Creating Prairie Dog Management Plans

A Guide for Local Governments and Stakeholders

Part 1: Background and Context

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The eyes of the future are looking back at us and they are praying for us to see beyond our own time. They are kneeling with hands clasped that we might act with restraint, that we might leave room for the life that is destined to come. To protect what is wild is to protect what is gentle. Perhaps the wildness we fear is the pause between our own heartbeats, the silent space that says we live only by grace. Wilderness lives by this same grace. Wild mercy is in our hands.

~Terry Tempest Williams

Executive Summary

- Part 1 provides an overview of prairie dog ecology, discusses the importance of prairie dog conservation, explains why prairie dogs have declined, and clarifies the roles of federal, state, and local governments in prairie dog management.
- Part 2 describes the basic elements of a prairie dog management plan and provides direction for policy documents that can be customized to the needs of any community.
- The appendices provide in-depth information on 1) non-lethal management (including barrier installation and both active and passive relocation), 2) consequences of lethal control, 3) mitigation for habitat destruction, 4) state agency designations of prairie dogs, and 5) model habitat monitoring sheets
- Prairie dogs are one of the most controversial and widely misunderstood wildlife species in North America, both celebrated as a keystone species and reviled as a pest.
- Published scientific research indicates that prairie dogs are intelligent, social creatures that play key roles in grassland ecosystems, including:
    - Turning, aerating, and fertilizing soil
    - Increasing water penetration
    - Providing a prey base for associated and dependent species
    - Providing burrows and shelter to associated and dependent species
    - Creating habitat mosaics, including potential firebreaks, through vegetation consumption and clipping
- Since the 1900s, prairie dog populations have declined an estimated 87 to 99 percent, depending on the species, due to:
    - Poisoning
    - Sylvatic plague
    - Habitat conversion
    - Shooting
- Much of the decline in prairie dog populations can be traced to negative attitudes about prairie dogs, which are based in part on myths, misinformation, and misperceptions.
- A prairie dog management plan is important for local governments because:
    - Local governments have strong land use control powers to protect wildlife habitat
    - Prairie dog conservation plans can effectively address land-use conflicts
    - It creates accountability for landowners and developers working in the community
    - Collaborative conservation with other local governments and agencies is necessary for range-wide species persistence
    - It can incentivize conservation and encourage local environmental stewardship
    - It can promote local tourism and recreation activities
    - It can educate people about the plight of prairie dogs and the grassland ecosystem
    - Healthy wildlife populations indicate a healthy environment and increase human quality of life
    - Local wildlife depends upon prairie dogs and the ecosystems they create and maintain
    - It fosters humane treatment of prairie dogs and species dependent upon their presence.
- Prairie dog conservation at the local level can be challenging due to a lack of collaboration from state and federal agencies in the management of local prairie dog populations.
- Connectivity to state and federal conservation goals is an important first step in the creation of a local prairie dog management plan.

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1. Statement of Purpose

The purpose of this document is to provide guidance to communities developing local prairie dog management or conservation plans with the ultimate objective of improving collaborative efforts with other agencies to protect prairie dog colonies and the grassland habitats necessary for the continued range-wide persistence and distribution of prairie dogs. This document is divided into three parts:

- Part 1 provides an overview of prairie dog ecology, discusses the importance of prairie dog conservation, explains why prairie dogs have declined, and clarifies the roles of federal, state, and local governments in prairie dog management
- Part 2 describes the basic elements of a prairie dog management plan and provides direction for policy documents that can be customized to the needs of any community
- The appendices provide in-depth information on 1) non-lethal management (including barrier installation and both active and passive relocation), 2) consequences of lethal control, 3) mitigation for habitat destruction, 4) state agency designations of prairie dogs, and 5) model habitat monitoring sheets

For more immediate needs, such as protecting a local colony from development or finding a release site for a relocation, see the Prairie Dog Action Packet (PDC, 2014), available at https://tinyurl.com/yc2g5dat.

Prairie dogs are one of the most controversial and widely misunderstood wildlife species in North America. Since early European migration onto the North American grasslands, prairie dogs have been celebrated as an essential keystone species for healthy grasslands ecosystems, but also vilified and in some locations managed as destructive rodent pests. Human-caused changes to the grasslands stemming from crop agriculture, livestock grazing, energy development, residential and commercial development, prairie dog shooting, poisoning campaigns, and plague (an introduced disease) have caused the five species of prairie dogs to disappear from an estimated 87 to 99 percent of their historic (1800s) range, depending on the species (*see* Table 1).

In most states, local governments strongly influence land-use planning decisions for prairie dog conservation at local, state, and federal levels. However, very few local governments have a conservation plan for prairie dogs or are aware of their range-wide decline. Of the local plans reviewed, only a fraction aligned their policies with federal or state conservation goals. This document will clarify the roles of the three levels of government—local, state, and federal—and allow them to more seamlessly work together to ensure the long-term future of grassland biodiversity.

A note on terminology: we use "management plan" and "conservation plan" interchangeably in this document. We prefer "conservation plan," which prioritizes the preservation of wildlife and wild places *in situ*. However, we know this phrasing is not universally accepted or applicable and thus use "management plan" where appropriate.

2. Prairie Dog Biology and Natural History

2.1. Taxonomy

Prairie dogs are rodents in the squirrel family. Evolutionarily, they share a role in grassland ecosystems with many social, herbivorous, burrowing mammals around the world (Davidson et al., 2012). Prairie dogs belong to the genus *Cynomys*, which is divided into two subgroups: black-tailed (subgenus *Cynomys*) and white-tailed (subgenus *Leucocrossuromys*). There are five species of prairie dog, all of which are found only in North America (Figure 1). Black-tailed prairie dogs and Mexican prairie dogs make up the black-tailed subgroup, while Gunnison's prairie dogs, Utah prairie dogs, and white-tailed prairie dogs make up the white-tailed subgroup. Since all five species differ in geographic range, and may vary in breeding times, density, dispersal patterns, social structure, or interactions with vegetation, it is important to distinguish between species when reviewing research or planning management actions. Table 1 provides an outline of the differences between the five species.

Fossils representing both black-tailed and white-tailed subgroups appear on the central Great Plains from 1.8 million to 750,000 years before the present (BP). The Gunnison's prairie dog appeared between 750,000 and 500,000 years BP and is the oldest known prairie dog species that still exists today. The modern black-tailed prairie dog first appeared in the fossil record 75,000 to 10,000 years BP (Goodwin, 1995).

2.2. Social Structure

Within colonies, prairie dogs live in territorial family groups called coteries (black-tailed prairie dogs) or clans (Gunnison's prairie dogs [Hoogland, 1995]), usually consisting of one adult male and several adult females related to each other (mothers, daughters, granddaughters, sisters, nieces, etc.). Recorded black-tailed prairie dog coteries have contained between one and 26 individuals and their territories ranged in size from 0.12 acres to 2.5 acres. Over time, coteries may expand, contract, or go extinct; fusion (blending) of coteries is rarely observed (Hoogland, 1995). While prairie dog species may differ in terms of their degree of territoriality, all members of coteries tend to defend territorial boundaries, but usually only against members of the same sex (Slobodchikoff et al., 2009). Colonies are comprised of multiple coteries or clans (Hoogland, 1995).

2.3. Burrow System

Burrows provide protection from predators, a place to raise young, a place to hibernate for some species, and a more stable climate than the outside world. They can be single tunnels or complex tunnel systems with multiple exits and entrances. Tunnels can reach a depth of two to five meters and can be five to 35 meters long (Slobodchikoff et al., 2009). Prairie dog burrows also provide refuge and shelter to numerous associated species.

2.4. Breeding, Birthing, and Mortality

Prairie dogs are unlike typical rodent species in that they have much slower population growth rates (Hoogland, 2001; Pizzimenti & McClenaghan, 1974). Sexually mature female prairie dogs are receptive to mating for less than one day per year. If breeding is successful, the average litter size is

three to four pups, and about half of the litter will survive to adulthood (Slobodchikoff et al., 2009; Hoogland, 2001).

For black-tailed prairie dogs, breeding times vary throughout their geographic range. Black-tailed prairie dogs usually breed in January in Oklahoma, late February in Colorado, late February through March in South Dakota, and late March through early April in Montana (Hoogland, 1995). Black-tailed prairie dogs have high mortality rates before reaching adulthood. Mortality in the first 12 months averages 53 percent for males and 46 percent for females. Males that survive their first year typically live two to three years and females may live four to five years (Hoogland, 2006a). The life span of a Gunnison's prairie dog is generally three to five years (USFWS, 2013a) and the life span of a white-tailed prairie dog is four years or less (USFWS, 2010).

The three main natural causes of mortality are predation, infanticide, and the inability to survive the winter. Predation on prairie dogs is common and predators include black-footed ferrets, badgers, bobcats, coyotes, long-tailed weasels, swift foxes, red foxes, golden eagles, goshawks, prairie falcons, and others (*see* Section 3.3). Inability to survive the winter is generally caused by a prairie dog's failure to store enough fat during summer and early fall (Hoogland, 2006a). Infanticide occurs in some prairie dog species. Most infanticidal prairie dogs are lactating females, and most victims are the offspring of close kin (Hoogland, 1995). Males that invade a territory with juveniles may also commit infanticide (Hoogland, 2006a). In some species, infanticide is theorized to be a response to competition or overcrowding, but Hoogland's documentation of infanticides occurred at a colony that did not have an unusually high density (Hoogland, 2006a). The cause of infanticide in prairie dogs is uncertain.

2.5. Density

As a prey species, prairie dogs live in groups for protection. Prairie dog densities can vary depending on space, time, and both natural and unnatural factors (Hoogland, 2006a). Black-tailed prairie dog densities typically range from 2 to 18 individuals per acre in early spring, before the emergence of young-of-the year (USFWS, 2009). Hoogland (2006b) estimates densities of black-tailed prairie dogs to be roughly 10 adults and yearlings per acre, with the number approximately doubling with the addition of juveniles once they emerge in the spring. Densities of Gunnison's prairie dogs range from 2 to 23 per acre (Hoogland, 1995; USFWS, 2013a). Densities of white-tailed prairie dogs are more difficult to determine as they can fluctuate more than 50 percent per year (USFWS, 2010). However, their burrow densities can range from 0.3 to 118 per acre with a mean of 0.8 to 16.8 per acre, with home range sizes from 0.5 to 4.7 acres (USFWS, 2010).

2.6. Dispersal

Dispersal is defined as permanent movement of an individual animal from one area to another. This behavior is different from migration, during which entire populations move. Prairie dogs do not migrate, but they do disperse (Hoogland, 1995). Studies in plague-free areas noted that colonies can remain in the same place for decades if not centuries (Augustine et al., 2008) with little variation in burrow density (Hoogland, 1995). Dispersal largely occurs between different coteries within the natal (birth) colony; prairie dogs more rarely disperse to a different colony because predation risk during dispersal is very high. Most males remain in their natal coterie for only one year, after which

Table 1. Taxonomy and comparison of the five prairie dog species (*adapted from* Hoogland, 2006b & S. Forrest, pers. comm., 2016 (elevation ranges); Manno, 2014; Hoogland 1995; & Slobodchikoff et al., 2009)

Species	**Scientific name**	**Subgroup**	**Range**	**Hibernation**	**Mating season**	**Colony structure**	**Elevation (feet above sea level)**	**Decline since the 1900s**
Black-tailed prairie dog	*Cynomys ludovicianus*	Black-tailed	AZ, CO, KS, MT, NE, NM, ND, OK, SD, TX, WY, northern Mexico, and southern Canada	No	January to April, depending on latitude	Most social; usually socially polygynous. Rarely changing common territories defended by related females over generations.	2,300-6,000	99%
Gunnison's prairie dog	*Cynomys gunnisoni*	White-tailed	AZ, CO, NM, UT	Yes	Mid-March to early April	Less social; flexible social system depending on availability of food resources. Common territories defended by related females over generations; territorial boundaries that fluctuate with time.	4,900-9,800	95%
Mexican prairie dog	*Cynomys mexicanus*	Black-tailed	Coahuila and San Luis Potosí, Mexico	No	Late January to March	Most social; probably similar to black-tailed.	2,300-7,200	98%
Utah prairie dog	*Cynomys parvidens*	White-tailed	UT	Yes	Mid-March to early April	Less social; flexible social system. Common territories defended by related females over generations; territorial boundaries that fluctuate with time.	4,900-9,800	87%
White-tailed prairie dog	*Cynomys leucurus*	White-tailed	CO, UT, southern MT, WY	Yes	Mid-March to early April	Least social; flexible social system. Common territories defended by related females over generations; territorial boundaries that fluctuate with time.	4,900-9,800	92-98%

Figure 1. Ranges of the five prairie dog species. Source: Rocky Mountain Wild.

they disperse. Breeding males can remain in their breeding territory for one or two years before moving to new territory. Male dispersal prevents inbreeding, either with mothers, aunts, or sisters in the natal territory or with daughters; and extreme incest in prairie dog populations is rare (Hoogland, 2006a). Most females remain within their natal coterie for life.

Dispersal between colonies (intercolonial dispersal) most likely occurs along low-lying dry creek drainages connecting isolated colonies when it occurs (Roach et al., 2001). Black-tailed prairie dogs have been recorded travelling 3.7 miles between colonies, but the average distance for dispersal (at least for prairie dogs starting new colonies) appears to be 1.7 miles. Most dispersing prairie dogs move into an established colony or recolonize an abandoned site rather than trying to start a colony in a new location (Hoogland, 2006a; Roach et al., 2001).

Little is known about dispersal behavior in Gunnison's and white-tailed prairie dogs. Dispersal likely occurs in fall prior to hibernation and in spring prior to the mating season. Recorded dispersal distances for white-tailed and Gunnison's prairie dogs have been as little as 55 yards or as much as 4.8 miles (Seglund & Schnurr, 2010).

Dispersal links prairie dog complexes. A complex is a group of two or more prairie dog colonies in which each colony is less than 7 kilometers (4 miles) from another colony, so that individuals can disperse between colonies (Hoogland, 2006b). In this system, colonies can be depopulated but later be recolonized by dispersing animals (Magle & Crooks, 2009). Dispersal also creates gene flow between colonies, contributing to genetic diversity (Roach et al., 2001). Potential dispersal corridors, such as drainages, should be maintained to ensure recolonization of unoccupied colonies and continued dispersal between colonies.

Dispersal also links prairie dog metapopulations. A metapopulation is defined as a population of populations: a group of several interacting local subpopulations linked together by arrivals and departures of dispersing animals (Slobodchikoff et al., 2009). In a metapopulation, gene flow within subpopulations is greater than gene flow between subpopulations.

2.7. Communication

Communication is one of the prairie dog's most important survival tactics. By living in large social groups and sharing the responsibility of keeping a lookout for predators, prairie dogs ensure that each individual has more time to forage and defend territory (Slobodchikoff et al., 2009). Biologist Dr. Con Slobodchikoff has identified over 100 alarm calls used by Gunnison's prairie dogs that differentiate between animals such as hawks, badgers, coyotes, and humans. They incorporate information including size, color, and rate of travel. The prairie dog communication system is remarkably similar to human language in many ways; prairie dogs can communicate meaningful information to each other, describe novel objects, and even have regional and local dialects (Slobodchikoff et al., 2009).

3. Prairie Dog Roles in the Ecosystem

Burrowing mammals, including prairie dogs, have important roles in grasslands. Prairie dogs are considered by most biologists to be a "keystone species" and/or "ecosystem engineer" (*see* Ceballos et al., 1999; Kotliar et al., 1999; Kotliar et al., 2006). Keystone species play a critical function in

determining the structure of natural communities, and their removal causes substantial changes in species composition and other characteristics of the ecosystem. A keystone species is defined as a species that has unique and significant effects on its ecosystem that are disproportionately large relative to the species' abundance (Kotliar et al., 2006). Ecosystem engineers modify the availability of resources to other species by physically altering environments. Ecosystem engineers can be considered keystone species because of their engineering abilities and relative rareness, but a species may also be considered a keystone for other reasons, such as its role in the food chain (Jones et al., 1994). Prairie dogs contribute to shaping grassland ecosystems in three main ways: burrowing, grazing, and providing food or habitat for associated species (Kotliar et al., 2006).

3.1. Burrowing

Through burrowing, prairie dogs turn the soil, redistributing nutrients and minerals (Kotliar et al., 2006) and allowing water to penetrate the ground, leading to faster groundwater recharge (Martínez-Estévez et al., 2013). Burrows also provide important habitat for associated species (see Section 3.3).

3.2. Grazing

All prairie dog species are herbivores; when available, grasses make up a major component of their diet along with forbs and shrubs. They also eat seeds (Slobodchikoff et al., 2009). Over time, prairie dogs may significantly change vegetation composition within their colonies via grazing and clipping (Lehmer et al., 2010). Black-tailed and Mexican prairie dogs prefer short vegetation (less than 12 inches tall) to increase visibility so they can scan for predators (Hoogland, 2006b). Through foraging and clipping of vegetation, they create unique islands of grassland habitat, maintaining a low, dense turf of forbs and grazing-tolerant grasses (Martínez-Estévez et al., 2013; *see* Figure 3). Vegetation in colonies of white-tailed, Gunnison's, and Utah prairie dogs is usually more than 20 inches tall (Hoogland, 2006b), and those species do not actively clip vegetation, so the boundaries of their colonies are more obscured (Slobodchikoff et al., 2009).

Prairie dog grazing and burrowing may cause plant composition and heterogeneity to change over time. Studies on the effects of vegetation consumption by black-tailed prairie dogs on mixed-grass prairie in South Dakota indicated that within two years of prairie dog colonization, mixed-grasses were reduced by 50 percent. As grass cover decreased, forbs (flowering plant species) increased until they were almost equal to the previous cover of grasses. A similar pattern was observed on other colonies (Detling, 2006). There are distinct zones on prairie dog-occupied sites where the core of a colony that has been occupied the longest is predominately comprised of forbs, annuals, and shrubs. In transition zones or newly colonized areas, plant composition is a mixture of perennial grasses and forbs (Slobodchikoff et al., 2009). Vegetative changes from predominantly grasses to forbs and dwarf shrubs increases plant diversity. This provides favorable habitat patches for other animals such as bees, birds, and insects, thus increasing diversity of other wildlife species (Detling & Whicker, 1987). In well-established shortgrass prairie, buffalograss and blue grama are resilient to prairie dog grazing.

Some plants (black nightshade, fetid marigold, pigweed, and scarlet globemallow) are more common on prairie dog towns (Kotliar et al., 2006; Magle & Crooks, 2008). Prairie dogs control the spread of mesquite and other woody plants and prevent desertification (Weltzin et al., 1997; Ponce-Guevara et al., 2016). In a study comparing prairie dog towns to grasslands without prairie dogs and grasslands

that had transitioned to mesquite scrub, the plant cover in prairie dog towns was better able to prevent soil erosion than mesquite scrub, and equal to grasslands without prairie dogs (Martínez-Estévez et al., 2013). In an arid environment in Mexico, standing biomass (grass and forb forage) was greatest in grasslands with prairie dogs. Prairie dog towns also stored the most soil carbon (Martínez-Estévez et al., 2013).

By keeping vegetation short within colonies, black-tailed prairie dogs may suppress undesirable weedy species. Plants considered weeds that are consumed or clipped by prairie dogs include black nightshade, death camas, foxtail, horsetail, knotweed, plantain, three-awn, and spurge (Hoogland, 1995). Russian thistle, brome, prickly lettuce, goosefoot, and kochia have also been either consumed or clipped by prairie dogs (Clippinger, 1989; Hoogland, 1995). Short vegetation in prairie dog towns may serve as firebreaks (Kotliar et al., 1999).

Today, many vegetative communities occupied by prairie dogs have been significantly altered by past agricultural practices that removed native grasses and flowering plants. Many native plants have been replaced by Eurasian invasives. Existing grassland habitats that contain prairie dogs and have not been significantly altered by agriculture provide an opportunity to understand which native plants flourished on prairie dog-occupied sites pre-European settlement. Some of these plant communities include: aster, geranium, flax, mallow, penstemon, yarrow, primrose, rose, milkweeds, lupine, sage, verbenas, succulents, dwarf shrubs, and shortgrasses (blue grama and buffalograss) (Figure 2).

Bare ground and large patchy areas also occur on prairie dog towns. While this landscape may not be aesthetically pleasing to some people, it is part of a natural ecosystem and contains important habitat patches for birds such as the horned lark and the mountain plover (Augustine and Baker, 2013).

Research into native plants that resist or are resilient to prairie dog grazing has gained attention as a potential strategy to combat invasive nonnative plants and to control erosion from blowing soil. Vickery (2015) presents a list of native plants and plant features that are resilient to prairie dogs grazing and clipping: these plants have a disagreeable taste (milkweeds, snakeweed); strong odor (fetid marigold, cleomes, sage, rabbitbrush, pennyroyal); are prickly (rosa species, prickly poppy, purple three-awn); have an abundance of hairs (blazing star, golden rod, aster, vervain); are prostrate or have a low profile (bracted vervain, salt and pepper, wild parsley, woolly plantain, buffalo grass); or are sticky or gummy (gumweed, bee plant).

Native plants are valuable commodities and some communities have begun to expand local seed banks to address limited commercial seed availability. Seeds of desirable native plants can be harvested and preserved for reintroduction into prairie dog-occupied sites.

3.3. Associated Animal Species

Many species are either dependent on prairie dogs or strongly associated with prairie dog colonies (Kotliar et al., 2006; Figure 3). The following are just a few of the species that meet four criteria for dependence on prairie dogs: they are more abundant on prairie dog colonies than elsewhere; they use features that are specific to colonies (such as burrows); their populations increase or decrease along with fluctuations in prairie dog populations; and their chances of survival or reproduction are higher on colonies than elsewhere (Kotliar et al., 2006, Augustine & Baker, 2013). These species

either depend on prairie dogs for food or prefer to use the habitats that prairie dogs create and maintain.

3.3.1. Mountain plovers

Mountain plovers are small birds that frequently nest on prairie dog colonies because they prefer open, level ground with short vegetation. Mountain plover numbers have declined alongside prairie dog numbers in recent decades (Kotliar et al., 2006). Multiple factors are involved in the decline of mountain plovers; loss of nesting habitat on black-tailed prairie dog towns is a significant one.

3.3.2. Western burrowing owls

Unlike most other owls, burrowing owls nest in underground burrows and are active during the day. Western burrowing owl migratory range stretches from Canada to Mexico and from the West Coast of the United States to the central Great Plains. They depend on colonial burrowing rodents like prairie dogs and their nests are most often found in black-tailed prairie dog towns. Successful nesting is more likely when there are more active burrows around the nest site. The owls move their young to a new burrow at 10 to 14 days, presumably to avoid predation or nest parasites. Black-tailed prairie dog colonies are one of the few habitats with enough burrows to provide these "satellite" nests (Klute et al., 2003). Burrowing owls are hunted by some of the same predators that hunt prairie dogs, and the owls "eavesdrop" on prairie dog alarm calls, increasing their vigilance in response to prairie dog predator warnings (Bryan & Wunder, 2014).

Though burrowing owls occupy the majority of their historical range and may be stable or increasing in some areas, in other areas their populations have shrunk and fragmented as both grasslands and prairie dogs declined. The owls are facing significant population declines in the northern, western, and eastern edges of their range (Klute et al., 2003). Along with impacts on wintering grounds, a primary cause is the loss of burrowing rodents. Burrowing owls favor active prairie dog colonies for nesting sites, and have moderate to high site fidelity, returning to the same prairie dog colonies or nesting burrows year after year (Butts & Lewis, 1982; Klute et al., 2003). Without maintenance engineers like prairie dogs, burrow habitat becomes unusable for the owls in one to three years (Klute et al., 2003). Maintenance of large, active prairie dog colonies is therefore important to burrowing owl reproductive success.

3.3.3. Raptors

Raptors that prey on prairie dogs include ferruginous hawks, golden eagles, bald eagles, red-tailed hawks, Swainson's hawks, rough-legged hawks, northern harriers, and goshawks (Slobodchikoff et al., 2009). Raptors dependent on prairie dogs according to Kotliar et al.'s (2006) definition are American kestrels (which feed on smaller prey such as insects that are more abundant or easier to hunt on prairie dog colonies), ferruginous hawks, and golden eagles. Prairie dogs appear to be particularly important to ferruginous hawks, which depend on them as a food source in the winter (Gietzen et al., 1996). Raptors appear to use urban prairie dog colonies as much as, if not more than, rural colonies; for most raptors, the number of prairie dogs appears to influence their use of colonies more than the degree of urbanization (Weber, 2004).

Figure 2. Vegetation on prairie dog colonies

Prairie dog colony damaged by introduced Eurasian weeds including curly dock and bindweed.

Healthy vegetation on a prairie dog colony.

Examples of native plants resistant or resilient to prairie dog grazing.

Cowpen daisy
Verbesina encelioides

Geranium sp.

Plains milkweed
Asclepias pumila

Wooly plantain
Plantago patagonica

Prickly poppy
Argemone polyanthemos

Cutleaf evening primrose
Oenothera coronopifolia

Prairie sagewort
Artemisia frigida

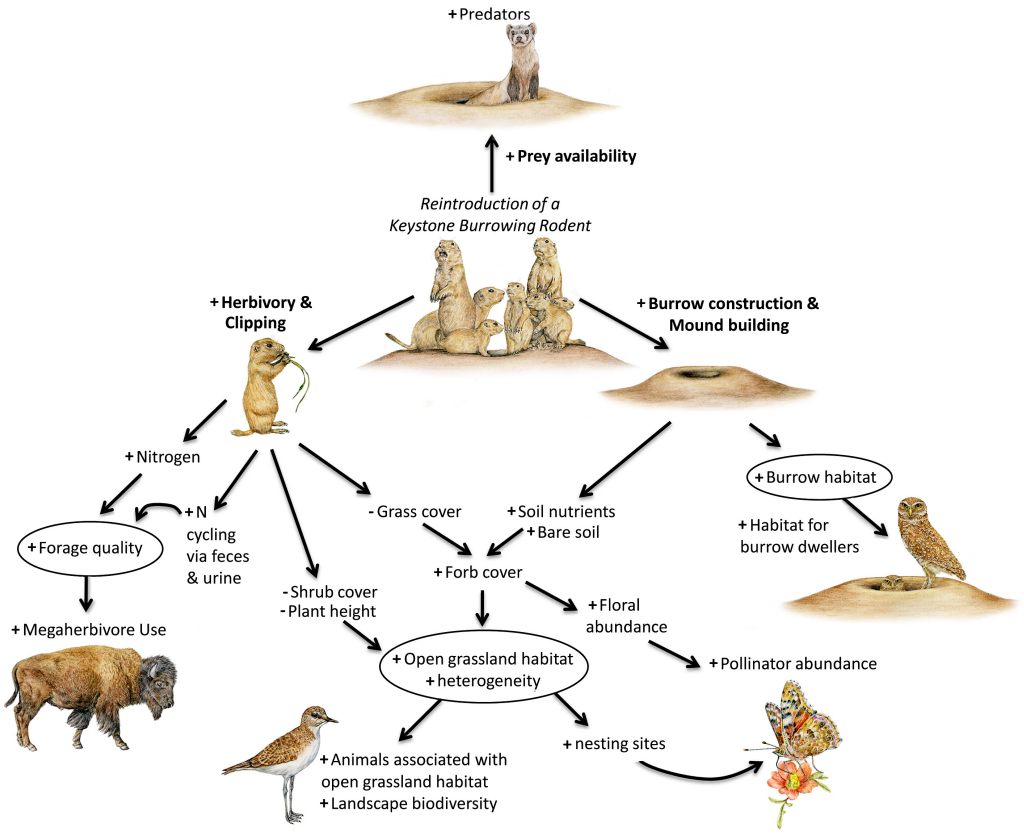
Scarlet globemallow
Sphaeralcea coccinea

Snow on the mountain
Euphorbia marginata

Wood's rose
Rosa woodsii

Healthy vegetation photo: Sandy Nervig. All other photos: Pam Wanek

Figure 3. Diagram showing the food chain (herbivory, predation) and ecosystem engineering (vegetation clipping, burrowing) effects of prairie dogs on grassland ecosystems. Plus signs indicate an increase; minus signs indicate a decrease. Source: A. Davidson.



3.3.4. Bison

Bison and prairie dogs appear to benefit from each other's presence. Grazing and removal of tall vegetation by bison at the edges of colonies improves prairie dog foraging opportunities, and in turn, bison preferentially forage on prairie dog towns (Krueger, 1986; Chipault & Detling, 2013). Grazing by prairie dogs removes aging plant matter and stimulates the growth of new plant tissue that generally has higher concentrations of nitrogen and greater digestibility than ungrazed plants (Detling & Whicker, 1987; Slobodchikoff et al., 2009). The consistent clipping of forage creates a shorter, yet more nutrient-rich blade of grass, which attracts large herbivores like bison (Detling & Whicker, 1987; Chipault & Detling, 2013; Ponce-Guevara et al., 2016).

3.3.5. Black-footed ferrets

Black-footed ferrets are one of the rarest mammals in North America and are listed as "endangered" under the Endangered Species Act. They specialize in hunting prairie dogs, which comprise over 90 percent of their diet (Miller et al., 1996). As prairie dogs declined, black-footed ferrets were nearly lost to extinction, but the last known wild population persisted in the vicinity of Meeteetse, Wyoming until early 1987. Some of those Meeteetse ferrets were captured and used to start a captive breeding program. Captive-born ferrets were reintroduced to Shirley Basin, WY, in the early 1990s,

and since then captive-bred ferrets have been reintroduced to numerous other sites in a variety of states (Luce, 2006a). All ferrets in the wild are reintroduced and thus are managed as "experimental, non-essential" populations under a 10(j) rule, which is less protective than a full "endangered" or "threatened" listing. Private landowners who allow release of ferrets onto their property under the 10(j) rule are shielded from prosecution under the "take" prohibitions of the ESA if they inadvertently kill, harm, or disturb a ferret during otherwise legal activities.

All wild ferret populations remain small, fragmented, and intensively managed. Only a few of the wild populations contain adults that were born in the wild. The U.S. Fish and Wildlife Service has been clear that the fate of black-footed ferrets and prairie dogs is linked. That agency stated in the Black-footed Ferret Recovery Plan that "…the single, most feasible action that would benefit black-footed ferret recovery is to improve prairie dog conservation" (USFWS, 2013b).

3.3.6. Other mammals

Other mammals that depend on or benefit from prairie dog colonies for food and habitat include swift foxes, American badgers, black-tailed jackrabbits, coyotes, deer mice, eastern cottontails, northern grasshopper mice, striped skunks, and thirteen-lined ground squirrels (Kotliar et al., 2006).

3.3.7. Herptiles

Some amphibians (Great Plains toad, plains spadefoot toad, tiger salamander, and Woodhouse's toad) depend on prairie dog colonies for habitat and breed more successfully on colonies than elsewhere; the same is true for a number of reptiles (Texas horned lizard, ornate box turtle, prairie rattlesnake, Western Plains garter snake) (Kotliar et al., 2006; Shipley & Reading, 2006). Many of these species use prairie dog burrows as hibernacula.

3.4. Ecosystem Services

"Ecosystem services" are all of the ways ecosystems and their component species sustain human life. They include the atmosphere that makes our planet habitable, the air we breathe, the water we drink, the food we eat, the materials we use, and the aesthetic experiences that inspire us and inform our cultures (Millennium Ecosystem Assessment, 2005).

Prairie dogs provide the following ecosystem services and probably others not yet discovered:

- Increased groundwater recharge and water penetration (Martínez-Estévez et al., 2013; Outwater, 1996; Detling, 1998)
- Soil aeration (Kotliar et al., 2006)
- Carbon sequestration (Martínez-Estévez et al., 2013)
- Nutrient cycling via burrowing and defecation (Kotliar et al., 2006)
- Increased nitrogen content of soil and plants (Holland & Detling, 1990; Detling, 1998)
- Creation of a diverse mosaic of grassland habitats (Detling & Whicker, 1987; Slobodchikoff et al., 2009; Detling, 2006)
- Prevention of desertification via mesquite and woody plant control (Weltzin et al., 1997; Ponce-Guevara et al., 2016)

- Fire breaks (Kotliar et al., 2006)
- Habitat creation and food provision for dependent and associated species (Kotliar et al., 2006)
- Preservation of the black-footed ferret, a species listed as "endangered" under the Endangered Species Act (USFWS, 2013b)
- Wildlife-viewing opportunities for diverse species including prairie dogs themselves, mammalian carnivores, and raptors (Kotliar et al., 2006; Slobodchikoff et al., 2009)

3.5. Urban Colonies

While the keystone and ecosystem engineer roles of prairie dogs are well documented in large rural colonies, the role of smaller colonies in urban and developed landscapes is less clear. Research on 54 fragmented urban colonies throughout the Denver metropolitan area suggests that urban prairie dogs may still play keystone and ecosystem engineering roles (Magle & Crooks, 2008). However, more studies will need to be conducted to confirm this theory. Prairie dog effects on vegetation on sampled urban colonies was similar to sampled rural colonies, where prairie dogs removed grasses, reduced plant litter, and increased bare ground and forbs (flowering plants). This provides some evidence that they maintain their ecological role even in urbanized, fragmented landscapes (Magle & Crooks, 2008). Human conflicts with coyotes were lower close to habitat patches occupied by prairie dogs, potentially because coyotes prefer colonies as foraging habitat over backyards or neighborhoods (Magle et al., 2014). If future studies confirm that prairie dogs function as a keystone species in urban systems, their conservation will be an important step in maintaining functional grassland systems in urban environments (Magle & Crooks, 2008).

Prairie dogs in urban communities are important for multiple reasons:

- They provide a prey base for local or migrating raptors and local carnivores (Weber, 2004; *but see* Magle et al., 2012, which detected no difference in avian diversity and richness in urban habitat fragments with or without prairie dogs).
- They are more likely to be sequestered from plague (Lomilino et al., 2003, Magle & Crooks, 2009), thereby potentially providing a source population for augmentation of wild colonies or repopulation of extinct colonies.
- They can provide a connection to prairie ecosystems for urban humans.
- They contribute to statewide and region-wide persistence of prairie dog species.
- Their colonies could function as an urban grasslands system (Magle & Crooks, 2008).

4. Population Declines

Prairie dogs have declined considerably since the early 1900s, with most species occupying five percent or less of their historic range (Table 1). Reasons for this decline are summarized below.

4.1. Poisoning

The main cause of historic prairie dog declines was intensive poisoning campaigns carried out by the federal government starting in 1905, with the aim of eliminating species believed to be "economically injurious," including prairie dogs. Between 1915 and 1965, at least 30 million acres of

black-tailed prairie dogs were poisoned, and only after prairie dogs shrank to less than five percent of their previous range did poisoning begin to taper off in the 1960s (Forrest & Luchsinger, 2006).

Control activities continue today. Animal Plant Health Inspection Services (APHIS) (of the U.S. Department of Agriculture) and Environmental Protection Agency (EPA) records indicate that an average of 200,000 acres of prairie dogs are poisoned in the United States each year under the permitting authority of those agencies (Luce, 2006b). Vyas et al.'s (2013) research suggests anti-coagulant use results in wildlife mortalities in addition to prairie dogs, and that recorded unintended mortalities may represent only the tip of the iceberg. In most states, poisoning on private property does not require a permit and is not tracked.

4.2. Sylvatic Plague

Sylvatic plague (*Yersinia pestis*) is an exotic disease and a serious threat to prairie dogs because they have little to no immunity once infected. An outbreak can rapidly cause 85 to 99 percent mortality in a colony, or even wipe the colony out completely. The disease was inadvertently introduced to North America in the early 1900s and has spread throughout the western states. The bacterium is known to infect more than 200 species of mammals worldwide (Biggins & Kosoy, 2001a) and over 70 North American species (Cully et al., 2006). Susceptibility to plague varies among species; some species, such as prairie dogs, are highly susceptible and experience high levels of mortality, while others, such as mice, domestic dogs, coyotes, and foxes, are more resistant and less susceptible to plague (Biggins & Kosoy, 2001b). Resistant species may play a role as reservoirs, meaning they maintain the disease in the environment. Plague was first documented in black-tailed prairie dogs in 1946-7 in Texas. The disease has since infected most areas within the range of prairie dogs (Luce, 2006b).

The Pawnee National Grasslands reviewed data from 25 years of monitoring to estimate the frequency of plague epizootics (outbreaks) in prairie dog colonies (Hartley et al., 2009). Approximately 98 percent of colonies experienced plague epizootics within 15 years of continuous colony activity. Nearly half of infected colonies remained inactive for at least five years following plague outbreaks, and less than half attained their pre-plague area within 10 years. Mean length of continuous occupation before an epizootic was 6.6 years. Because of plague, colonies more than 20 years old have become rare on the Pawnee. Plague will likely continue to influence prairie dogs and their ecosystems; there is little evidence that prairie dogs are evolving significant resistance to the disease (Antolin et al., 2006).

The Centers for Disease Control Procedure for Visual Evaluation of Prairie Dog Colonies for Plague in the Southwestern United States (*cited in* Luce, 2003), provides the following guidelines for evaluating colonies for the presence of plague and when to take samples from a colony for testing:

> **A. HEALTHY COLONY**
> OBSERVATION: The vast majority of burrows show signs of recent use, unless it has rained within the past 24 hours – in which case the colony should be reexamined following a period of at least 24 hours without precipitation. Active prairie dogs are observed during periods of acceptable weather conditions. Only a relatively few (<10%) burrow openings appear inactive (lack of disturbed dirt, presence of cobwebs or wind-blown vegetation over

the entrance). An occasional carcass or dried bones may be present as a result of non-plague death or predation.

EVALUATION: Unless recently (days) introduced, plague is not likely to be present. Fleas are not likely to test positive.

SAMPLE RECOMMENDATIONS: No samples recommended.

B. DEAD COLONY

OBSERVATION: The colony appears completely inactive. Burrows show no signs of recent use (re-examine if it has rained within 24 hours). An occasional desiccated carcass and bones may be present, and have likely been scavenged.

EVALUATION: 1) Make inquiries to determine if the colony was poisoned. This is especially likely if it appears that dirt was shoveled into the burrows. If there is no evidence of poisoning and the food supply appears ample: 2) it is likely that plague or some other zoonotic disease killed the colony. An experienced observer can usually make an estimate (recently, 1 season, or 2 seasons) on how long the colony has been inactive by considering the soil type and degree of burrow degeneration.

SAMPLE RECOMMENDATIONS: Sample only if there is no evidence of poisoning. A recent (same season) die-off might produce many fleas through burrow swabbing. Older die-offs will likely produce few or no fleas. Typically, many burrows (dozens or even hundreds) may be swabbed with only a few producing flees. If burrowing owls are using the inactive burrows, small black stick-tight fleas may be present in large numbers (in contrast to the larger, reddish-brown prairie dog fleas). Fresh or desiccated prairie dog carcasses may also be collected for analysis.

C. SCATTER PATTERN:

OBSERVATION: Inactive burrows constitute an unusually high (typically 20-90%) percentage of the total burrows. Active burrows however are clearly evident and active prairie dogs are observed during periods of acceptable weather. Active and inactive burrows are scattered amongst each other in no particular pattern (see below), keeping in mind that family units may have multiple burrow openings and hence an inactive unit may produce a small cluster of 2-5 inactive burrow openings. An occasional carcass (fresh or desiccated) and bones may be present.

EVALUATION: Several scenarios could account for these observations – and more than one scenario may be in play at the same place and time. Presented in order of likelihood: 1) Make inquiries to determine if the colony was poisoned. This is especially likely if it appears that dirt was shoveled into the burrows. This scatter pattern could be produced if the application of poison was scattered and not comprehensive, 2) If there is no evidence of poisoning, assess the available food supply. Such a pattern of death could also be attributable to a population crash as a result of lost carrying capacity of the site or over-population, 3) If there is no evidence of poisoning or population crash, hunting by humans or excessive predation by carnivores or birds of prey are highly likely. Human hunting usually produces physical evidence such as footprints, tire tracks and spent ammunition shells. Depending upon the local culture, human hunters may collect their prey (many Native American groups

regard prairie dogs as a delicacy) or leave it for scavengers. Experienced observers can often spot carnivore tracks and recognize hunting and attack patterns in these tracks near burrow entrances, 4) Finally, a zoonotic disease could be responsible, but given this mortality pattern, a disease with a lower mortality rate than plague is more likely.

SAMPLE RECOMMENDATIONS: If there is no evidence of poisoning, population crash, or excessive human hunting: collect fleas by swabbing burrows – especially inactive burrows – and collect fresh or desiccated prairie dog carcasses if available.

D. DEAD ZONE

OBSERVATION: Within an otherwise healthy appearing colony, there is a zone of inactive burrows. This zone may encompass a relatively small or large proportion of the colony, and may be located anywhere in the colony. Eventually it spreads to encompass a section of the colony and appears to be spreading, along a discernable line of demarcation over the remaining section of the colony. Experienced observers can often clearly distinguish and mark (flagging tape) this demarcation line between active and inactive regions. Marking allows for periodic re-examination to assess the rate of spread and facilitates sampling. Fresh or desiccated carcasses may be present. Near the demarcation line, recently inactive burrows may reveal the odor of decaying carcasses and flies may be common at burrow entrances.

EVALUATION: 1) There is a high probability that plague is active in such a colony. Although other zoonotic diseases are possible, plague is most likely, 2) Depending upon the location of the dead zone with respect to other human activity (homes, barns, etc.) poisoning is also a possibility and should be investigated.

SAMPLE RECOMMENDATIONS: Collect fleas by swabbing burrows immediately along both sides of the demarcation line, concentrating a majority of your efforts immediately along (within 10meters) the inactive (dead) side of the line. Fleas are likely to be numerous. You may wish to apply extra insect repellent but be extremely cautious not to directly or indirectly get repellent on your burrow swab! (If this happens: discard it, wash your hands, and start with a new one). If others in a group are getting fleas and you are not, and you are swabbing essentially the same area, you likely have repellent on your swab. Collect any available rodent carcasses (fresh or desiccated, prairie dog or other rodent) for testing. Additional Notes: Please include GPS coordinates for all samples. One set of coordinates per colony is acceptable. Specify the type of inactivity pattern noted for each sampled colony: dead colony, scatter pattern, dead zone. Analysis of samples from "dead zone colonies" will receive laboratory priority.

The above activity patterns are typical for the warm months. Visual examination during winter months is more difficult due to decreased daily activity among even healthy animals.

One of the few ways to minimize plague is killing the fleas that host the plague bacterium. One commonly used product is deltamethrin (Delta Dust, Bayer Corporation), a powdered insecticide applied inside prairie dog burrows. Delta Dust is in the chemical class of pyrethroids, synthetic chemicals modeled after natural insecticides found in chrysanthemum flowers. Some communities have expressed concern about Delta Dust's impact on non-target arthropods, other non-target species such as birds, and potential pet or human exposure. Recent research indicates that Delta Dust effectively reduces flea populations "with minimal and non-lasting negative effects on

arthropod populations" (Dombro, 2016). Delta Dust is low in toxicity when it is touched or breathed in and is low to moderately toxic if eaten. The EPA classifies Delta Dust as "not likely to be a human carcinogen" by all routes of exposure (NPIC, 2010). There may be negative impacts to arthropod and arthropod-dependent species from dusting, but currently dusting is the only tool publicly available to protect prairie dogs from plague.

Another approach to plague management is the use of sylvatic plague vaccine (SPV). While still in the testing stage, SPV has shown promising results for protecting prairie dogs against plague for up to nine months and is delivered to prairie dogs by way of oral bait (USGS, 2012). Potentially, a single drone could deliver bait to more than 60 acres per hour (USFWS, 2016). Additional plague management strategies are under evaluation and generally speaking, the defensive toolbox against sylvatic plague is growing, although continued efforts to provide sylvatic plague abatement measures will be essential to ensuring the persistence of prairie dogs on the landscape as the eradication of the plague-causing bacteria does not seem likely at the present time.

4.3. Habitat Conversion

Conversion to cropland, and to a lesser extent urban development, has reduced grasslands by 33 to 37 percent across the prairie dog's range. As a result of habitat conversion, prairie dogs live mainly in isolated, relatively small islands of habitat that are vulnerable to extirpation from genetic inbreeding, sylvatic plague, human development of the landscape, and chance events. Larger distances between colonies and barriers due to habitat alteration limit dispersal and interchange between colonies that would normally offset colony losses (Luce, 2006b).

4.4. Shooting

Given the drastic decline in prairie dog populations and total area, lethal control by shooting (for land management and/or recreation) can compound an already bleak situation. For example, in 2000 in South Dakota, recreational shooters killed 1.2 million prairie dogs (Reeve & Vosburgh, 2006). Shooting may depress colony productivity and health, fragment populations, and kill nontarget species. Recreational shooting can significantly impact colonies in areas where shooting is intense or persistent over an entire year (Vosburgh & Irby, 1998). Shooting can result in reduced fitness by increasing time spent on alertness and decreasing time spent foraging. The summer following shooting, reproductive output on a study colony decreased by 82 percent (Pauli & Buskirk, 2007). Emigration can result from shooting on prairie dog colonies. Sixty-nine percent of black-tailed prairie dogs left their colony after hunters shot only 22 percent of the population (Keffer et al., 2000).

5. Clearing Up Misconceptions About Prairie Dogs

Prairie dogs are vilified in some cases due to concerns about their impacts on vegetation or livestock, or fears of disease. Recent science shows that many of the fears regarding prairie dogs are unfounded and that eradication campaigns are rarely cost-effective or necessary.

5.1. Prairie dogs rarely spread plague or other diseases

Plague in humans is generally rare. According to the Center for Disease Control and Prevention, the roughly 300 million people in the United States experience just five to 15 cases of the plague each year. Of these, only one in seven is fatal and very few are associated with prairie dogs; most recorded cases were associated with other animals such as rock squirrels or domestic cats (Gage et al., 1992; Abbott & Rocke, 2012). Plague in humans can be treated with antibiotics. Since plague is found in at least 70 other wildlife species in North America, eliminating prairie dogs will not remove the disease from the ecosystem (Cully et al., 2006).

It is not easy for prairie dogs to transmit plague to people. Plague is transmitted through the bites of infected fleas, and prairie dog fleas are very host-specific and therefore generally avoid humans and other animals (Cully et al., 2006). People should not handle dead prairie dogs or other wild animals. Additional safety precautions include wearing long pants and applying insect repellent when on prairie dog towns, and keeping companion animals off prairie dog towns to avoid disturbing the prairie dogs and to eliminate the small risk of fleabites. If dead prairie dogs or other dead rodents are discovered or plague is suspected, the local wildlife agency and/or health department should be notified.

Other diseases such as rabies, tularemia, or monkeypox are either rare or non-existent in wild prairie dog populations. Rabies has never been documented in prairie dogs. In 2002, wild-caught, commercially traded prairie dogs (sold as pets) began to die from tularemia, raising concerns that they could transmit the disease to humans. Fortunately, only one exposed person tested positive for the disease (Avashia et al., 2004). Tularemia is typically found in rabbits and is usually contracted through physical contact with infected animals, bites from infected ticks or deer flies, or contact with contaminated soil. Like plague, it can be treated in humans with antibiotics. No human cases of tularemia have arisen from contact with prairie dogs (Long et al., 2006). Another atypical incident involved transmission of monkeypox from pet prairie dogs to humans, resulting in 37 human cases of the disease. Monkeypox was transmitted from exotic African rodents to prairie dogs sold in the same pet store (Guarner et al., 2004). Monkeypox has never been present in wild prairie dog populations. It should be mentioned that keeping wildlife as pets is generally not legal, and for multiple reasons, captive wildlife rarely make good pets.

5.2. Prairie dogs can co-exist with livestock

Prairie dogs, cattle, and other livestock can co-exist on grasslands in the majority of well-managed parcels. One of the strongest historical pieces of evidence for coexistence is that prairie dogs evolved alongside another large herbivore: the bison. These two animals benefited from each other's presence, rather than competing (*see* Section 3.3.5.)

Inaccurate assessments of competition between cattle and prairie dogs from the early 1900s (*e.g.,* Merriam, 1902), which greatly overestimated the amount prairie dogs consumed, fueled existing poisoning campaigns aimed at eradicating prairie dogs. Contemporary studies indicate that in situations of limited space and resources, high prairie dog concentrations, or low precipitation, prairie dogs may compete with cattle, but even under those circumstances, competition is less than expected due to increased forage quality on prairie dog towns (Detling, 2006; Augustine, 2013). Other studies found no significant difference in the weights of cattle grazing on or off prairie dog

colonies (Hansen & Gold, 1977; O'Melia et al., 1982). In some situations, cattle (like bison) are attracted to prairie dog colonies for grazing, and prairie dog clipping can make generally unpalatable grasses like tabosagrass palatable to livestock (Miller et al., 2007).

Prairie dogs are often associated with denuded ground because they tend to colonize areas that livestock have already overgrazed. In these cases, the prairie dogs are the effect, not the cause, of overgrazing (Hoogland, 1995). For example, Klatt & Hein (1978) reported that eradication of prairie dogs would not significantly benefit livestock, as changes in vegetation following five years of prairie dog abandonment were minor in the shortgrass prairie; in fact, there were decreases in total vegetative cover after prairie dog abandonment. The use of proper range science in determining allowable grazing levels and proper stocking rates is a major contributor to healthy long-term pasture management. A low or moderate stocking rate promotes range health and should also decrease whatever competition may occur between prairie dogs and livestock (Miller et al., 2007).

The financial costs of many types of prairie dog control are relatively high. Wildlife managers disagree about whether poisoning prairie dogs appreciably increases income from livestock production (Andelt, 2006), but several studies indicate that poisoning costs exceed the value of any increase in forage (Collins et al., 1984; Derner et al., 2006; Miller et al., 2007; Schenbeck, 1981). Indeed, most poisoning would not take place without government agencies covering or subsidizing the costs of such control operations. We agree with Miller et al. (2006), who suggest that subsidies for poisoning be turned into subsidies for prairie dog conservation on public lands as a more efficient use of taxpayer dollars.

5.3. Risk of direct injury to livestock is low

Dr. John Hoogland, a prairie dog researcher since 1974, interviewed more than a hundred ranchers in Wyoming, Colorado, and South Dakota but could not confirm a single case of livestock breaking legs in prairie dog burrows (Hoogland, 1995). Burrows usually have large mounds around entrances, making them easy for livestock to avoid. The small risk presented by burrows is a manageable one and does not justify wholesale extermination of prairie dogs.

5.4. Prairie dog presence is not an indication of poor land stewardship

Misunderstandings about prairie dogs' impact on grasslands can lead to prairie dog presence becoming associated with poor land stewardship (Lamb et al., 2006). Prairie dogs are able to persist and even thrive in areas where land degradation from past human land use has left invasive, non-native vegetation. Prairie dogs are often highly visible in such areas, leading to the misconception that their presence is the cause of the degradation. This line of thinking is changing as more landowners are educated about prairie ecosystems and the importance of prairie dogs. The willingness of landowners to coexist with and preserve native species is a sign of respect for the integrity of the native grassland rather than a sign of neglect.

5.5. Summary

Competition between prairie dogs and cattle is probably minimal; injury to livestock from prairie dog burrows is extremely rare; and plague transmission from prairie dogs to humans is uncommon and easily prevented. Therefore, historic and ongoing attempts to control or eradicate prairie dogs

due to these perceived conflicts and risks are unnecessary, wasteful, and costly, and provide little long-term benefit.

Coexisting with prairie dogs sometimes takes work; via burrowing and grazing, they can cause crop loss, landscaping headaches, or infrastructure damage. However, there are ways to preserve the important ecosystem services that prairie dogs provide while also meeting the needs of landowners. Nonlethal options for coexisting with prairie dogs and preventing prairie dog/human conflicts include proactive planning for prairie dog-friendly areas and prairie dog exclusion areas with strategic buffer zones in between, barrier installation, passive and active relocation, and vegetation management.

6. Why Local Governments Should Create Prairie Dog Management Plans

A prairie dog management plan is important because:

- Local governments often have strong land-use control powers to protect wildlife habitat
- Prairie dog conservation plans can effectively address land-use conflicts
- It creates accountability for landowners and developers working in the community
- Collaborative conservation with other local governments and agencies is necessary for range-wide species persistence
- It can incentivize conservation and encourage local environmental stewardship
- It can promote local tourism and recreation activities
- It can educate people about the plight of prairie dogs and the grassland ecosystem
- Healthy wildlife populations indicate a healthy environment and increase human quality of life
- Local wildlife depends upon prairie dogs and the ecosystems they create and maintain
- It fosters humane treatment of prairie dogs

Local governments frequently have the primary authority over land-use decisions, including powers to protect wildlife habitat. Governments that fail to plan for wildlife habitats are more apt to become frustrated with conflicting land uses and create problems with developers and other landowners. Citizens can also become discontented when plans for preserving habitat fail. When local governments accept responsibility for wildlife habitat protection, they are placing value on wildlife and helping state and federal agencies protect range-wide biodiversity.

Protecting wildlife and their habitats is important for maintaining quality of life. Wildlife, open space, and the associated opportunities to connect with nature are negatively impacted by development. Seventy-three percent of states consider development an important issue affecting wildlife either regionally or statewide (Michalak & Lerner, 2007). More than half of the State Wildlife Action Plans (SWAPs) for all 50 states indicated that lack of land-use planning and increasing sprawl exacerbated habitat loss and fragmentation resulting from development (Michalak & Lerner, 2007). However, there is a disconnect between wildlife conservation and land-use planning, often because state wildlife agencies are not directly involved in land-use decision making. Few state wildlife agencies have a coordinated, consistent system for working with land-use planners (Michalak & Lerner, 2007).

State Wildlife Action Plans (SWAPs) address animals and habitats considered as "greatest conservation need," and all local governments should consider the SWAP a key document when considering land use decisions for wildlife. SWAPs can be incorporated into local natural resources protection codes. For state-specific information on prairie dog conservation, contact the state wildlife department. It will help both local governments and wildlife agencies to plan for the future if local governments take the initiative to bring their development plans and strategies in line with SWAPs.

Prairie dog towns provide ideal wildlife watching opportunities because prairie dogs live in relatively dense colonies, are active during the day, and are always found in the same location. Prairie dog towns also attract a myriad of other species as described in previous pages, including coyotes, raptors, and burrowing owls, and thereby create additional wildlife watching opportunities. Wildlife watching is a favorite pastime for millions in the United States. Over 86 million people 16 years old and older photographed or observed wildlife in 2011. They spent $75.9 billion on these activities (including equipment, lodging, and transportation) (USFWS, 2017). As an example, Devils Tower National Monument in Wyoming promotes their 40-acre prairie dog colony as one of their main attractions. Prairie dog towns also provide ideal opportunities to educate the public about grassland ecosystems.

Prairie dog management plans can reduce conflict. For example, a developer in Castle Rock, Colorado, encountered weeks of protests, referendums, work stoppage, and media scrutiny when they destroyed a prairie dog colony that was a wildlife-watching site for local residents. If Castle Rock had had a prairie dog management plan, then this situation could have been avoided, the prairie dogs could have been preserved, and the headaches and heartaches of all humans involved or affected could have been prevented.

Prairie dog management plans should be written according to the "precautionary principle," meaning that decisions should err in favor of nature, especially if human actions might lead to changes that are difficult to reverse or to the loss of something irreplaceable such as a species or a unique ecosystem (Hoogland, 2006c).

7. Federal, State, and Local Framework

7.1. Federal Agencies and Regulations

7.1.1. Endangered Species Act

The Endangered Species Act (ESA) was ratified by Congress in 1973 to protect imperiled species and "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" (16 U.S.C. § 1531(b)). The intention of the ESA is that all declining species be given the benefit of the doubt and provided with a margin of safety (Corn et al., 2013).

The U.S. Fish and Wildlife Service (USFWS) administers the ESA for terrestrial species. The ESA prohibits "take" (including harm or harassment) of listed species, and the USFWS has a duty to undertake recovery planning for listed species, including developing a recovery plan. The Utah prairie dog is listed as "threatened" and the Mexican prairie dog is listed as "endangered" (50 C.F.R.

§ 17.11). The other three species of prairie dog—black-tailed, white-tailed, and Gunnison's—have been petitioned for listing (a summary of efforts to list these species can be found in Jones, 2015), but listing of these species is unlikely to occur in the near future.

7.1.2. Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances

Candidate species are those that are warranted for listing as threatened or endangered under the ESA, but listing is precluded (delayed) due to higher priority species. The USFWS can utilize Candidate Conservation Agreements (CCAs) or Candidate Conservation Agreements with Assurances (CCAAs) as a measure to encourage landowners to proactively conserve species and protect them if they become listed in the future. Currently, no species of prairie dog is a candidate for listing; however, CCAs and CCAAs can serve as models for proactive conservation.

CCAs are "formal, voluntary agreements between the USFWS and one or more parties to address the conservation needs of one or more candidate species or species likely to become candidates in the near future. Participants in CCAs voluntarily commit to implement specific actions designed to remove or reduce threats to the covered species, so that listing may not be necessary" (USFWS, 2011). Generally, the USFWS enters into CCAs with federal agencies or States; however tribes, private property owners, or local governments can also enter into CCAs.

Private property owners generally choose to enter into CCAAs, which, in addition to protecting the species, also protect the land-use rights of non-federal landowners, if a species becomes listed under the ESA. The primary objectives of CCAA's may include the following:

- Protect and enhance existing populations and habitats;
- Restore degraded habitats;
- Create new habitats;
- Augment existing populations;
- Restore historic populations;
- Avoid undertakings that impact or damage habitats or the species directly.

As long as landowners uphold the provisions of the CCAA, which usually require the landowner to engage in specific conservation actions, they will not be required to implement additional measures should a species become listed (64 Fed. Reg. 37,726 (June 17, 1999)). Since a single CCAA may not be adequate to alleviate the need for listing, the property owner needs only to address the threats he/she can control on the enrolled property. Should a landowner sell or give away lands enrolled in a CCAA, the agreement will still be valid as long as the new owner becomes party to the original CCAA.

According to the USFWS, "[i]mplementing conservation efforts before species are listed and their habitats become highly imperiled increases the likelihood that simpler, more cost-effective conservation options are available, and that conservation efforts will succeed" (USFWS, 2011).

7.1.3. National Environmental Policy Act

Whenever a major federal agency action—including financing, assisting, conducting, or approving projects or programs; agency rules, regulations, plans, policies, or procedures; and legislative proposals—may have environmental impacts, the agency must conduct a National Environmental Policy Act (NEPA) analysis to determine whether those impacts will be significant. Frequently, private companies or individuals will become involved in the NEPA process when they need a permit from a federal agency. NEPA applies whenever an agency has discretion to choose from a range of alternative actions; it does not require the agency to choose the environmentally preferable alternative, but does require agency decision makers to make informed choices. Therefore, there can be several points during which public comment is accepted during the NEPA process, for example, during the development of an Environmental Assessment (wherein the agency has discretion over the amount of public involvement, but must involve the public "to the extent practicable") or Environmental Impact Statement (when the requirements for public comment are more detailed and include a scoping period when the agency is required to identify and involve interested persons). Interested individuals can let the appropriate agency representative (the NEPA point of contact at the proposing agency) know if they want to be notified of NEPA documents or NEPA processes related to a particular type of action (CEQ, 2007).

7.1.4. U.S. Forest Service and Bureau of Land Management

Large tracts of prairie dog habitat are found on federal land, specifically lands administered by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS). The BLM in Arizona, Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming manages one or more species of prairie dogs as a BLM "sensitive species," which means that the BLM should address them in land-use planning processes and NEPA analyses (BLM Manual § 6840.2B (2008)). The specifics of how sensitive species are included in the planning process may vary widely between field offices or between projects. BLM Resource Management Plans (RMPs) can include guidelines for prairie dog management.

The Rocky Mountain (R2), Northern (R1), and Southwestern (R3) regions of the USFS all manage prairie dogs as "sensitive species," meaning they receive special emphasis in planning and management activities on national forest-administered public lands to ensure their conservation. This does not mean that prairie dogs on national forest lands are protected, however. USFS and BLM generally defer to the states' shooting and poisoning regulations regarding prairie dogs and these activities are generally allowed on these public lands.

The USFS manages the national grasslands, which are extremely important focal areas for prairie dog conservation. Several national grasslands contain large prairie dog complexes and have the potential to contribute significantly to region-wide persistence of prairie dogs. Over 75 percent of the habitat within national grasslands is probably suitable for prairie dogs, yet they inhabit less than 2 percent (Miller et al., 2007; Sidle et al., 2006). Therefore, national grasslands have incredible potential for prairie dog conservation, and local prairie dog management plans in adjacent communities can support grassland conservation goals.

7.1.5. Environmental Protection Agency

All pesticides distributed or sold in the United States, including those approved for use to kill prairie dogs, must be registered (licensed) by the Environmental Protection Agency (EPA). The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) controls the regulation, sale, distribution, and use of pesticides in the United States and authorizes the EPA to review and register pesticides and allow them for specified uses. The EPA uses a risk/benefit analysis standard for pesticide approval and registration and is mandated by FIFRA to protect human health and the environment through regulations. The EPA is specifically authorized to put the burden of proof on the chemical manufacturer, to enforce compliance against banned and unregistered products, and to promulgate the regulatory framework. Before a pesticide is registered under FIFRA, the applicant must show that, among other things, using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment" (7 U.S.C. § 136a(d)(1)(B)). FIFRA defines the term "unreasonable adverse effects on the environment" as (1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food (7 U.S.C. § 136(bb)). Under the FIFRA umbrella, the EPA works with federal, state, and tribal regulatory partners to assure compliance with pesticide laws.

The EPA classifies pesticides into two categories: restricted use pesticides and general use pesticides. Restricted use pesticides may be applied only by or under the direct supervision of trained and certified applicators (*see* Appendix 2).

7.2. Multi-state Management and Conservation Plans

There are both federal- and state-level management plans and guidance documents regarding prairie dogs. These documents are intended to guide policy and conservation implementation on the ground. Thus, they are important resources; all management plans created at a local level should take these larger-scale plans into consideration.

7.2.1. Multi-state Conservation Plan for the Black-tailed Prairie Dog

One of the most significant multi-state documents is the Multi-State Conservation Plan for the Black-tailed Prairie Dog (MSCP). In 1998, several conservation organizations petitioned the USFWS to list the black-tailed prairie dog under the Endangered Species Act. After several rounds of litigation and placement of the species on the ESA candidate list from 2000 to 2004, the 11 states within black-tailed prairie dog range formed the Black-tailed Prairie Dog Conservation Team. The team developed the MSCP for the Black-tailed Prairie Dog (Luce, 2003). In 2002, the Black-tailed Prairie Dog Conservation Team was expanded to include all prairie dog species and is now known as simply the Prairie Dog Conservation Team.

The MSCP sets target occupied acreage objectives for black-tailed prairie dogs in 11 states: Arizona, Colorado, Kansas, Montana, Nebraska, North Dakota, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming (*see* Table 2). The total occupied acreage objective for all 11 states is 1,693,695 acres. "Occupied acreage" is land with prairie dogs in residence (Luce, 2003), with no reference to density.

The MSCP directs states to work toward various goals to meet their occupied acreage objectives, including but not limited to: each state developing its own conservation strategy with target objectives, maintaining both large and small complexes, and ensuring at least 75 percent distribution of prairie dogs across historically occupied counties (Luce, 2006b; *see* Part 2, Section 4.2.). The MSCP depends on the states to conduct occupied acreage counts at specific time intervals on a county-by-county basis. Each state's success in meeting the goals of the plan varies. Some states have met their occupied acreage goals and thus have ceased focusing management efforts on prairie dogs. Three states have met their acreage goals, two are within 1,000 acres of their goals, and six have not met their goals (Table 2).

Even if the MSCP goals were fully realized, it would not guarantee long-term persistence of prairie dogs due to the presence of plague. There are no population models that account for plague, so it is difficult to predict the amount of occupied acreage necessary for long-term viability of prairie dogs, and the current goals of the MSCP are therefore only a starting point for conservation (Luce, 2003). Miller & Reading (2006) recommended a 10-year goal of four million occupied acres (about 5 percent of historic range), and a 20-year goal of eight million acres.

The occupied acreage goals of the MSCP also do not address the geographic range needed for the natural expansion and contraction of prairie dog complexes over long periods of time. Prairie dogs do not inhabit the entirety of their geographic range, but rather occupy portions of it at different times in response to environmental factors such as drought and fire (Proctor et al., 2006). Two hundred years ago, black-tailed prairie dogs occupied about 19 percent of their geographic range. Today, black-tailed prairie dogs inhabit less than 0.5 percent of their geographic range (Proctor et al., 2006). In its present form, the MSCP fails to protect sufficient unoccupied potential habitat that prairie dogs could move into if environmental conditions make current occupied habitat unsuitable. A good long-term conservation strategy will involve states, counties, and cities cooperatively working together to adopt land-use planning strategies that retain prairie dogs, because most "occupied acreage" is unprotected and thus at risk of disappearing.

The MSCP emphasizes the importance of counties in achieving broad regional protection of prairie dogs. In case of a catastrophic event such as a plague outbreak, multiple conservation areas in multiple counties across the landscape will ensure that not all prairie dogs are impacted. This is one reason the MSCP calls for at least 75 percent distribution of prairie dogs across historically occupied counties. Counties should support prairie dog occupancy on federal, state, municipal, and private land within county boundaries as an equitable and shared responsibility. These landowners can contribute to county-wide acreage inventories without the county shouldering the entire responsibility of managing prairie dog complexes. In states where the MSCP goals have been met, local governments can still benefit from local management plans when they are interested in preserving specific colonies, avoiding conflict, creating accountability for landowners and developers, or preventing inhumane treatment of animals.

Table 2. Black-tailed prairie dog historic acreage estimates, current occupied acreage, and acreage objectives from the Multi-state Conservation Plan (MSCP). Note that different methodologies were used for different surveys so numbers may not be comparable. This is why we do not total the historic and recent occupied acreage counts.

State	Historic occupied acreage (low and high estimates)[1]	Most recent occupied acreage count (year)[2]	Minimum occupied acreage objective for 2011[4]	Acreage objective met
AZ	650,000 1,396,000	18.5 (2016)	4,594	No
CO	3,000,000 7,000,000	500,000 (2016)[3]	255,773	Yes
KS	2,000,000 7,503,000	148,000 (2008)	148,596	No, but within 1,000 acres
MT	1,471,000 10,667,000	191,000 (2008)	240,367	No
NE	6,000,000 9,021,000	137,000 (2003)	137,254	No, but within 1,000 acres
ND	2,000,000 2,201,000	18,000 (2012)	100,551	No
NM	6,640,000 8,950,000	40,000 (2005)	87,132	No
OK	950,000 4,625,000	22,000 (2013)	68,657	No
SD	1,757,000 6,411,000	526,641 (2015)	199,472	Yes
TX	16,703,000 57,600,000	115,000 (2006)	293,129	No
WY	5,786,000 16,000,000	269,520 (2016)	158,170	Yes

[1]USFWS, 2009
[2]Multiple sources; *see* Jones, 2017
[3]Howlin & Mitchell, 2016
[4]Luce, 2003

7.2.2. Western Association of Fish and Wildlife Agencies Memorandum of Understanding

In 2006, the 12 states within the range of the four U.S. prairie dog species (the 11 states within black-tailed prairie dog range, plus Utah), as well as several federal agencies, signed the Western Association of Fish and Wildlife Agencies (WAFWA) Memorandum of Understanding (MOU) for the Conservation and Management of Species of Conservation Concern Associated with Prairie Ecosystems (WAFWA, 2006). The MOU directed the agencies to develop prairie dog management plans, maintain and enhance prairie habitat and wildlife including prairie dogs, and communicate about policy and other changes with WAFWA, among other objectives. Each agency signatory designated representative staff members to participate in annual Prairie Dog Conservation Team

meetings to provide prairie dog management progress reports. The MOU was updated and renewed in 2015 (WAFWA, 2015).

7.2.3. Western Association of Fish and Wildlife Agencies Grassland Initiative

In 2004, WAFWA directed its Habitat and Nongame and Endangered Species Committees to adopt an ecosystem conservation approach and develop a comprehensive prairie conservation strategy for shrub and grassland species and habitats. This effort became known as the WAFWA Grassland Initiative (WGI), and it attempts, through a multi-state cooperative approach, to stabilize and expand grassland habitat and halt the decline of grassland species. In July 2011, WGI released its Western Grassland Initiative Strategic Plan, outlining its mission and strategies (WGI, 2011). The Strategic Plan is authorized by the WAFWA MOU.

7.3. Tribal Governments

The U.S. constitution recognizes tribal nations as sovereign governments. Federally recognized tribes have a nation-to-nation relationship with the U.S. government. Most tribal governments have their own wildlife management agency and their own regulations pertaining to prairie dog management.

Tribal lands are important prairie dog habitat. For example, in 2010, the Navajo Nation in Arizona, New Mexico, and Utah, and the Reservation of the Hopi Tribe in Arizona, reported that they supported approximately 253,567 acres of active Gunnison's prairie dog colonies spread throughout the land holdings of both Tribes (USFWS, 2013a). Overall, about eight percent of occupied prairie dog habitat is on Tribal land (Luce et al., 2006).

7.4. State Regulations

Depending on the state, there may be more than one agency that regulates prairie dogs. For example, the game commission might create regulations regarding species management including recreational shooting that the state department of fish and game would enforce; meanwhile the state department of agriculture may be responsible for both state and federal poisoning regulations.

7.4.1. State Agriculture Departments

State agriculture departments usually administer poisoning regulations. Many state agriculture departments list prairie dogs as a "pest," "varmint," or "nuisance" species (Appendix 4). Depending on department regulations, the agriculture department may be required to control animals deemed pests or allocate money to help landowners eradicate them. These regulations sometimes come into conflict with those of state fish and game agencies that include prairie dogs on their "species of greatest conservation" list or "sensitive species" list.

7.4.2. State Wildlife Agencies

Many state wildlife agencies list prairie dogs on their "species of greatest conservation" list or "sensitive species" list, meaning that prairie dogs get special considerations during planning

processes (Appendix 4). State wildlife agencies enforce regulations regarding overall management of prairie dogs including prairie dog removal.

The role of state wildlife officers is best described as to protect native species as a present and future natural resource. Wildlife officers are generally involved with multiple local government jurisdictions and can provide useful information that is not common public knowledge. Local governments that adopt prairie dog management plans benefit wildlife officers by allowing them to focus on other pressing wildlife matters instead of dedicating time to prairie dog/human conflicts.

7.4.3. Wildlife Commissions

Generally speaking, the wildlife commission (or game commission in some states) sets hunting and fishing regulations yearly—including seasonal closures or bag limits on prairie dog shooting—and steers the direction of the state wildlife agency through hiring the agency director, budget allocation, and regulation development. The governor appoints members of the commission for multiyear terms. To stay updated on wildlife commission regulations regarding prairie dogs, interested parties should keep track of upcoming commission meeting agenda items via their local commission website. Members of the public can usually attend commission meetings, though opportunities for public comment may be limited by procedural rules.

7.4.4. State Trust Lands

State trust lands were conveyed to states by the federal government for the purpose of generating revenue to fund public education. Each state has its own trust structure and vision for these lands. All states except Kansas within the region of the MSCP hold millions of acres in state land trusts administered by state land boards. While some of these lands are not suitable for prairie dogs, many others are and offer tremendous opportunities to allow prairie dogs to fulfill their keystone function.

Historically, revenue generated from state land trusts came from mineral and agricultural leases involving gas and oil production, rangeland grazing, and other agriculture. Some trusts have begun generating revenue as payment for ecosystem services or mitigation (*see* Appendix 3). For more information about state trust lands visit: statetrustlands.org.

7.4.5. State Wildlife Action Plans and Comprehensive Wildlife Conservation Strategies

Every state has a State Wildlife Action Plan (SWAP) that is generally updated every 10 years. In order to receive funds through the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program, each state and territory must develop a wildlife action plan. These proactive plans assess the health of each state's wildlife resources and habitats, identify the problems they face, and outline the actions that are needed to conserve them over the long term. All 50 states and five U.S. territories developed SWAPs in 2005. SWAPs outline the steps needed to conserve wildlife and habitat before they become too rare or costly to restore. These plans are critically important documents for local and regional land-use planners. SWAPs are generally open for public comments and take into account concerns about the natural environment.

In 2005, Congress mandated that each state develop Comprehensive Wildlife Conservation Strategies (CWCS) in order to receive federal wildlife grants and funding from the federal Wildlife

Conservation and Restoration Program. Among eight plan requirements, a state's CWCS must include actions for conserving and monitoring priority species and habitat. Several state CWCSs identify prairie dogs as priority species for conservation action. Each state developed its own conservation measures to monitor and conserve its priority species.

7.4.6. State Prairie Dog Management Plans

State fish and wildlife agencies often have management plans specific to prairie dogs that specify statewide goals and actions. Some states have met their goals while others are still working toward them. Local management plans could contribute to statewide goals. All states within black-tailed prairie dog range, except Nebraska and Wyoming, have a management plan for black-tailed prairie dogs (Arizona has a draft plan) (*see* Table 3). Colorado, Montana, and Utah have state white-tailed prairie dog management plans, but Wyoming does not (*see* Table 4). All states within Gunnison's prairie dog range have final or draft state plans for Gunnison's prairie dog management (*see* Table 5). Management plan citations can be found in Section 9.

7.4.7. State Natural Heritage Programs

State Natural Heritage Programs are available in each state. They provide information on all native species and rank their statewide and global conservation status. They offer detailed maps, data sets, and conservation planning advice to local governments, developers and planners.

7.5. Local Regulations

County commissioners, city council members, and town boards wield some of the most powerful tools for either threatening or protecting wildlife habitat. Zoning, planning, and subdivision decisions sometimes rest primarily with local governments, and those decisions can have large impacts on wildlife and habitat. A growing number of communities are including wildlife components in community comprehensive plans (Duerkson et al., 1996).

7.5.1. Planning Commissions

Planning commissions or planning boards can operate at the county, metropolitan, or regional scale. Members are generally appointed. The commission provides policy advice to relevant local officials and helps guide the growth and development of their jurisdiction. The specific duties of each planning commission vary but can include approving comprehensive plans, setting zoning and other local land-use ordinances, setting subdivision regulations, and reviewing rezoning and subdivision applications (Michalak & Lerner, 2007).

Providing commission members with information about the impacts of land-use planning decisions on wildlife and ecosystems, as well as information about the prairie dog ecosystem and its importance, will help them make informed zoning and permitting decisions.

7.5.2. Transportation Planners and Metropolitan Planning Organizations

Transportation planning is an inherently regional exercise that requires coordination with land-use planners across multiple jurisdictions. As a result, most regions have Metropolitan Planning

Organizations (MPOs) that do long-range planning to identify future transportation needs for the community. Working with these organizations is critical, given the impacts of new or expanded roads and highways. Transportation planners work over a particularly long time horizon, making it critical for wildlife agencies and conservationists to get involved as early as possible. Early intervention also helps to better identify funding sources needed to mitigate projects that may negatively impact important habitat areas. By the time a project has completed an Environmental Impact Statement, it is usually too late to make substantive changes.

Gaining familiarity with different planning organizations, commissions, boards, and planners is complex and daunting. One way to approach this task is to contact the state chapter of the American Planning Association (APA). These experts should be able to explain generally how land-use planning works in that state and identify any regional bodies or other major planning entities.

7.5.3. Local Comprehensive Land-use Plans

Most communities have comprehensive land-use plans that provide detailed maps and strategies about how a community wishes to grow. They are generally available through local government offices, and many can be found online through local government websites. Land-use plans are often considered advisory planning documents and are generally updated every ten years with the input of local residents. These plans are a critical piece in determining how communities designate, protect, and link wildlife habitat and are probably one of the most important documents for protecting wildlife habitat. Some of these plans may also incorporate sensitive-species overlay zoning strategies. Citizen participation early and throughout the planning process is a key to ensuring that quality wildlife information is incorporated into comprehensive land-use plans.

7.5.4. Local Government Mitigation Plans

Mitigation for prairie dogs involves preserving occupied prairie dog habitat by 1) avoidance during development, 2) protecting or translocating prairie dogs either onsite or offsite, or 3) purchasing "credits" to operate programs that support occupied prairie dog habitat. Most agencies are familiar with wetlands mitigation, but programs for prairie dogs are still in their infancy. Some reasons local governments may not adopt mitigation plans include resistance to taking responsibility for managing prairie dog habitats within local communities; the difficulty of determining a fair valuation system for lost habitat; or the fear that adopting a local mitigation plan may increase prairie dog exterminations on private land. However, inaction may mean that local governments forgo significant opportunities to protect prairie dogs and their habitats.

A few local governments charge mitigation fees for prairie dogs. In some cases the monies are returned to the private landowner if more humane lethal control measures are taken, and in others, monies are collected regardless of what the landowner does with the animals. Monies collected are generally used to operate prairie dog mitigation plans. The funds collected should be kept separate from the city or county general fund. There are more details on mitigation funds in Appendix 3.

7.5.5. Local or County Parks and Open Space

Some local governments have departments that manage local parks and open space. In many instances, open space—defined here as space conserved in a natural state and left undeveloped—has

been purchased with taxpayer funds for wildlife protection. Parcels that are purchased for wildlife protection can be valuable conservation areas for prairie dogs and receiving sites for prairie dogs displaced by development.

7.6. Other Interests

7.6.1. Non-governmental Organizations

Non-governmental organizations (NGOs) or nonprofits may provide services including site consultation for non-lethal management, prairie dog relocation, land acquisition or conservation easements, monitoring and mapping, and lobbying for specific policies. In many cases, NGOs are smaller and more flexible than government agencies and can implement new, untested, or otherwise innovative ideas and strategies for prairie dog conservation and management.

7.6.2. Private Landowners

Private landowners may assist in prairie dog conservation by implementing nonlethal management on their properties, entering into conservation easements to preserve habitat, or creating private nature preserves. Since most prairie dogs reside on private lands, private landowners are extremely important participants in curtailing the loss of native wildlife and habitats.

7.7. Summary

While federal and state governments provide an essential framework for prairie dog management and conservation, local governments also play a crucial role in prairie dog protection. All local governments have key resources available to help them create effective conservation plans, including State Wildlife Action Plans and state conservation plans for prairie dogs. Through their authority to appropriately zone and authorize land uses, local governments are pivotal in protecting habitat and mitigating habitat loss, which may ultimately ensure the stability of wildlife populations including prairie dogs.

Table 3. Black-tailed prairie dog management plans by state.

State	Year published	State management plan occupied acreage goal	Most recent occupied acreage count (year)[1]	State occupied acreage goal met
AZ	2008 (Draft)	7,100 occupied acres, 1,000 acres of which are on BLM land (Underwood et al., 2008)	18.5 (2016)	No
CO	2003	350,000 to 450,000+ occupied acres (CDW, 2003)	500,000 (2016)[2]	Yes
KS	2002	Maintain 130,000 occupied acres of prairie dogs, 150,000 with federal incentives (KPDWG, 2002)	148,000 (2008)	Yes
MT	2002	Sustain a "viable population" distributed over 90% of historic range, expected to total 125,000 to 145,000 acres (MPDWG, 2002)	191,000 (2008)	Yes
NE	None	None	137,000 (2003)	n/a
ND	2001	Maintain a "viable population" (10,000 acres minimum) (NDGFD, 2001)	18,000 (2012)	Yes
NM	2001	97,000 occupied acres (NMBTPDWG, 2001)	40,000 (2005)	No
OK	2001	40,000 occupied acres (Hoagland, 2001)	22,000 (2013)	No
SD	2005	199,472 occupied acres (Cooper, 2005)	526,641 (2015)	Yes
TX	2004	293,129 occupied acres (TBTPDWG, 2004)	115,000 (2006)	No
WY	None	None	269,520 (2016)	n/a

[1]Multiple sources; *see* Jones, 2017.
[2]Howlin & Mitchell, 2016

Table 4. White-tailed prairie dog management plans by state.

State	Year published	State management plan goal	Most recent occupied acreage count (year)[1]
CO	2010	Develop and implement conservation and management strategies designed to maintain viable populations range-wide in Colorado to prevent the need to list this species under the Endangered Species Act (Seglund & Schnurr, 2010)	Not available
MT	2002	Enhance populations with the aim of preventing extirpation from the state (MPDWG, 2002)	227 (2009)
UT	2007	Maintain populations above 60% of the 2008 population baseline (Lupis et al., 2007)	168,844 (2002-2003)
WY	None	None	2,893,487 (2008)

[1]USFWS, 2010

Table 5. Gunnison's prairie dog management plans by state.

State	Year published	State management plan goal	Most recent occupied acreage count (year)[1]
AZ	2007	75% of 1900 acreage (4,950,000 acres) (Underwood, 2007)	109,402 (2011)
CO	2010	Develop and implement conservation and management strategies designed to maintain viable populations range-wide in Colorado to prevent the need to list this species under the Endangered Species Act (Seglund & Schnurr, 2010)	151,547 (2002)
NM	2008 (Draft)	1) Establish focal areas for conservation of Gunnison's prairie dog; 2) ensure persistence of populations in each focal area; and 3) provide habitat connectivity between focal areas (NMDGF, 2008)	9,108 (minimum) (2004)
UT	2007	Maintain populations above 60% of the 2008 occupancy baseline (Lupis et al., 2007)	Not available

[1]USFWS, 2013a

8. Bibliography

Abbott, R. C., & Rocke, T. E. (2012). *Plague: U.S. Geological Survey Circular 1372*. Reston, VA: USGS National Wildlife Health Center.

Andelt, W. F. (2006). Methods and Economics of Managing Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (129–138). Washington, DC: Island Press.

Antolin, M. F., Savage, L. T., & Eisen, R. J. (2006). Landscape features influence genetic structure of black-tailed prairie dogs (*Cynomys ludovicianus*). *Landscape Ecology, 21,* 867–875.

Augustine, D. J. & Baker, B. W (2013). Associations of grassland bird communities with black-tailed prairie dogs in the North American Great Plains. *Conservation Biology, 27*(2), 324–334.

Augustine, D. J., Matchett, M. R., Toombs, T. P., Cully, J. F., Johnson, T. L., & Sidle, J. G. (2008). Spatiotemporal dynamics of black-tailed prairie dog colonies affected by plague. *Landscape Ecology, 23*, 255–267.

Avashia, S. B., Petersen, J. M., Lindley, C. M., Schriefer, M. E., Gage, K. L., Cetron, M., et al. (2004). First reported prairie dog-to-human tularemia transmission, Texas, 2002. *Emerging Infectious Diseases*, Mar (June 3, 2016). Available from: wwwnc.cdc.gov/eid/article/10/3/03-0695

Biggins, D. E., & Kosoy, M. Y. (2001a). Disruptions of ecosystems in western North America due to invasion by plague. *Journal of the Idaho Academy of Science, 37*(1), 62-65.

_____ (2001b). Influences of introduced plague in North American mammals: Implications from ecology of plague in Asia. *Journal of Mammalogy, 82*(4), 906–916.

Bryan, R. D., & Wunder, M. B. (2014). Western burrowing owls (*Athene cunicularia hypugaea*) eavesdrop on alarm calls of black-tailed prairie dogs (*Cynomys ludovicianus*). *Ethology*, *120*, 180–188.

Butts, K. O., & Lewis, J. C. (1982). The importance of prairie dog towns to burrowing owls in Oklahoma. *Proceeding of the Oklahoma Academy of Science, 62*, 46-52.

Ceballos, G., Pacheco, J., & List, R. (1999). Influence of prairie dogs (*Cynomys ludovicianus*) on habitat heterogeneity and mammalian diversity in Mexico. *Journal of Arid Environments, 41*, (161–172).

[CEQ] Council on Environmental Quality (2007). *A Citizen's Guide to the NEPA: Having Your Voice Heard*. Washington, D.C.: Executive Office of the President.

Chipault, J. G., & Detling, J. K. (2013). Bison selection of prairie dog colonies on shortgrass steppe. *Western North American Naturalist, 73*(2), 168–176.

Clippinger, N. W. (1989). *Habitat Suitability Index Models: Black-tailed Prairie Dog.* U.S. Department of the Interior, Fish and Wildlife Service, Biological Report 82(10.156).

Collins, A. R., Workman, J. P., & Uresk, D. (1984). An economic analysis of black-tailed prairie dog (*Cynomys ludovicianus*) control. *Journal of Range Management, 37*(4), 358–361.

Corn, M. L., Alexander, K., & Buck, E. H. (2013). The Endangered Species Act and "Sound Science." *Congressional Research Service, 7-7500*, 1–30.

Cully, J. F., Biggins, D. E., & Seery, D. B. (2006). Conservation of Prairie Dogs in Areas with Plague. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (157–168). Washington, DC: Island Press.

Davidson, A. D., Detling, J. K., & Brown, J. H. (2012). Ecological roles and conservation challenges of social, burrowing, herbivorous mammals in the world's grasslands. *Frontiers in Ecology and the Environment, 9*(10), 477–486.

Derner, J. D., Detling, J. K., & Antolin, M. F. (2006). Are livestock weight gains affected by black-tailed prairie dogs? *Frontiers in Ecology and the Environment, 4*(9), 459-464.

Detling, J. K. (1998). Mammalian herbivores: ecosystem-level effects in two grassland national parks. *Wildlife Society Bulletin 26*, 438–448.

Detling, J. K. (2006). Do Prairie Dogs Compete with Livestock? In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (65–88). Washington, DC: Island Press.

Detling, J. K., & Whicker, A. D. (1987). Control of ecosystem processes by prairie dogs and other grassland herbivores. *Great Plains Wildlife Damage Control Workshop Proceedings*. Lincoln, NE: University of Nebraska.

Dombro, L. M. (2016). *Ecological Effects of Deltamethrin Insecticide in Prairie Dog Colonies of Western South Dakota.* Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science. Auburn, AL: Auburn University.

Duerkson, C. J., Hobbs, N. T., Elliott, D. L., Johnson, E., & Miller, J. R. (1996). Managing development for people and wildlife: A handbook for habitat protection by local governments. *American Planning Association, PAS*, *470*.

Forrest, S. C., & Luchsinger, J. C. (2006). Past and Current Chemical Control of Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (115–128). Washington, DC: Island Press.

Foster, K. R., Vecchia, P., & Repacholi, M. H. (2000). Science and the precautionary principle. *Science, 288*, 979–981.

Gage, K. L., Lance, S. E., Dennis, D. T., & Montenieri, J. A. (1992). Human plague in the United States: A review of cases for 1988–1992 with comments on the likelihood of increased plague activity. *Border Epidemiological Bulletin, 6,* 1–10.

Gietzen, R. A., Jones, S. R., & McKee, R. J. (1996). *Wintering Raptor Populations in Boulder County, 1983–1996*. Boulder, CO: Boulder County Nature Association.

Goodwin, H. T. (1995). Pliocene-Pleistocene biogeographic history of prairie dogs, genus Cynomys (Sciuridae). *Journal of Mammalogy, 76*(1), 100–122.

Guarner, J., Johnson, B., Paddock, D, Shieh, W., Goldsmith, C., Reynolds, M., Damon, I., Regnery, R., Zaki, S., & the Veterinary Monkeypox Virus Working Group (2004). Monkeypox transmission and pathogenesis in prairie dogs. *Emerging Infectious Diseases 10*(3), 426-431.

Hansen, R. M., & Gold, I. K. (1977). Blacktail prairie dogs, desert cottontails and cattle trophic relations on shortgrass range. *Journal of Range Management, 30*(3), 210-214.

Hartley, L. M., Detling, J. K., & Savage, L. T. (2009). Introduced plague lessens the effects of an herbivorous rodent on grassland vegetation. *Journal of Applied Ecology, 46*, 861–869.

Holland, E. A., & Detling, J. K. (1990). Plant response to herbivory and below ground nitrogen cycling. *Ecology 71,* 1,040–1,049.

Hoogland, J. (2006a). Demography and Population Dynamics of Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (27–52). Washington, DC: Island Press.

Hoogland, J. (2006b). Social Behavior of Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (7–26). Washington, DC: Island Press.

Hoogland, J. (2006c). Glossary. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (279–288). Washington, DC: Island Press.

Hoogland, J. (2001). Black-tailed, Gunnison's, and Utah prairie dogs reproduce slowly. *Journal of Mammalogy, 82*(4), 917–927.

Hoogland, J. (1995). *The Black-tailed Prairie Dog: The Social Life of a Burrowing Mammal.* Chicago, IL: University of Chicago Press.

Howlin, S., & Mitchell, J. (2016). *Monitoring Black-tailed Prairie Dogs in Colorado with the 2015 NAIP Imagery*. Laramie, WY: Western Ecosystems Technology, Inc.

Jones, C. G., Lawton, J. H., & Shachak, M. (1994). Organisms as ecosystem engineers. *Oikos, 69*(3), 373-386.

Jones, T. (2017). *Report from the Burrow: Forecast of the Prairie Dog 2017*. Denver, CO: WildEarth Guardians. Available at: http://www.wildearthguardians.org/site/DocServer/RFTB_2017_final.pdf?docID=17502.

Jones, T. (2015). *Report from the Burrow: Forecast of the Prairie Dog 2015*. Denver, CO: WildEarth Guardians. Available at: http://www.wildearthguardians.org/site/DocServer/RFTB2015Final.pdf?docID=15282.

Keffer, K., Gordon, K., & Anderson, S. (2000). *Effects of recreational shooting on behavior of black- tailed prairie dogs: 2000 progress report, Wyoming Cooperative Fish and Wildlife Research Unit.* Laramie, WY: University of Wyoming.

Klatt, L. E., & Hein, D. (1978). Vegetative Differences Among Active and Abandoned Towns of Black-tailed Prairie Dogs (*Cynomys ludovicianus*). *Journal of Range Management, 31*(4), 315-317.

Klute, D. S., Ayers, L. W., Green, M. T., Howe, W. H., Jones, S. L., Shaffer, J. A., Sheffield, S. R., & Zimmerman, T. S. (2003). *Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States.* Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R6001-2003.

Kotliar, N. B., Baker, B. W., & Whicker, A. D. (1999). A critical review of assumptions about the prairie dog as a keystone species. *Environmental Management, 24*(2), 177–192.

Kotliar, N. B., Miller, B. J., Reading, R. P., & Clark, T. W. (2006). The Prairie Dog as a Keystone Species. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (53–64). Washington, DC: Island Press.

Krueger, K. (1986). Feeding relationships among bison, pronghorn, and prairie dogs: An experimental analysis. *Ecology 56*: 760–770.

Lamb, B. L., Reading, R. P., & Andelt, W. F. (2006). Attitudes and Perceptions About Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (27–52). Washington, DC: Island Press.

Lehmer, E. M., Hartley, L., Lanci, J., & Kolb, C. (2010). Evaluating the impacts of black-tailed prairie dogs on vegetation in traditional and non-traditional habitat. *The Prairie Naturalist, 42*(1/2): 67-70.

Lomolino, M. V., Smith, G. A., & Vidal, V. (2003). Long-term persistence of prairie dog towns: insights for designing networks of prairie reserves. *Biological Conservation, 115*, 111–120.

Long, D, Bly-Honess, K., Truett, J. C., & Seery, D. B. (2006). Establishment of New Prairie Dog Colonies By Translocation. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (188–209). Washington, DC: Island Press.

Luce, R. J. (2003). *A Multi-state Conservation Plan for the Black-tailed Prairie Dog,* Cynomys ludovicianus*, in the United States—An Addendum to the Black-tailed Prairie Dog Conservation Assessment and Strategy, Nov. 3, 1999.*

Luce, R. J. (2006a). Areas where habitat characteristics could be evaluated to identify potential black-footed ferret reintroduction sites and develop conservation partnerships. In Roelle, J. E., Miller, B. J., Godbey, J. L, & Biggins, D. E. (Eds.), *Recovery of the Black-footed Ferret—Progress and Continuing Challenges: U.S. Geological Survey Scientific Investigations Report 2005–5293*.

Luce, R. J. (2006b). *A multi-state approach to black-tailed prairie dog conservation and management in the United States*. USDA Forest Service Proceedings RMRS-P-40.

Luce, R. J., Manes, R., & Van Pelt, B. (2006). A Multi-state Plan to Conserve Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (211–217). Washington, DC: Island Press.

Magle, S., & Crooks, K. R. (2008). Interactions between black-tailed prairie dogs (*Cynomys ludovicianus*) and vegetation in habitat fragmented by urbanization. *Journal of Arid Environments, 72,* 238–246.

Magle, S. B., & Crooks, K. R. (2009). Investigating the distribution of prairie dogs in an urban landscape. *Animal Conservation, 12*, 192–203.

Magle, S. B., Poessel, S. A., Crooks, K. R., & Breck, S. W. (2014). More dogs less bite: The relationship between human-coyote conflict and prairie dog colonies in an urban landscape. *Landscape & Urban Planning, 127,* 146–153.

Magle, S. B., Salamack, K. A., Crooks, K. R., & Reading, R. P. (2012). Effects of habitat fragmentation and black-tailed prairie dogs on urban avian diversity. *Biodiversity and Conservation 21*, 2,803–2,821.

Manno, T. (2014). *The Utah Prairie Dog: Life Among the Red Rocks*. Salt Lake City, UT: The University of Utah Press.

Martínez-Estévez, L., Balvanera, P., Pacheco, J., & Ceballos, G. (2013). Prairie dog decline reduces the supply of ecosystem services and leads to desertification of semiarid grasslands. *PLOS ONE, 8*(10), 1–9.

Merriam, C. H. (1902). The prairie dog of the great plains. *USDA Yearbook 1901*, 257–270.

Michalak, J., & Lerner, J. (2007). *Linking Conservation and Land Use Planning: Using the State Wildlife Action Plans to Protect Wildlife from Urbanization*. Washington, DC: Defenders of Wildlife.

Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*. Washington, DC: Island Press.

Miller, B., & Reading, R. P. (2006). A Proposal for More Effective Conservation of Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (248–260). Washington, DC: Island Press.

Miller, B., Reading, R. P., Biggins, D. E., Detling, J. K., Forrest, S. C., Hoogland, J. L., Javersak, J., Miller, S. D., Proctor, J., Truett, J., & Uresk, D. W. (2007). Prairie dogs: An ecological

review and current biopolitics. *Journal of Wildlife Management, 71*(8), 2,801–2,810.

Miller, B., Reading, R. P., & Forrest, S. (1996). *Prairie Night: Black-footed Ferrets and the Recovery of Endangered Species*. Washington, DC: Smithsonian.

[NPIC] National Pesticide Information Council (2010). *Deltamethrin General Fact Sheet*. Available at: http://www.npic.orst.edu/factsheets/DeltaGen.pdf.

O'Meilia, M. E., Knopf, F. L., & Lewis, J. C. (1982). Some consequences of competition between prairie dogs and beef cattle. *Journal of Range Management, 35*(5), 580-585.

Outwater, A. (1996). *Water: A Natural History*. New York, NY: Basic.

Pauli, J. N., & Buskirk, S. W. (2007). Risk-disturbance overrides density dependence in a hunted colonial rodent, the black-tailed prairie dog *Cynomys ludovicianus*. *Journal of Applied Ecology 44,* 1,219-1,230.

[PDC] Prairie Dog Coalition of the Humane Society of the United States (2014). *Prairie Dog Action Packet*. Available at: https://issuu.com/prairiedogcoalition/docs/pdc_action_packet_2014.

Pizzimenti, J. J., & McClenaghan, L. R. (1974). Reproduction, growth and development, and behavior in the Mexican prairie dog. *American Midland Naturalist, 92*,130–145.

Ponce-Guevara, E., Davidson, A., Sierra-Corona, R., & Ceballos, G. (2016). Interactive effects of black-tailed prairie dogs and cattle on shrub encroachment in a desert grassland ecosystem. *PLOS ONE, 11*(5), e0154748.

Proctor, J., Haskins, B., & Forrest, S. C. (2006). Focal Areas for Conservation of Prairie Dogs and the Grassland Ecosystem. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (232–247). Washington, DC: Island Press.

Reeve, A. F., & Vosburgh, T. C. (2006). Recreational Shooting of Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (139–156). Washington, DC: Island Press.

Roach, J. L., Stapp, P., Horne, B. V., & Antolin, M. F. (2001). Genetic structure of the metapopulation of black-tailed prairie dogs. *Journal of Mammalogy, 82*(4), 946–959.

Schenbeck, G. L. (1981). Management of black-tailed prairie dogs on the National Grasslands. *Great Plains Wildlife Damage Control Workshop Proceedings*. Paper 143.

Shipley, B. K., & Reading, R. P. (2006). A comparison of herpetofauna and small mammal diversity on black-tailed prairie dog (*Cynomys ludovicianus*) colonies and non-colonized grasslands in Colorado. *Journal of Arid Environments 66*, 27–41.

Sidle, J. G., Schenbeck, G. L., Lawton, E. A., & Licht, D. S. (2006). Role of Federal Lands in the Conservation of Prairie Dogs. In J. Hoogland (Ed.), *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands* (27–52). Washington, DC: Island Press.

Slobodchikoff, C. N., Perla, B. S., & Verdolin, J. L. (2009). *Prairie Dogs: Communication and Community in an Animal Society*. Cambridge, MA: Harvard University Press.

[USGS] U.S. Geological Survey (2012). *Sylvatic Plague Vaccine and Management of Prairie Dogs*. Fact Sheet 2012-3087. August 2012.

[USFWS] U.S. Fish and Wildlife Service (2009). 12-month finding on a petition to list the black-tailed prairie dog as threatened or endangered. *Federal Register, 74*(231), 63,343–63,366.

____ (2010). 12-month finding on a petition to list the white-tailed prairie dog as endangered or threatened. *Federal Register, 75*(104), 30,338–30,363.

____ (2011). Candidate Conservation Agreements. Available at: https://www.fws.gov/endangered/esa-library/pdf/CCAs.pdf

____ (2013a). 12-month finding on a petition to list the Gunnison's prairie dog as an endangered or threatened species. *Federal Register*, *78*(220), 68,660–68,685.

____ (2013b). Recovery plan for the black-footed ferret (*Mustela nigripes*). U.S. Fish and Wildlife Service, Denver, CO. Available at: https://www.fws.gov/mountain-prairie/species/mammals/blackfootedferret/2013NovRevisedRecoveryPlan.pdf

____ (2016). *Environmental Assessment: Use of Unmanned Aerial Systems to Deliver Prairie Dog Sylvatic Plague Vaccination. UL Bend National Wildlife Refuge, Charles M. Russell National Wildlife Refuge*. Available at: https://www.fws.gov/uploadedFiles/UAS_2016_EA_final.pdf

____ (2017). *2016 National Survey of Fishing, Hunting, and Wildlife-associated Recreation. National Overview*. Available at: https://wsfrprograms.fws.gov/Subpages/NationalSurvey/nat_survey2016.pdf

Vickery, J. (2015). Vegetation Management in Urban-to-Exurban Prairie Dog Colonies: Context, Issues and Native Plant "Survivors." Conference poster. *High Altitude Revegetation Conference.* Central Rockies Chapter of the Society for Ecological Restoration and the HAR Committee. March 10–12, 2015. Ft. Collins, CO.

Vosburgh, T. C., & Irby, L. R. (1998). Effects of recreational shooting on prairie dog colonies. *The Journal of Wildlife Management, 62*(1), 363–372.

Vyas, N. B. (2013). Untested pesticide mitigation requirements: ecological, agricultural and legal implications. *Drake Journal of Agricultural Law*, *18*(2):335-348

Weber, D. A. (2004). Winter raptor use of prairie dog towns in the Denver, Colorado vicinity. In Shaw et al. (Eds.), *Proceedings 4th International Urban Wildlife Symposium.*

Weltzin, J. F., Archer, S., & Heitschmidt, R. K . (1997). Small-mammal regulation of vegetative structure in a temperate savanna. *Ecology, 78*(3), 751–763.

[WAFWA] Western Association of Fish and Wildlife Agencies (2006). *Memorandum of Understanding for Conservation of Species of Conservation Concern Associated with Prairie Ecosystems.*

___. (2015). *Memorandum of Understanding for the Continuation of the Conservation and Management of Western Grassland Ecosyastems and Species of Conservation Concern.*

[WGI] Western Grassland Initiative (2011). *Western Grassland Initiative: A Plan for Conserving Grassland Habitat and Wildlife.* Western Association of Fish and Wildlife Agencies.

9. State Management Plans

[CDW] Colorado Division of Wildlife (2003). *Conservation Plan for Grassland Species in Colorado.*

Cooper, J., & Gabriel, L. (2005). *South Dakota Black-tailed Prairie Dog Conservation and Management Plan.* South Dakota Department of Game, Fish, and Parks and South Dakota Department of Agriculture.

Hoagland, J. (2001). *The Oklahoma black-tailed prairie dog management plan.* Oklahoma Department of Wildlife Conservation.

[KPDWG] Kansas Black-Tailed Prairie Dog Working Group (2002). *Kansas Black-Tailed Prairie Dog Conservation and Management Plan.*

Lupis, S. G., Bunnell, K. D., Black, T. A., & Messmer, T. A. (2007). *Utah Gunnison's Prairie Dog and White-tailed Prairie Dog Conservation Plan: Draft #5.* Salt Lake City, UT: Utah Division of Wildlife Resources.

[MPDWG] Montana Prairie Dog Working Group (2002). *Conservation Plan for Black-tailed and White-tailed Prairie Dogs in Montana.*

[NDGFD] North Dakota Game and Fish Department (2001). *Black-tailed Prairie Dog State Management Plan.* Bismarck, ND: North Dakota Game and Fish Department.

[NMBTPDWG] New Mexico Black-tailed Prairie Dog Working Group (2001). *Conservation and Management Strategic Plan for Black-tailed Prairie Dogs in New Mexico.*

[NMDGF] New Mexico Department of Game and Fish (2008). *Draft Conservation Plan for Gunnison's Prairie Dog (Cynomys gunnisoni) in New Mexico.* Santa Fe, NM: New Mexico Department of Game and Fish, Conservation Services Division.

Seglund, A. E., & Schnurr, P. M. (2010). *Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy*. Denver, CO: Colorado Parks and Wildlife.

[TBTPDWG] Texas Black-tailed Prairie Dog Working Group (2004). *Texas Black-tailed Prairie Dog*

Conservation and Management Plan. Texas Parks and Wildlife Department Publication PWD RP W7000-1100 (7/05).

Underwood, J. G. (2007). *Interagency Management Plan for Gunnison's Prairie Dogs in Arizona*. Phoenix, AZ: Nongame and Endangered Wildlife Program, Arizona Game and Fish Department.

Underwood, J. G., & VanPelt, W. E. (2008). *A proposal to reestablish the black-tailed prairie dog (*Cynomys ludovicianus*) to southern Arizona*. Nongame and Endangered Wildlife Program Draft Technical Report. Phoenix, AZ: Arizona Game and Fish Department.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