History of Policies Concerning the Black-tailed Prairie Dog: A Review

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INTRODUCTION

The black-tailed prairie dog (*Cynomys ludovicianus*) is a large burrowing rodent found in western American grasslands (*1*). The prairie dog was first described in the early 1800's and was named the Louisiana Marmot (*Arctomys ludovivianus*) by Ord in 1815. Rafinesque proposed the genus *Cynomys* in 1817, and J.A. Allen recognized two species of prairie dogs, the black-tailed and whitetailed (*C. leucurus*) in 1858 (*2*). When Europeans colonized North America, many of their activities, such as planting crops and killing predators [e.g., the coyote (*Canis latrans),* the badger (*Taxidea taxus*), and the prairie rattlesnake (*Crotalus viridus*)], allowed the black-tailed prairie dog to colonize new areas.

In this paper I will discuss: (a) historic distribution and range of the blacktailed prairie dog, (b) history of Federal Poisoning Campaigns, (c) prairie dog impacts on rangelands, (d) the prairie dog "ecosystem" , and (e) sylvatic plague (*Yersinia pestis*) and its impacts on prairie dog colonies. Parts of this information have been published in conjunction with scientific results, but a comprehensive review on the history and policies surrounding the black-tailed prairie dog is needed, especially because this species was recently denied listing under the Endangered Species Act and has been referred to as a keystone species of the prairie ecosystem (i.e., modified habitat of prairie dog colonies affects the survival of many other species).

HISTORICAL DISTRIBUTION and RANGE

The black-tailed prairie dog was once the most numerous and widespread herbivore in the Great Plains and ranged from the Rocky Mountains, north to the US/Canada border, south to Mexico, and east to the western edge of the Mississippi Valley (*2-4*). It was distributed over ca. 40 million ha during pre-settlement times, which comprised more than 20% of the natural shortgrass and mixed prairie (*5,6*). Merriam (*3*) estimated that prairie dogs (all species included) ranged over 283 million ha during the late 1800's and colonies were often 32-48 km in length with an average of 10 prairie dogs per ha. This area was reduced to 40.5 million ha by 1919 (*1*), 600,000 ha by 1960 (*7,8*) and 566,000 ha by 1971 (*1*). A single colony in Texas was reported to cover 6.5 million ha at the turn of the century (*3,9).*

HISTORY of the FEDERAL POISONING CAMPAIGN

Merriam (*3*) reported a 50-75% reduction in forage production due to prairie dog activities and quoted a prominent Texas newspaper editorial:

> No man who has not gone through the portions of Texas infested by prairie dogs can conceive the enormous ravages they have committed. Millions of acres of land once covered with nutritious grasses have been eaten off by these animals, until the land is naked and worthless, and will remain so as, long as the prairie dog remains. They invade the farms and eat down the growing crops. Here and there individual effort has been made to destroy them, without avail, and their numbers steadily increase, until they are a menace to the prosperity of the land.

This estimated loss in forage production was based on a formula developed by Professor W.W. Cooke in the early 1900's (*3*) for determining relative quantities of food consumed by animals of different sizes. He reported that 32 prairie dogs consume as much grass as 1 sheep, and 256 prairie dogs consume as much as 1 cow. Therefore, Merriam reported, the large Texas colony could support ca. 1,562,500 cattle annually if no prairie dogs were present (*3*). The estimated loss from prairie dogs reported by Merriam (*3*) was accepted and used to justify poisoning campaigns that were implemented and carried out during most of the 20th century. Merriam had many supporters. Lantz (*4*) stated that prairie dogs greatly decreased the carrying capacity of land for livestock and claimed half of the pasturage. Bell (*10*) stressed that eradication campaigns must be a cooperative effort among all agencies involved (i.e., farmers, local organizations, and county, state, and federal officials). He also wanted legal provision for the extermination of pests on neglected lands. Bell (*11*) stated that rodents, including the black-tailed prairie dog, caused an annual crop production loss of $500 million each year and that federal officials, state officials, and landowners needed to combat rodents.

Prairie dog eradication became a federal issue in 1915; previously, programs were implemented by local land-owners and on countywide and statewide bases. In 1917, the Cooperative Campaigns for the control of ground squirrels (*Citellus* sp.), prairie dogs, and white-tailed jackrabbits (*Lepus townsendii)* began under the Department of Agriculture and at least 26 million ha of prairie dog and ground squirrel habitat were poisoned between 1916 and 1920 (*8,11*). Farmers reported a crop return of $15 to $20 for each dollar invested in eradication, in addition to improved range conditions (*11*). By 1920, the Biological Survey began poisoning millions of ha of prairie dog colonies, funded by the Federal Government (*9*). In 1929, the Division of Predatory Animal and Rodent Control (PARC) was established, under the supervision of the National Biological Survey (*9*). In 1939, PARC was transferred to the Bureau of Sport Fisheries and Wildlife, when the U.S. Fish and Wildlife Agency was formed, and remained there until 1986 (*9*). During this time, it was renamed the Federal Animal Damage Control Program (ADC). The Animal Damage Control Act of 1931 gave the federal government permission to develop techniques to control "problem" animals on both public and private lands (*12*). In 1986, ADC was transferred to the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) (*9,12*). Federal poisoning ceased in 1972 with Presidential Executive Order II 11643 that stated that toxicant Compound 1080 could not be used on federal lands, in federal programs, or on private lands (*1,11*). In February 1973, the Wildlife Services Division of the Fish and Wildlife Service began selling strychnine-treated grain, at cost, to interested parties, with demonstrations of poisoning techniques available (*11*). In 1976, zinc phosphide was approved for poisoning (*1*). Prairie dogs on federal lands are still poisoned today by persons with grazing leases (*9*).

POISONING TECHNIQUES

After 1900, both small- and large-scale extermination procedures were in use. The most common small-scale methods were trapping, drowning, destruction by domestic ferrets, and capture in sand or straw barrels placed over holes (*3*). The large-scale methods were poisoning and fumigation. The most common poisons were strychnine and potassium cyanide, while carbon disulfide was the most common fumigator (*3*). Today, zinc phosphide, diethylstilbestrol, strychnine, aluminum phosphide, shooting, habitat alteration, and visual barriers are used commonly (*13*). Treated colonies often are rapidly invaded by immigrant prairie dogs, which reestablish the colony. Recolonized populations can reach pre-poisoning size in 1 to 3 years. It is therefore suggested that potential immigrants, located in nearby colonies, be eliminated before a prairie dog control program is implemented (*14,15*).

IMPACTS ON RANGELAND

Taylor and Loftfield, in 1924, conducted the first studies of prairie dog-range relationships. They concluded:

> The prairie dog *(Cynomys* spp.*)* is one of the most injurious rodents of the southwest and plains region. These animals assemble in areas called towns, where populations become very high; thus, the removal of vegetation in its entirety from the vicinity is common.

The next prairie dog-range relationship study was not conducted until the 1950's (*16*). Since then, many studies have been conducted to assess the impacts of blacktailed prairie dogs on vegetation and have produced conflicting results.

Although shorter vegetation prevails on prairie dog colonies, it is more succulent and has higher nutrient content, digestibility, and productivity than uncolonized prairie (*17*). Because prairie dog colonies support quality forage, domestic cattle, bison *(Bison bison),* and other herbivores prefer to graze on these areas (*6,18,19*). Hassien (*20*) found the mean number of cattle droppings was higher on 122 of 123 prairie dog colonies compared to uncolonized areas in the Oklahoma Panhandle. There were no significant differences in weight gain, in Harper County, OK, between cattle that fed in prairie dog colonies vs. prairie without colonies, and plant productivity did not improve when prairie dogs were removed from an overgrazed cattle range (*5,17*).

Alternatively, Garrett et al. (*21*) found that grazing pressure from prairie dogs, in Wind Cave National Park, South Dakota, limited species diversity and nutrient quality, and permitted unpalatable vegetation to dominate the colony. Grazing pressure by prairie dogs has been reported to reduce both mulch cover and maximum height of vegetation in western South Dakota (*22*). Hassien (*20*) found that forage quality was lower on prairie dog colonies when compared to surrounding areas in the Oklahoma Panhandle.

Contemporary expansion of prairie dog colonies is related to livestock grazing. Prairie dogs colonize grazed rangelands and are often blamed for their deterioration. Prairie dogs can be used as bio-indicators of overgrazed grasslands that are losing productivity because these are areas that they most frequently colonize (*23,24*). Prairie dogs are ecosystem regulators (i.e., they disturb soil structure and chemical composition by burrowing, excreting biological wastes, increasing plant and animal diversity, and decreasing primary production of the area in their colony) (*19,22,23,25*). Between 200 and 225 kg of soil axe mixed per burrow system if it has 50-300 entrances per ha (*17*). Hassien (*20*) found that prairie dogs increase the nutrients in soil, particularly potassium, phosphorus, and calcium. Whicker and Detling (*6*) stated that ecosystem processes in prairie dog colonies may proceed at different rates due to the patchy microhabitats that they create within a grassland.

PRAIRIE DOG ECOSYSTEM

Prairie dog populations have been estimated to have declined 98% throughout their range over the past century, because of eradication programs (*3,6,9*). Recent studies have suggested that prairie dogs create an important "habitat" for many wildlife species (*23*) and provide a larger prey abundance, especially for carnivores and granivores (*22*). Clark et al. (*26*) reported that there are 107 vertebrate species and subspecies associated with colonies of prairie dogs (all prairie dog species included). These species include: the black-footed ferret *(Mustela nigripes),* swift fox (*Vulpes velox),* snowy owl *(Nyctea scandiaca),* bald eagle *(Haliaeetus leucocephalus),* golden eagle *(Aquila chrysaetos),* ferruginous hawk *(Buteo regalis),* red-tailed hawk (*B. jamaicensis),* kestrel *(Falco sparverius),* mountain plover *(Charadrius montanus),* shorteared owl *(Asio flammeus),* and burrowing owl *(Speotyto cunicularia).* Agnew et al. (*22*) found a greater density of all rodents, and greater avifaunal richness and abundance on prairie dog colonies throughout the growing season when compared to surrounding areas.

Burrowing owls use abandoned prairie dog burrows for cover and nest sites. These owls are declining throughout their range because of the loss of nest sites and prairie dog colonies (*27*). The mountain plover *(Charadrius montanus)* relies heavily on prairie dog colonies for nesting. Mountain plovers also feed at prairie dog colonies because insects may be more visible and abundant (*9,28*). Knowles et al. (*29*) reported that the decline in mountain plovers may be directly related to the near extermination of prairie dogs.

Many carnivorous birds and mammals are attracted to prairie dog colonies because of the presence of a large prey-base (*23*). Ferruginous hawks occur near colonies regardless of surrounding land condition (*30*). Swift foxes sometimes den in abandoned prairie dog burrows and use colonies as hunting grounds (49% of their diet are prairie dogs) (*31-33*). Miller (*9*) reported that most black-tailed prairie dog colonies are small and isolated because of habitat fragmentation, which negatively affects population survival and biological diversity. Small populations usually have low genetic diversity and are more susceptible to extinction because of catastrophes, such as sylvatic plague.

SYLVATIC PLAGUE

Sylvatic plague was first introduced into the United States from Asia in ca. 1899 and was first documented in a black-tailed prairie dog colony near Lubbock, TX in 1946 (*35,36*). It has spread throughout the United States west of the 100th meridian and has been found in 5 mammalian orders: Rodentia, Lagomorpha, Insectivora, Artiodactyla, and Primates (*34,35*). Approximately 340 mammal species, which include 220 rodent species, can be infected with plague (*35*). Carnivorous mammals, such as the coyote and blackfooted ferret, appear to be unaffected by sylvatic plague, but act as carriers by transmitting plague-infected fleas to other localities (*37,38*).

Sylvatic plague is caused by a small ovoid bacillus that survives by using fleas as vectors (i.e., agents which transmit disease) (*35*). Approximately 33 of 3,000 known species of fleas transmit plague. This bacterium may persist in reservoir species (i.e., species with high resistance to plague and low resistance to infection, such as the kangaroo rat *(Dipodomys* sp.*),* deermouse *(Peromyscus maniculatus),* and grasshopper mouse (*Onychomys leucogaster),* in soil, or in fleas and their eggs (*34,38-40*). This bacterium affects the flea by a method called blocking. A sticky mass is created by the bacterium that seals the proventriculus (i.e., valve that controls passage of food to the gut). When the flea feeds, none of the sucked blood reaches the stomach because of the blockage, and is driven back into the wound with infectious sylvatic plague bacteria. Eventually, the flea will feed more frequently and infect more host organisms, because it is in a state of dehydration and starvation (*35*).

This is a devastating disease to prairie dogs, and they are highly susceptible; the mortality rate is near 99%. The few survivors should be immune to the plague, but will produce susceptible offspring (*34,38-40*). During an epizootic plague outbreak (i.e., outbreak of a disease affecting a large number of animals within a short amount of time), the number of infected fleas living in the colonies increases. Because of high prairie dog mortality, many raptors and scavengers are attracted to infected colonies. They ingest infected tissues and transmit plague-infected fleas to other localities and colonies (*34,38,41*).

The black-tailed prairie dog is found in various geographic regions across the United States where different reservoir species may be present. This must be considered when discussing plague ecology, because general statements may not be applicable to all prairie dog populations (*34*). Although the black-tailed prairie dog has been studied and documented for over a century, many aspects of its ecology are not fully understood. Whether or not the black-tailed prairie dog functions as a keystone species is an important issue because it affects future conservation, eradication, and management pro-

grams. Some species reported to be associated with black-tailed prairie dog colonies are specialists (i.e., black-footed ferret *(Mustela nigripes)* and have been listed under the Endangered Species Act because of their sensitivity to habitat fragmentation. Hopefully, the shift from single-species management to ecosystem management will provide further insight on the importance of the black-tailed prairie dog to the prairie ecosystem.

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