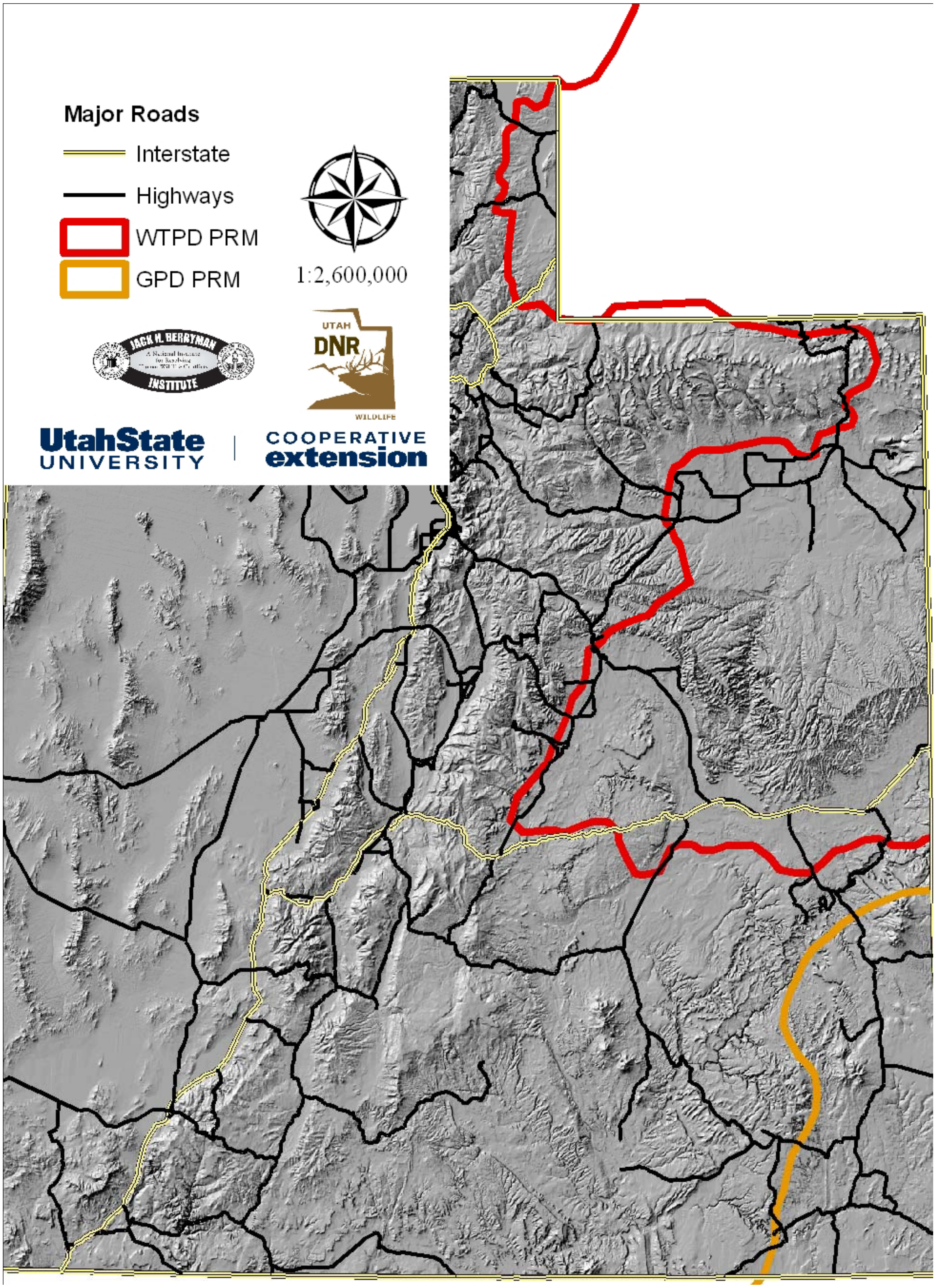

Figure 1. Predicted range model (Seglund et al. 2006a, Seglund et al. 2006b) for Gunnison's and white-tailed prairie dogs in Utah and the revised predicted range model for Gunnison's prairie dogs in Utah.

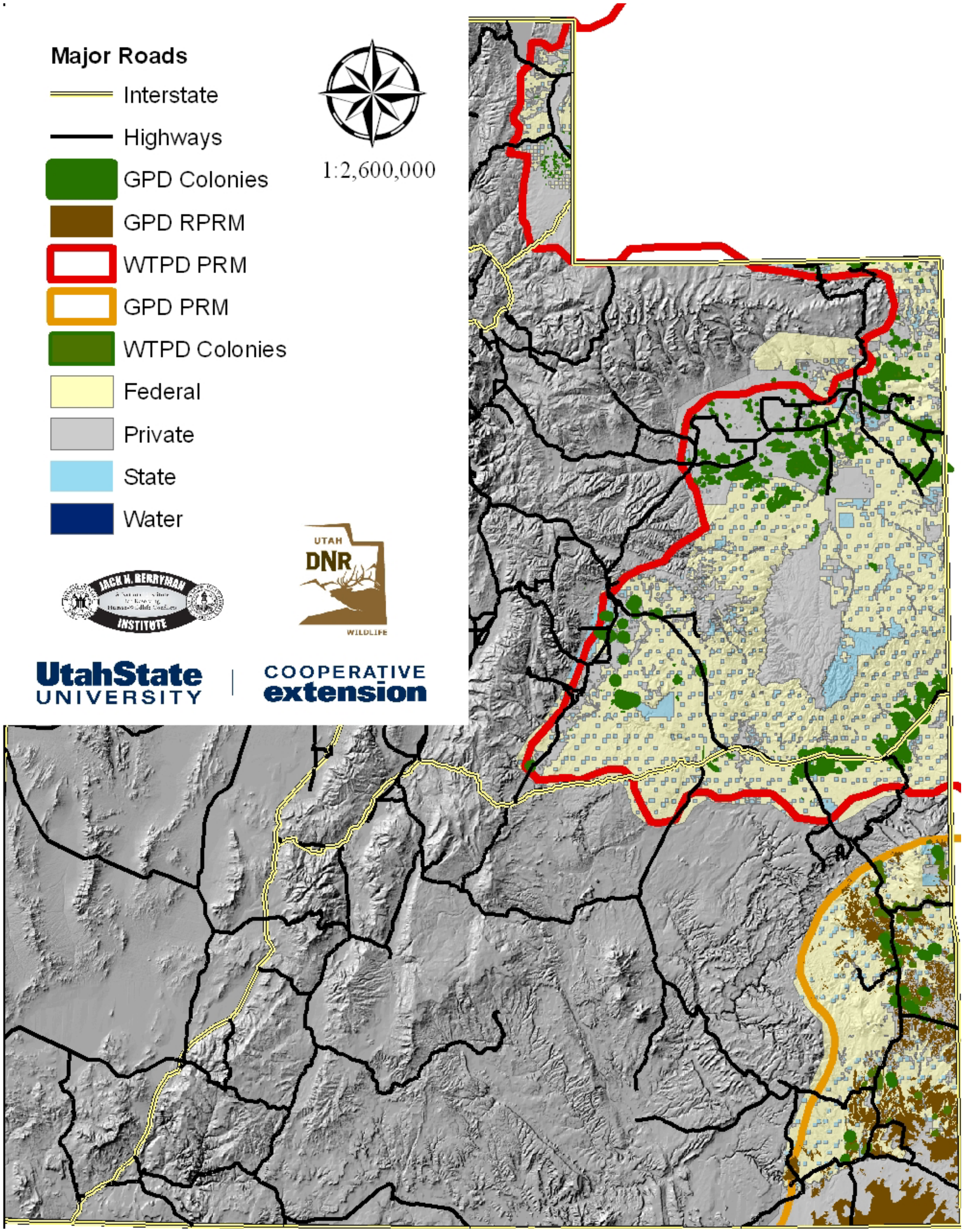

Figure 2. Landownership in the predicted range model (PRM; Seglund et al. 2006a, Seglund et al. 2006b) for Gunnison's and white-tailed prairie dogs and the revised predicted range map (RPRM) for Gunnison's prairie dog in Utah. Gunnison's and white-tailed prairie dog colonies mapped between 2002-2003 are also shown. *NOTE: Gunnison's prairie dog colonies enhanced for visibility*.

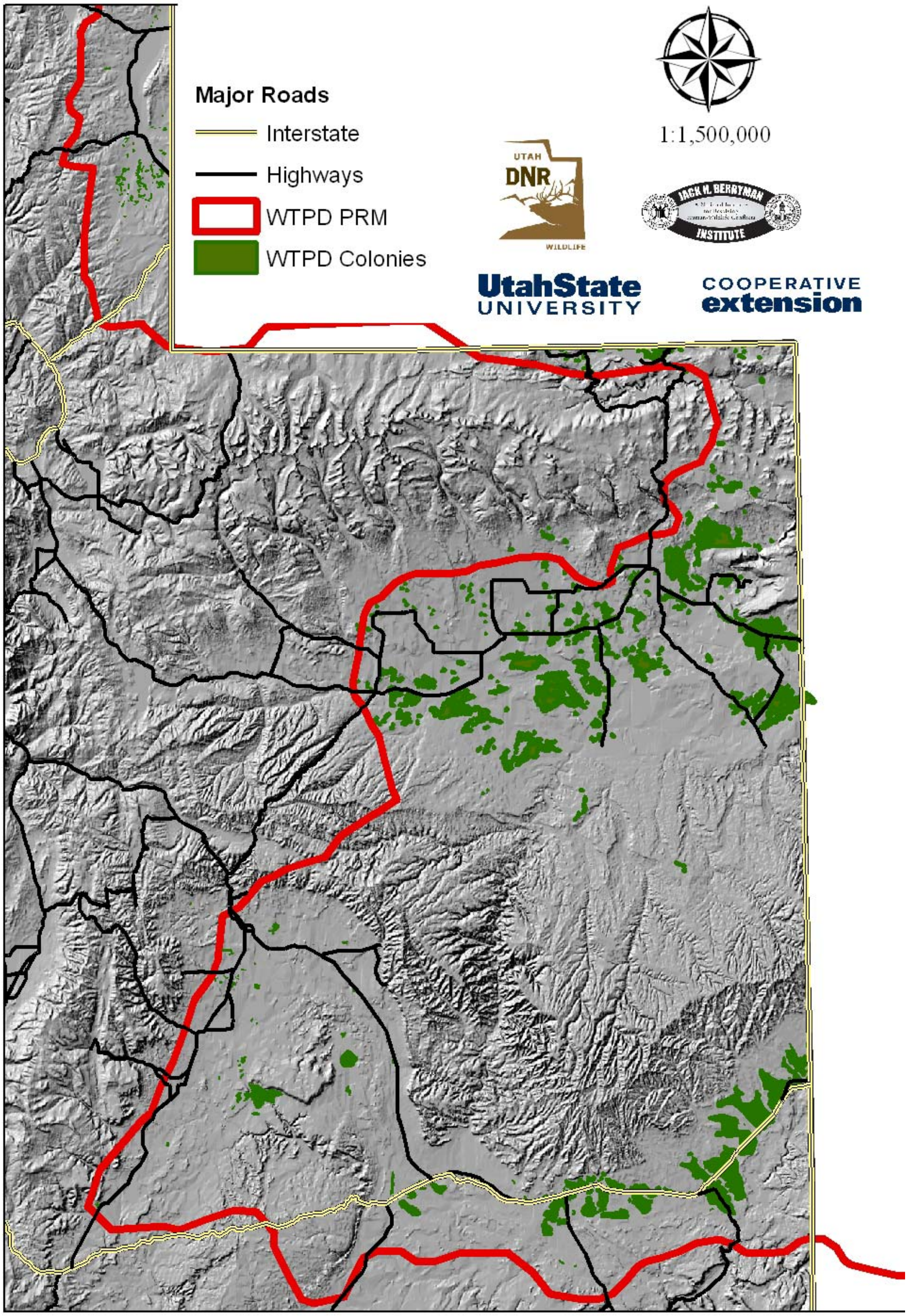

Figure 3. Predicted range model (Seglund et al. 2006b) and colonies of white-tailed prairie dogs mapped between 2002-2003 in Utah.

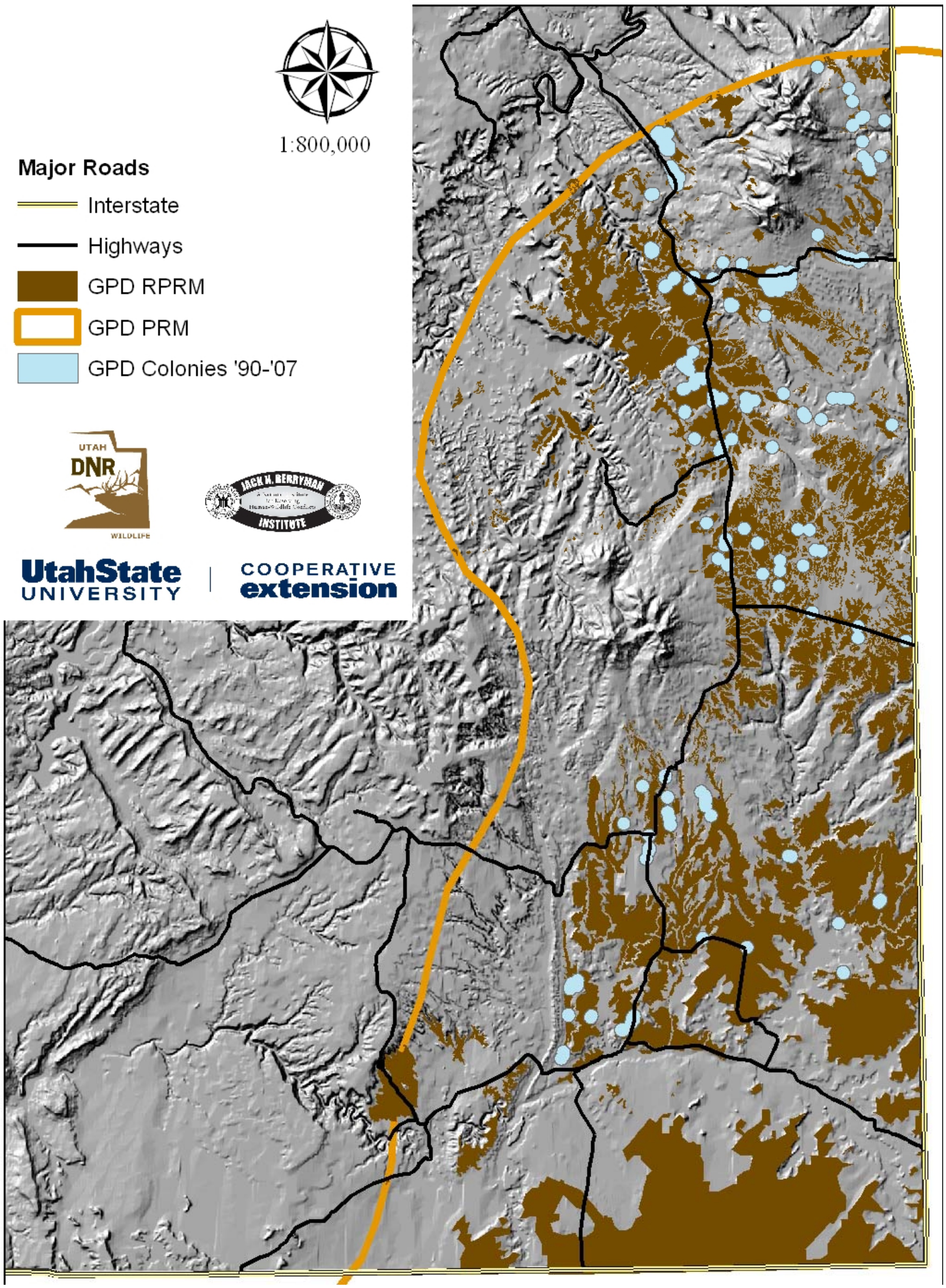

Figure 4. Predicted range model (PRM; Seglund et al. 2006a), revised predicted range map (RPRM) for Gunnison's prairie dog, and Gunnison's prairie dog colonies that have been reported to be active, 1990-2007, in Utah. *Note: Gunnison's prairie dog colonies enhanced for visibility.*

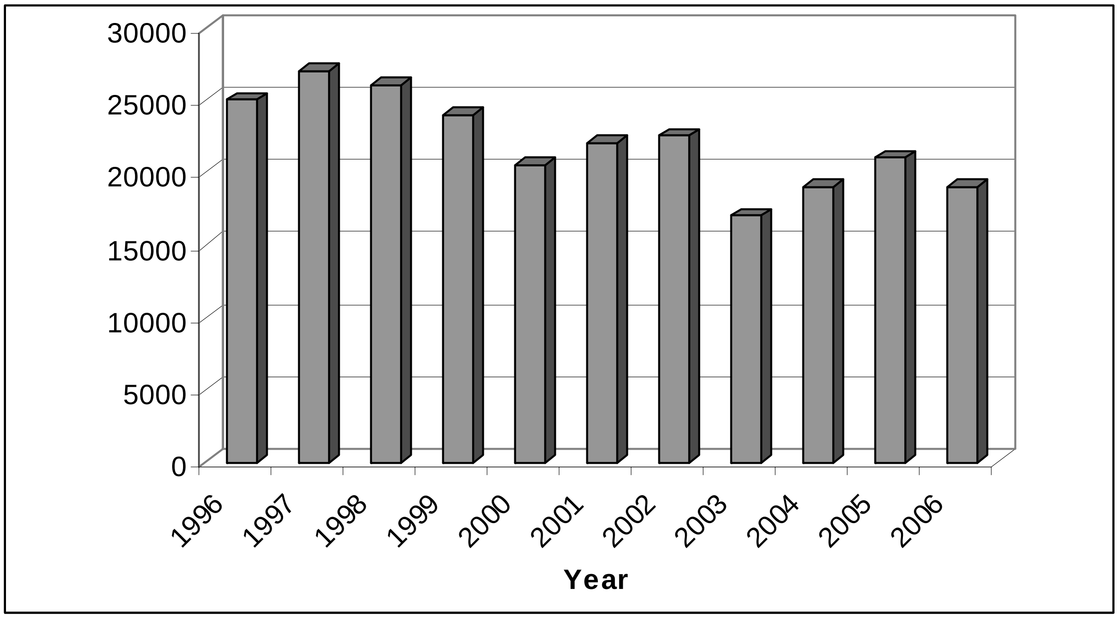

Figure 6. Number of cattle in San Juan and Grand Counties, 1996-2006 (data from USDA NASS), as a representation of the range of the Gunnison's prairie dog in Utah

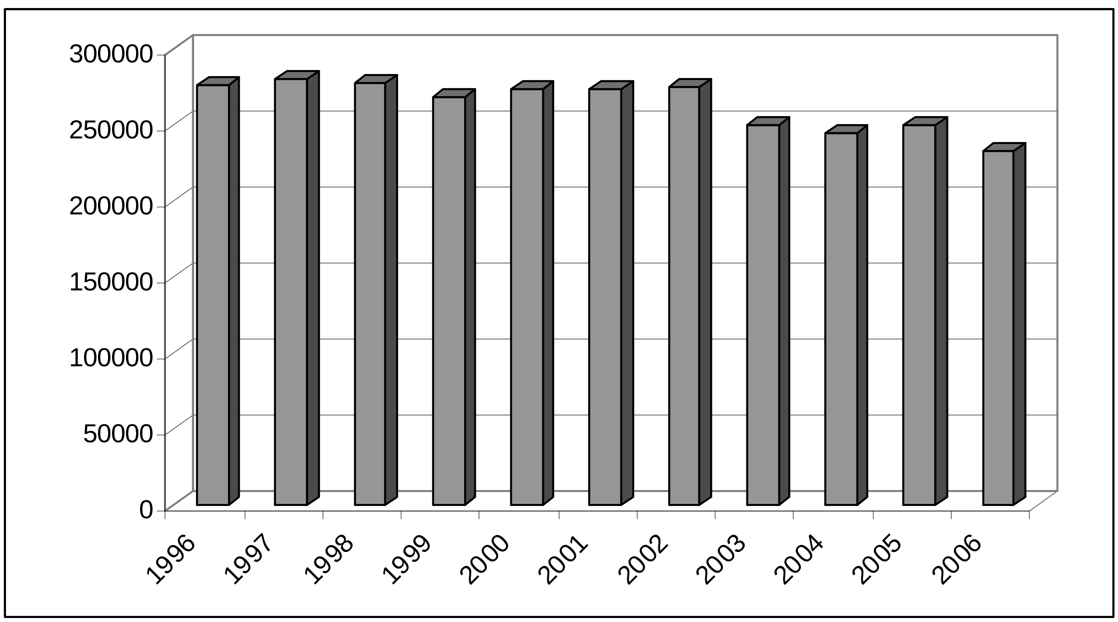

Figure 7. Number of cattle in Carbon, Dagget, Duchesne, Emery, Grand, Rich, Uintah, and Utah Counties, 1996-2006 (data from USDA NASS). These counties represent the range of white-tailed prairie dogs in Utah.

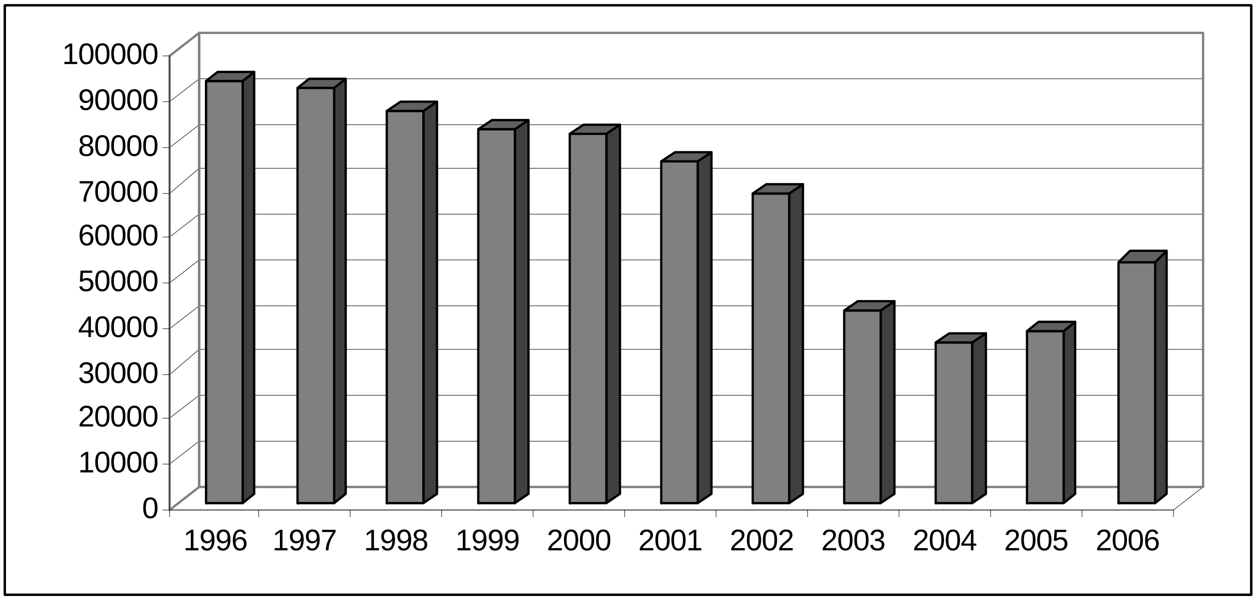

Figure 8. Number of breeding sheep and lambs in Carbon, Dagget, Duchesne, Emery, Grand, Rich, Uintah, and Utah Counties, 1996-2006 (data from USDA NASS).These counties represent the range of white-tailed prairie dogs in Utah.

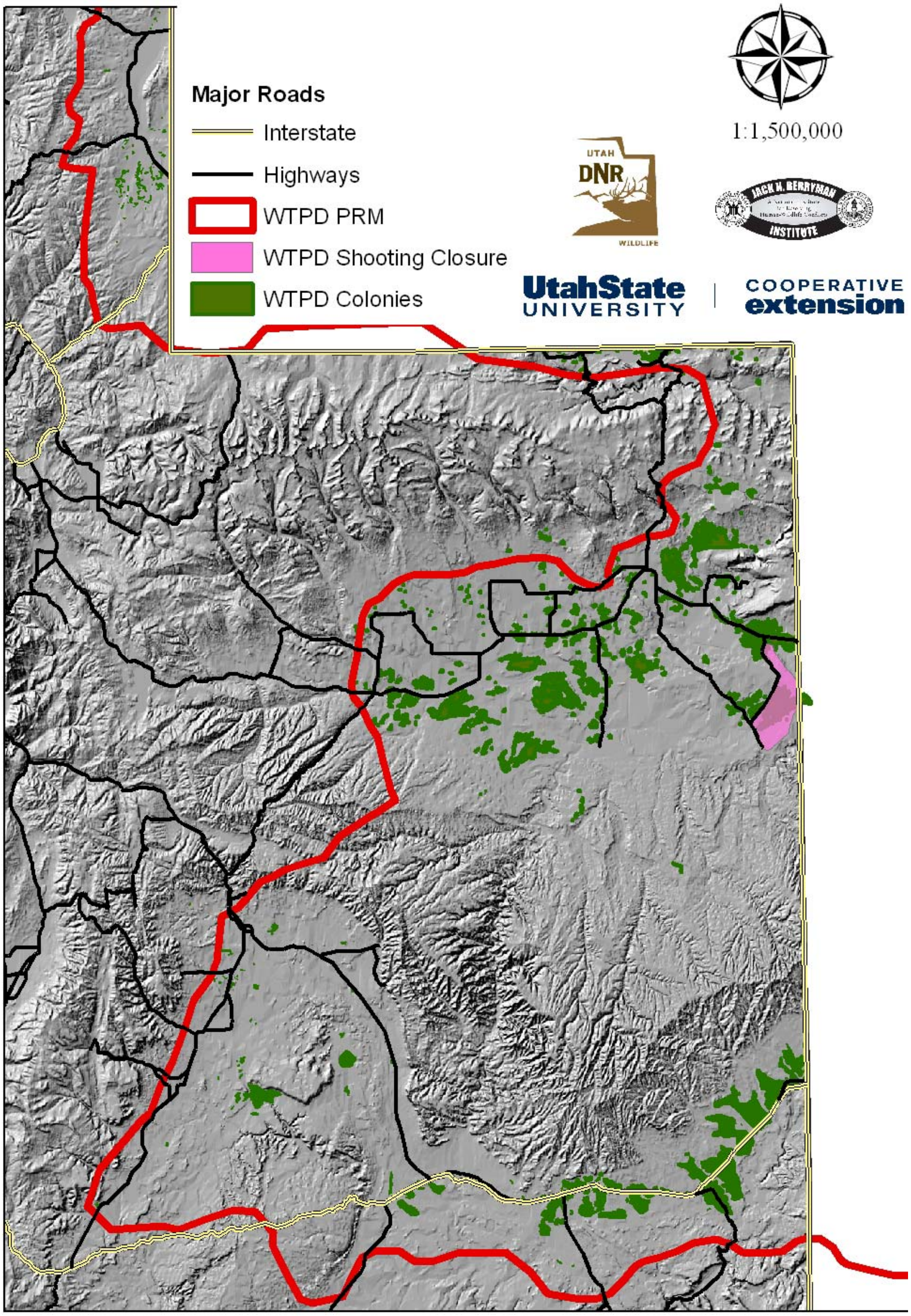

Figure 9. White-tailed prairie dog predicted range map (PRM; Seglund et al. 2006b), white-tailed prairie dog colonies mapped in 2002-2003, and the white-tailed prairie dog shooting closure.

APPENDIX A

Utah Gunnison's and White-tailed Prairie Dog
Statewide Planning Team

NAME	ORGANIZATION
Jan Anderson	Utah Farm Bureau Federation, Environmental Programs
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Tony Wright	Utah Division of Wildlife Resources, SE Region Sensitive Species Biologist
Erin Robertson	Center for Native Ecosystems
Adam Kozlowski	Utah Division of Wildlife Resources, Northern Region Sensitive Species Biologist
Janet Sutter	Utah Division of Wildlife Resources, CWCS Action Plan Coordinator
Joan Degiorgio	TNC
Clint McCarthy	US Forest Service, Region 4, Ogden, Utah
Steve Madsen	Bureau of Land Management, Utah State Office, Salt Lake City
Renee Chi	USFWS, Ecological Services
Karen Fullen	NRCS
Tyce Palmen	Utah Association of Conservation Districts, Ex. Vice President
Reed Balls	Wool Growers
Chris Kelleher	Utah Department of Natural Resources
Terry Messmer	Utah State University Extension

APPENDIX B

Rangewide Gunnison's and white-tailed prairie dog occupancy sampling protocol

PROTOCOL FOR CONDUCTING PRAIRIE DOG OCCUPANCY SURVEYS

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Prepared for

WTPD and GUPD Working Group

February 2007

Introduction

The White-tailed (*Cynomys leucurus*; WTPD) and Gunnison's Prairie Dog (*C. gunnisoni*; GUPD) Conservation Plan (WAFWA 2007) required the development and use of an objective, repeatable estimation technique to measure the response of WTPD and GUPD populations to factors affecting their viability. Techniques used to evaluate prairie dog populations have relied on delineating colony boundaries based on burrow distribution. However, WTPD and GUPD colony boundaries can be difficult to map with distribution and activity levels within boundaries extremely variable. The end result of mapping is therefore a subjective effort by investigators who rely on their best estimate by using topographic features or breaks in habitats to delineate boundaries. In addition, individual burrow activity is not assessed, resulting in both active and inactive areas included in estimates of occupied habitat. The consequence of mapping both active and inactive areas is an inaccurate estimation of occupied habitat.

In 2002, Colorado embarked on an effort to develop an objective technique to monitor WTPD and GUPD populations. Aerial surveys using the line intercept methodology had been developed for estimating occupied area by black-tailed prairie dogs (*C. ludovicianus*). Thus this was the first method investigated to determine if it could be successfully used for WTPD and GUPD. After conducting a pilot study, it was determined that the line intercept methodology significantly overestimated the lengths of GUPD and WTPD colonies compared to lengths measured on the ground. In addition, the proportions of lengths of prairie dog colonies detected by aerial crews were only weakly correlated; the crews did not consistently report finding prairie dogs in the same areas along transects. Due to the lack of correlation between aerial and ground crews, the line intercept methodology was abandoned as a viable technique to monitor WTPD and GUPD populations.

After abandoning the use of the line intercept methodology, Colorado investigated using Occupancy Modeling (MacKenzie et al. 2002) as an objective technique to monitor WTPD and GUPD. Unlike acreage estimates, measures of statistical precision and confidence intervals could be calculated for occupancy estimates. Currently Colorado is implementing Occupancy Modeling for both WTPD and GUPD within in the state. Colorado has completed one year of surveys in 2004 for WTPD and in 2005 for GUPD. Results from the surveys found WTPD occupying 24.1% (SE = 12.8) of 47,710 0.25-km^2 plots and GUPD occupying 7.5% (SE = 1.3) of 158,225 0.25-km^2 plots (Andelt et al. 2005).

Occupancy surveys have the potential to be a successful tool for establishing baseline occupancy rates for WTPD and GUPD in order to monitor changes in occupancy through time (Andelt et al. 2005, 2006a, 2006b). This manuscript was prepared to standardize occupancy surveys throughout the range of both the GUPD and WTPD. All states within the range of these species have agreed, in the Multi-state Conservation Plans, to implement an occupancy approach to monitor range-wide WTPD and GUPD population trends.

Range-wide Methodology for Occupancy Sampling for WTPD and GUPD

Defining Sampling Areas: Occupancy will be estimated by sampling 0.25 km^2 (0.5 km per side) quadrats. Quadrats will be randomly selected within each state boundary in areas designated as suitable WTPD and GUPD habitat. This defined area of inference within states will remain constant throughout the duration of the monitoring effort. In addition, the quadrats randomly selected to be sampled will not change unless all quadrats are disposed of and a new set of quadrats are randomly selected from the area of inference.

Suitable habitat does not necessarily mean that the habitat is occupied, rather it is defined as suitable or potentially suitable based on variables designated by a state as necessary for prairie dog colonization. States need not define their areas of inference in the same manned in order to conduct a range-wide occupancy survey. It is only necessary that the states develop the most accurate area of inference from the best available data.

States may wish to include the use of stratification. Stratification is useful for:

- Interest in occupancy at subdivisions smaller than the whole state or range
- Logistical convenience (ability to sample an entire stratum quickly and with similar methods)
- Need for different methods in different areas (some strata may be more easily sampled from the ground versus the air, some strata may have very good information on prairie dog locations)
- Variance reduction (individual strata with uniform occupancy rates will increase precision)

States however do not need to stratify and in addition, stratification does not need to be the same within each state boundary in order to conduct a range-wide occupancy approach.

Below is a description of how Colorado developed their area of inference and selected quadrats to sample for both WTPD and GUPD.

Colorado - Protocol for Developing Base Maps to Overlay Quadrats

Methods

WTPD: Development of Maps and Sampling Areas: Field personnel from the Colorado Division of Wildlife, Forest Service, and the Bureau of Land Management mapped colonies of active (prairie dogs present during the last $\pm$ 3 years), inactive (prairie dogs occurred in the area in the past but were not recently present) and unknown (prairie dogs had been active but current status was unknown) WTPD colonies on 1:50,000 US Geological Survey County maps in the summer of 2002 (Colorado Division of Wildlife 2002). These data, in addition to data on the overall range of WTPD areas were input into a GIS data base by Colorado Division of Wildlife personnel. The final product included active, inactive, and unknown colonies, and the overall range of white-tailed prairie dogs in each county on 11 x 17-inch (28 x 43-cm) colored topographic maps which contained an overlay of township, range, and sections. County extension agents, weed and pest supervisors, and Natural Resources Conservation Service, USDA Forest Service, Bureau of Land Management, and CDOW personnel reviewed and updated the sampling frame (Figure 1).

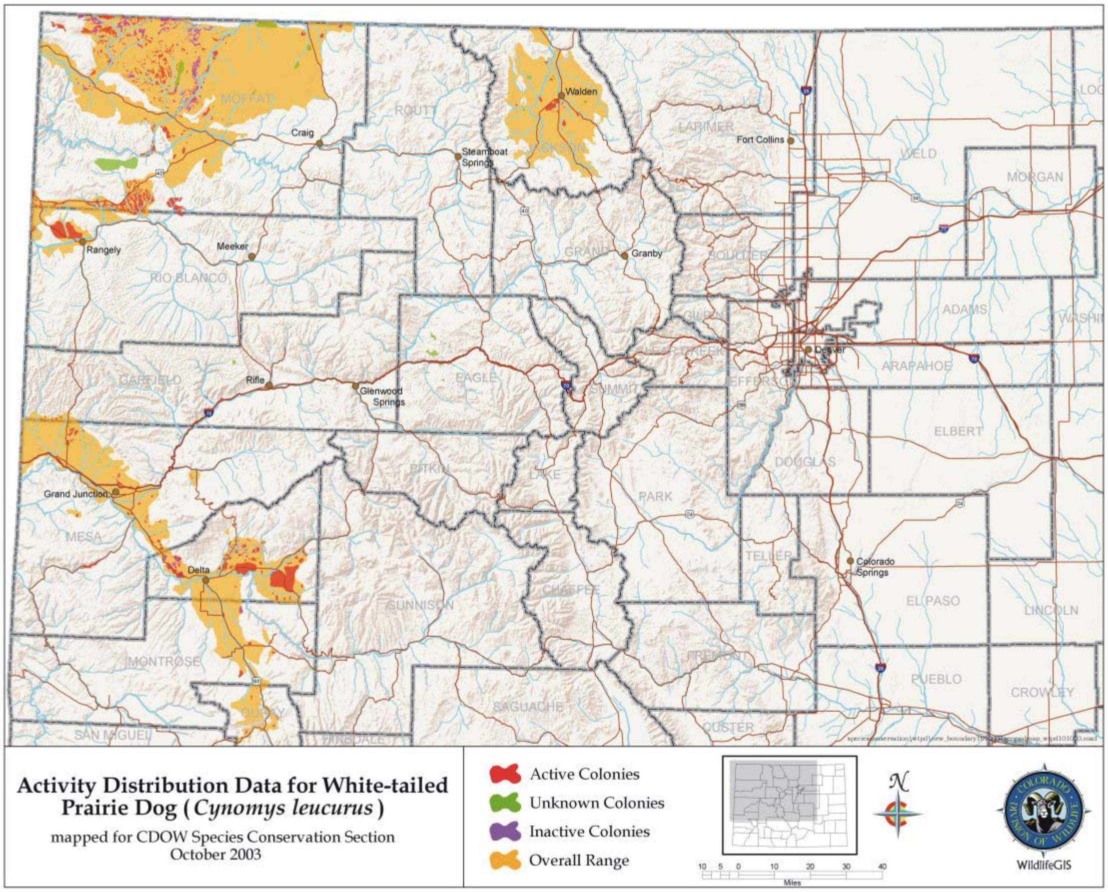

Figure 1. Range of white-tailed prairie dogs in Colorado. Three primary sampling strata consisted of Moffat and Rio Blanco counties, Eagle, Grand, Jackson, Larimer, and Routt counties, and Delta, Garfield, Mesa, Montrose, and Ouray counties.

WTPD: Selection of Quadrats: The range of WTPD in Colorado was overlaid with 1,640 x 1,640 feet (500 x 500 m) quadrats in ArcInfo using the NAD27 datum and the Zone 13 projection. Quadrats were eliminated if they occurred above 10,000 feet (3,048 m) elevation (using the 30 m digital elevation model), were on slopes >30^{o}, or were in vegetation where WTPD do not occur. A sampling frame of 47,710 quadrats was established from which a stratified random sample of 318 quadrats was selected from 10 strata (Table 1). Three general areas were sampled: Grand Junction (GJ), North Park (NP), and Northwest (NW). Quadrats in GJ and NW were classified a priori based on Colorado Division of Wildlife GIS layers as active, inactive, unknown, or other. Quadrats in NP were classified as either unknown (active, inactive, unknown) or other. The number of quadrats in each stratum was optimized based upon our a priori estimates of the probability (active = 0.9, unknown = 0.5, inactive = 0.1, and other = 0.05) of WTPDs being present within quadrats.

Table 1. Stratification for the sample of 318 quadrats from 10 strata of the WTPD occupancy survey in northwestern Colorado.

Strata	Stratum Population	Stratum Sample
GJ Active	1,963	20
GJ Inactive	170	12
GJ Other	11,654	55
GJ Unknown	523	9
NP Other	7,442	35
NP Unknown	462	7
NW Active	4,237	53
NW Inactive	1,278	23
NW Other	19,289	96
NW Unknown	692	8
Total	47,710	318

GUPD: Sampling Areas and Selection of Quadrats: A sampling area for GUPD was established preliminary from range maps in Armstrong (1972) and Fitzgerald et al. (1994). However, the sampling area was expanded by including areas in north-central Archuleta County, north-west El Paso County, and extreme north-east San Miguel County where colonies of GUPD were reported or where they were believed to possibly occur (Colorado Division of Wildlife 2002). Delta County, the north-eastern portion of Montrose County, and the northern half of Ouray County were eliminated from the sampling area because prairie dogs in these areas are WTPD (P. M. Schnurr, Colorado Division of Wildlife, personal communication). This modified range was input in a GIS database by personnel from the Colorado Division of Wildlife. Seven strata (Figure 1) were developed based upon the overall ranges (Armstrong 1972, Fitzgerald et al. 1994) of the *zuniensis* subspecies (Ute Mountain Ute Indian Reservation, Southern Ute Indian Reservation, and remaining areas [South-West]), and the *gunnisoni* subspecies (Gunnison Valley, San Luis Valley, South Park, and South-East), and geography of Colorado. The Continental divide and other mountain ridges usually separated strata.

Longhurst (1944) reported that GUPD are probably limited to 10,000 feet (3,048 m) in elevation however, in areas with warm air currents they may be found at slightly higher elevations. Pizzimenti and Hoffman (1973) and Fitzgerald et al. (1994) reported that GUPD range in elevation from 6,000–12,000 feet (1,830 to 3,660 m) across their range. Several professionals (J. Ferguson, Bureau of Land Management; M. Threlkeld, Colorado Department of Agriculture; J. A. Capodice, Bureau of Land Management [retired]; and J. F. Cully, Kansas State University; personal communications), familiar with Gunnison's prairie dogs in Colorado, indicated that they generally are not found above 10,000 feet (3,048 m) elevation.

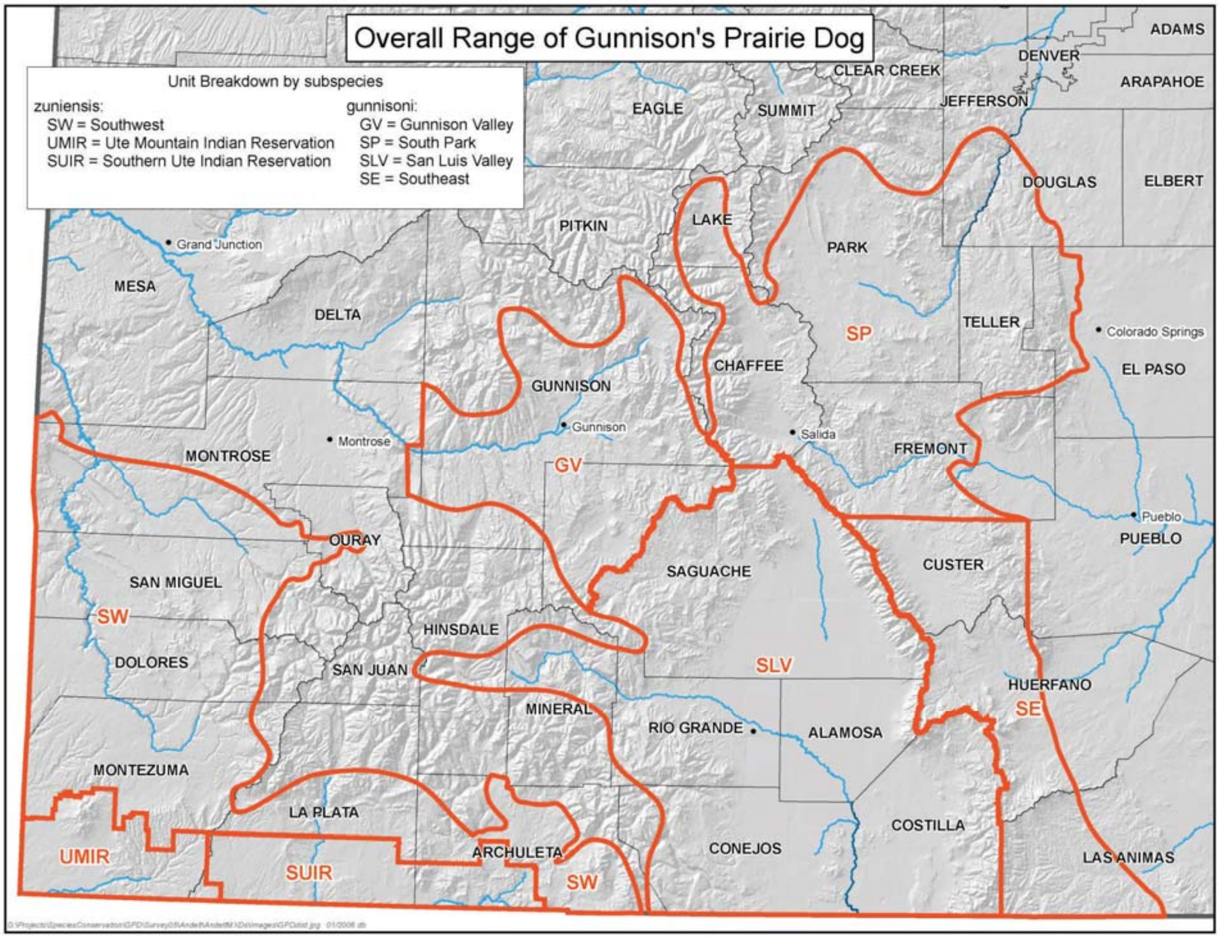

Figure 1. Strata used for sampling Gunnison's prairie dogs in Colorado during 2005.

GUPD have been described as inhabiting grasslands (Travis and Slobodchikoff 1993, Travis et al. 1997, Bangert and Slobodchikoff 2000, Perla and Slobodchikoff 2002, Girard et al. 2004), grasslands and shrub-grasslands (Cully 1997), grasslands to montane meadows (Findley et al. 1975), mountain grasslands (Lechleitner et al. 1962), valley floors to higher meadows (Longhurst 1944), and alpine meadows (Perla and Slobodchikoff 2002). The above articles and the expertise of 3 professionals (J. Ferguson, Bureau of Land Management; J. A. Capodice, Bureau of Land Management [retired]; and A. E. Seglund, Utah Division of Wildlife Resources; personal communications), familiar with GUPD, was used to further refine vegetation cover types contained in the Basin Wide Geographic Information System (GIS) as potentially occupied or unoccupied by GUPD in Colorado (Appendix 1). In addition, since GUPD are generally not found on slopes >15% (Fitzgerald and Lechleitner 1974; Lorance et al. 2002 [cited by Seglund et al. 2005]; Yazzie and Sanders 2003 [cited by Seglund et al. 2005]; J. Ferguson, Bureau of Land Management; M. Threlkeld, Colorado Department of Agriculture; J. A. Capodice, Bureau of Land Management [retired]; and J. F. Cully, Kansas State University; personal communications) a slope layer was added to better depict the suitable habitat. The overall range of GUPD in Colorado (Figure 1) was overlaid with 1,640 x 1,640 feet (500 x 500 m) square quadrats and the Basin Wide vegetation cover types in ArcInfo (ESRI, Redlands, California) using the NAD27 datum and the Zone 13 projection. Quadrats were eliminated if all areas within quadrats were above 10,000 feet (3,048 m) elevation (30 m digital elevation model), were on slopes <15%, or were in vegetation types where GUPD are not known to occur.

Three hundred and eighty-one quadrats were randomly selected from within 7 strata where occurrence of GUPD likely varied. The number of quadrats in each stratum were optimized (Table 2) based upon a priori estimates of the probability of GUPD occurrence within quadrats (W. F. Andelt, unpublished data) using the methods described in Thompson et al. (1998). Permission to visit quadrats on the Ute Mountain Ute Indian Reservation early in the sampling process was denied. Thus, this stratum was dropped from the survey, and the original sample size was reduced to 361 quadrats.

Table 2. A priori estimates of probability of occurrence of GUPD in quadrats, number of quadrats available for sampling, optimal allocation of the sampling effort, and actual numbers of quadrats sampled for each of 7 strata in Colorado during 2005.

Strata (h)	Estimated Probability of occurrence	Quadrats Available (U_h)	Optimal Allocation of Quadrats to Sample	Quadrats Sampled (u_h)
Gunnison Valley	0.03	14,178	20	20
South-East	0.03	15,543	21	21
San Luis Valley	0.05	47,143	83	83
South Park	0.05	27,297	48	47
Southern Ute Indian Reservation	0.25	9,823	34	34
Ute Mountain Ute Indian Reservation	0.10	7,600	20	0
South-West	0.25	44,241	155	153
Totals		165,826	381	358

Sampling of Quadrats

To locate quadrats on the ground, UTM locations of the 4-corners of a quadrat will be downloaded from ArcInfo shape files into GPS units. In addition, topographic maps (11 x 17 inch (28 x 43-cm) and land management maps (1:100,000) showing the location of quadrats will be provided to observers to assist in locating quadrats.

Quadrats will be visited 2 times during periods when prairie dogs are most active. For Colorado, these activity periods run from late March through mid-July for WTPD and late March through mid to late August for GUPD. Other states seasonal duration of sampling may differ due to elevation and latitudinal differences. Two visits to quadrats will be attempted to determine the detection probability however, limitations due to personnel, funding, and weather may result in areas being surveyed a single time. States will prioritize non-detection sites for revisit and those sites with a positive detection on the first visit as a lower priority for a second visit.

Two visits to a quadrat must be completed within 7 days so as to minimize violating the assumption of a closed population. To avoid observer bias and minimize possible independence violations (more likely to redetect a species once it has been detected due to prior knowledge), different observers should visit the quadrat on each of the two occasions. However, if only one technician is hired to conduct surveys, it is recommended that a supervisor or second observer visit a subset of the plots. Quadrats should be sampled unless winds are greater than 23 mi/hour and there is moderate to heavy rainfall.

Visual observations of a prairie dog can be recorded for a positive detection. Because auditory detections are hard to pinpoint with regards to exact location of the calling animal, this type of detection can not be used since detections need to be confirmed within a quadrat. After arriving at a quadrat corner, if an observer detects a prairie dog they do not need to visit all four corners of the plot. If the observer arrives and no prairie dogs are detected in the quadrat, they must conduct 5 minute observations at each of the four corners of the plot until they detect a prairie dog or until all four corners have been visited.

Data recorded for each study quadrat will include the name of the individual conducting the sampling, date, quadrat number, time spent at quadrat, and UTM coordinates of the southwest corner of the quadrat (Appendix 2). At each plot, the observer will record air temperature and wind speed averaged over 10 seconds.

During sampling of quadrats, observations of other important species such as ferruginous hawks (*Buteo regalis*), burrowing owls (*Athene cunicularia*), Mountain plovers (*Charadrius montanus*) and kit fox (*Vulpes macrotis*) can be recorded. Note that private landowners in Colorado were not informed that information on the occurrence of these species before field data was collected. Some landowners later expressed concern about this oversight. We recommend that data collection be limited only to those species that landowners have specifically approved.

Estimating Occupancy of WTPD Quadrats from Aircraft

To locate quadrats from the air, a GPS unit will be attached to a laptop computer that contains a DeLorme Topo USA program. The coordinates for the 4 corners of each grid quadrat are entered in the program and overlaid on a topographic map. The track function is used to show the position of the airplane relative to each quadrat and saved for later reference. The airplane is flown at an elevation of about 100 m above ground and 3 passes spaced across each quadrat are completed. The pilot and observer both watch for prairie dogs.

Statistical Analyses

Data will be input into an access database and forwarded to Colorado for analysis. Occupancy models (MacKenzie et al. 2002) will be fit to the observed encounter histories for WTPD and GUPD with program MARK (White and Burnham 1999) with model selection by information-theoretic methods (Burnham and Anderson 2002). MacKenzie et al.'s model estimates the probability of detection (p) during a single visit and the probability of occupancy (Ψ) based on multiple visits to quadrats. Thus, this model corrects for "false negatives", i.e., quadrats where no prairie dogs are observed, but where prairie dogs actually exist. The logit link will be used in all models to relate covariates to detection and occupancy probabilities.

Quadrat-specific covariates can be collected to improve the estimate of occupancy probability for each quadrat. Covariates that would likely improve estimation of quadrat-specific detection probabilities (p) include: average temperature, wind speed, starting time, and Julian date.

Elevation of the quadrat and elevation squared have been incorporated as covariates to improve prediction of occupancy rates for WTPD in Colorado. To improve estimation of the probability a quadrat was occupied by GUPD in Colorado, 5 quadrat-specific covariates were included in the analysis: elevation of the quadrat, elevation squared, percentage of the quadrat occupied by a prairie dog Colony, an additional percentage of the quadrat designated as Division of Wildlife Range (based on range-wide field mapping), and a further additional percentage of the quadrat designated as Modeled Range. If quadrat-specific covariates do not improve the estimation of occupancy rate within a strata, then the estimate of ψ obtained without covariates for the sampled quadrats would be an estimate of the proportion of the sampled quadrats that are occupied. Further, this simple estimate ($\hat{\psi}$) would be an estimate of the proportion of all quadrats in the sampling frame (*O*) that are occupied, because the sampled quadrats are a random sample of the quadrats available to be sampled.

Occupancy estimation for entire sampling frame in Colorado: Model selection results placed almost all weight on one model for both WTPD and GUPD, so model averaging was not required. However, quadrat-specific covariates greatly improved prediction of occupancy rates for both species, so a complex procedure was required to estimate occupancy rates for all quadrats in the sampling frame. For the minimum AICc model with *r* quadrat-specific covariates, the fitted model is

$$\hat{\psi}_i = \frac{\exp\left(\sum_{k=0}^{r}\hat{\beta}_k x_{ki}\right)}{1+\exp\left(\sum_{k=0}^{r}\hat{\beta}_k x_{ki}\right)} \quad ,$$

where the *r* covariate values for observation i are x_{1i}, x_{2i}, …, x_{ri}, and $x_{0i} = 1$. The estimates from Program MARK are the intercept ($\hat{\beta}_0$) and *r* slope parameters ($\hat{\beta}_1$, $\hat{\beta}_2$, …, $\hat{\beta}_r$). The number of quadrats estimated to be occupied in stratum $h = 1,...,H$ (*H* = 6 for GUPD, 10 for WTPD) with the minimum AICc model that included *r* covariates was computed as the sum of the estimated probability of occupancy of each quadrat, $\hat{N}_h = \sum_{i=1}^{U_h}\hat{\psi}_i$, where U_h is the number of quadrats in the population of stratum *h*. The total number of occupied quadrats for all strata was estimated as $\hat{N} = \sum_{h=1}^{H}\hat{N}_h$. The variance of $\hat{N}_h$ was estimated as the sum of the estimated variance-covariance matrix of the $\hat{\psi}_i$, $i = 1,...,U_h$, where

$$\hat{\text{Var}}(\hat{\psi}_i) = \left[\hat{\psi}_i(1-\hat{\psi}_i)\right]^2 \left[\sum_{k=0}^{r} x_{ki}^{\,2}\hat{\text{Var}}(\hat{\beta}_k) + \sum_{k'=0,k'<k}^{k-1} 2x_{ki}x_{k'i}\hat{\text{Cov}}(\hat{\beta}_k,\hat{\beta}_{k'})\right] \quad ,$$

and

$$\hat{\text{Cov}}(\hat{\psi}_i,\hat{\psi}_j) = \hat{\psi}_i(1-\hat{\psi}_i)\hat{\psi}_j(1-\hat{\psi}_j)\left[\sum_{k=0}^{r} x_{ki}x_{kj}\hat{\text{Var}}(\hat{\beta}_k) + \sum_{k'=0,k'<k}^{k-1}(x_{ki}x_{k'j}+x_{kj}x_{k'i})\hat{\text{Cov}}(\hat{\beta}_k,\hat{\beta}_{k'})\right]$$

where Var(.) indicates the variance of the enclosed estimator, and Cov(.,.) indicates the covariance of the 2 enclosed estimators. Thus,

$$\hat{\text{Var}}(\hat{N}_h) = \sum_{i=1}^{U_h} \hat{\text{Var}}(\hat{\psi}_i) + 2 \sum_{j=1,\, j<i}^{i-1} \hat{\text{Cov}}(\hat{\psi}_i, \hat{\psi}_j) \ .$$

The covariance of pairs of $\hat{\psi}_i$ estimates, when they occur in strata h and h' ($h \neq h'$), was also computed with the above covariance estimator formula, but indicator variables were used to adjust for different intercepts between the 2 strata. The covariance between pairs of $\hat{\psi}_i$ estimates, when they occur in strata h and h' ($h \neq h'$), was needed to compute the covariance of the $\hat{N}_h = \sum_{i=1}^{U_h} \hat{\psi}_i$ between the 6 or 10 strata. For GUPD strata where the Division of Wildlife Range covariate was not available, the x_{1i} or x_{1j} covariate value was taken as zero, and the formula reduces properly to the correct covariance. These formulae are different than those presented in Bowden et al. (2003) because they used a covariate to predict an estimated population size using a ratio estimator with correlated estimates, whereas our covariates are used to estimate directly the correlated estimates of occupancy rate.

Miscellaneous

Equipment: Equipment needed to conduct surveys include clipboards, waterproof pens, topographic maps, compasses, GPS units, battery chargers and rechargeable nickel metal hydride batteries, 10-power binoculars, backpacks, high lift jacks, tow chains, shovels, jumper cables, quadrat corner stakes, fluorescent red paint for corner stakes, hammers, thermometers, Skymate windspeed and temperature meters (Speedtech Instruments, Great Falls, Virginia), phone cards, and first aid kits.

Establishing Ownership of Quadrats: Plot ownership can be established by contacting County Assessor web sites and offices, reviewing plat books, and by contacting adjacent landowners. Contact information for lessees of State Land Board lands can be obtained from the State Land Board. Data sheets need to contain the plot number, owners name, address, and telephone number. The observer should record each phone call made to the landowner and special instructions such as need to notify a lessee shortly before visiting the land, access thru locked gates, and if the owner desires a copy of the final report. If information on species other than prairie dogs is desired, landowners should be asked for permission to collect that data.

Informing Cooperators: Inform anyone who may be affected by surveys including Extension Agents, County Sheriffs, Bureau of Land Management, U.S. Forest Service, Division of Wildlife, Division of Parks and Outdoor Recreation, National Park Service, National Wildlife Refuges, State Land Board, The Nature Conservancy, Native American tribes, Natural Resources Conservation Service, and USDA/APHIS Wildlife Services.

Liability Issues: Some private landowners may be concerned about their liability for observers while they are on the landowner's property. In Colorado, our legal advisors believe that a landowner's liability to persons on their land would be covered under provisions of Section 13-21-115 of the Colorado Revised Statutes. Observers should be considered a "licensee" on private property. A landowner can only be found liable to a licensee if he/she fails in his/her duty owed to that other person as that duty is described in the statute. The statute limits the landowner's risk of liability, and should provide adequate protection to a landowner under normal circumstances.

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APPENDIX C

U.S. Fish and Wildlife Service listing factors and associated potential conservation actions.

U.S. Fish and Wildlife Service listing factors and associated potential conservation actions; compiled from the GPD and WTPD Conservation Assessments (Seglund et al. 2006a, 2006b), GPD Conservation Plan (WAFWA 2007), the Northeastern Utah Black-Footed Ferret Management Plan (UDWR 2007), the Book Cliffs Resource Management Plan EA (BLM 1999), and the February 2007 Utah GPD/WTPD Statewide Planning Team meeting. Conservation actions will be implemented as needed in an ongoing manner and also as necessitated following a 40% decline (95% CI) in rangewide occupancy. At a minimum, occupancy modeling will be used to monitor the cumulative response to management actions.

LISTING FACTOR/THREAT	POTENTIAL CONSERVATION ACTIONS
Present or threatened destruction, modification, or curtailment of habitat or range	Develop or use existing private landowner incentive programs
	Identify and pursue protection for crucial areas.
	Avoid locating wells, roads, pipelines, and other facilities in occupied or potentially suitable habitat for GPDs and WTPDs. If avoidance is not possible, strive to locate development in at the edge of colonies or in smaller colonies or areas with low GPD/WTPD densities.
	Consider directional drilling techniques as a way of avoiding impacts to occupied and potentially suitable GPD and WTPD habitat.
	Institute timing restrictions and regulate vehicle traffic types to reduce impacts during crucial periods (March 1-July 1) when GPDs and WTPDs are active.
	Monitor sites before, during, and after development of oil and gas wells, roads, pipelines, or other facilities to evaluate severity and extent of impacts.
	Allow periodic rest from grazing during critical periods of plant growth, seed dispersal, and establishment.
	Fence crucial GPD and WTPD habitat.
	Emphasize use of native plant species when reseeding disturbed areas or conducting habitat restoration or enhancement projects.
	Use mechanical, chemical, and/or biological methods of weed control, as needed, to control invasive species or noxious weeds.
	Relocate prairie dogs into existing colonies or new, suitable habitat, from areas facing immediate threats from development; monitor success of translocations.
	Enhance habitat adjacent to or in the vicinity of existing GPD/WTPD colonies to facilitate natural relocation or expansion. Habitat enhancement could include mechanical, chemical, or biological control of woody vegetation, noxious/invasive plants, seeding, or fencing.

	Develop Candidate Conservation Agreement with Assurances program to conserve GPDs, WTPDs, associated species, and their habitats on private land.
Overutilization for commercial, recreational, scientific, or educational purposes	Reevaluate regulatory authorities and measures.
	Maintain seasonal closures (April 1-June 15) to shooting on public land.
	Require shooters to obtain a prairie dog shooting permit.
	Conduct harvest surveys to estimate annual harvest rates.
Disease or predation	Conduct flea dusting.
	Monitor for presence of disease in prairie dog populations and in populations of other small mammals inhabiting areas in and adjacent to GPD and WTPD occupied habitat.
	Where appropriate, translocate prairie dogs (possibly from urban/suburban settings or areas impacted by development) to augment colonies impacted by plague; evaluate the success of translocation.
	Continue predator management activities (conducted by USDA Wildlife Services).
	Avoid sighting powerlines or other tall structures that could serve as artificial raptor perches near GPD/WTPD occupied aeras.
	Promote testing and use (as success is demonstrated) of plague vaccines.
Inadequacy of existing regulatory mechanisms	Review current laws, statutes, and regulations.
	Review and comment on new Resource Management Plans to ensure that they address species-specific needs of GPDs, WTPDs, and associated species with regard to recognized threats and for consistency with existing conservation and management plans for these species.
	Develop and implement standardized rangewide monitoring and management strategies.
	Prioritize research needs (as outlined in GPD and WTPD Rangewide Conservation Assessment; Seglund et al. 2006a, 2006b).
	Facilitate the establishment of and support continuation or research projects addressing knowledge gaps (as identified in the GPD and WTPD Conservation Assessments; Seglund et al. 2006a, 2006b).
Other natural or manmade factors affecting continued existence	Develop and/or utilize existing incentive programs (NRCS Farm Bill, UFBF Financial Assistance programs, Candidate Conservation Agreements with Assurances) to encourage private landowners to maintain prairie dogs on private property.

	Where appropriate, translocate prairie dogs threatened with imminent destruction to supplement existing colonies or create new colonies; monitor success of translocation efforts.
	Alleviate cumulative effects of other impacts (shooting, poisoning, plague, livestock grazing, invasive and noxious weeds/plants, etc) during times of drought or other environmental stress (following large-scale disturbance, plague, etc).
	Develop and/or utilize existing public outreach and education mechanisms to inform the public about GPD/WTPD ecology, threats facing the species' and the ecosystems they inhabit, and conservation and management actions.