Recovery of black-tailed prairie dog colonies following a sylvatic plague epizootic
by Jeffry Dwight Fennell

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

Abstract:
Black-tailed prairie dogs suffered a 94-99%' reduction in habitat during the twentieth century. In recent decades, the introduced pathogen responsible for sylvatic plague has led to local extirpation of prairie dog colonies, reduction in colony size, and increased isolation between surviving colonies. Consequently, plague has become the biggest challenge to prairie dog conservation. For this study I estimated prairie dog densities on the Northern Cheyenne Indian Reservation following a sylvatic plague epizootic in the 1990s. I estimated densities using mark-recapture techniques and visual counting methods. I compared variations in densities based upon a colony's plague history and colony size. I hypothesized that densities would be higher on colonies that most recently experienced the plague. In 2000, prairie dog densities ranged between 11-91 prairie dogs/ha from 21 colonies. Densities ranged between 5-90 prairie dogs/ha from 23 colonies in 2001. Prairie dog density did not differ between years. There was no significant difference in densities based upon presence or absence of past plague or colony size. Colonies that had most recently recovered from a sylvatic plague had the highest densities. I also examined factors relating to a colony's probability of having had the plague, such as nearest neighbor distances, habitat between nearest neighbor, and distance to nearest road. I predicted that colonies would be more likely to contract plague if distances between neighboring colonies were small, the habitat between colonies facilitated dispersal, or colonies were on or near migration corridors. The distances to the nearest plagued colony and nearest non-plagued colony were the best predictors of a colony's probability of having experienced sylvatic plague. For those colonies that had sylvatic plague in the 1990s, distances to other colonies with plague were shorter (x = 3.1 km) than to colonies that did not experience plague (x = 19.7 km).

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APPROVAL

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Jeffry Dwight Fennell

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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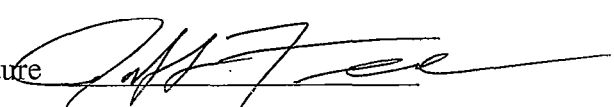
Signature 

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ABSTRACT

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INTRODUCTION

Prairie dogs (*Cynomys* spp.) affect a variety of ecosystem-level functions for nearly 120 vertebrate species (Miller et al. 1994, Kotliar et al. 1999). For example, prairie dogs serve as prey for such predators as the endangered black-footed ferret (*Mustela nigripes*) and golden eagle (*Aquila chrysaetos*). Their burrows provide nesting sites for the declining populations of burrowing owls (*Athene cunicularia*). Grazing by prairie dogs alters the plant community composition and creates open habitats within the prairie grasslands (Whicker and Detling 1988, Kotliar et al. 1999). Many types of avifauna, including the endangered mountain plover (*Charadrius montanus*), utilize these open areas.

Black-tailed prairie dog (*C. ludovicianus*) numbers began to decline as Europeans colonized the North American plains. Prairie dog habitat became fragmented as native grasslands were converted into pasture and agricultural fields (Hoogland 1995). Widespread poisoning campaigns further reduced prairie dog populations (Anderson et al. 1986, Cully and Williams 2001). Coupled with recurring sylvatic plague (*Yersinia pestis*) epizootics, black-tailed prairie dogs, along with the other 4 species of prairie dogs, continued to suffer population reductions during the past two decades (U. S. Department of the Interior 2000). Currently, the Mexican prairie dog (*C. mexicanus*) is listed as an endangered species while the Utah prairie dog (*C. parvidens*) is listed as a threatened species. Since European colonization, occupied prairie dog habitat has been reduced by 94-99% (U. S. Department of the Interior 2000, Roach et al. 2001).

Reductions in black-tailed prairie dog abundance prompted the National Wildlife Federation to file a petition with the United States Fish and Wildlife Service, requesting protection of the black-tailed prairie dog under the Endangered Species Act of 1973 (U.S. Department of Interior 2000). In 2000, the United States Fish and Wildlife Service determined that protection as a threatened species is warranted (U.S. Department of Interior 2000). However, listing of the species was precluded due to limited funds and the existence of higher priority species (U.S. Department of Interior 2000). This decision has allowed the 10 states with black-tailed prairie dog populations the opportunity to develop and implement management plans to avert federal listing.

Sylvatic plague, an introduced bacterial infection native to central Asia, has become the biggest challenge to prairie dog conservation (U.S. Department of Interior 2000, Cully and Williams 2001). To be effective, prairie dog management plans must cope with the unpredictability of sylvatic plague epizootics and the devastating effects that follow. Sylvatic plague is transmitted between mammals by a variety of flea species (Cully and Williams 2001). Although many North American mammals show some degree of resistance to the disease, mortality rates of infected black-tailed prairie dogs often exceeds 95% (Cully 1989). Sylvatic plague is able to spread quickly and thoroughly through black-tailed prairie dog colonies (Cully 1989). Plague epizootics often lead to local extirpation of prairie dog colonies, reduction in colony size, and increased isolation between surviving colonies (Cully and Williams 2001). Within such a highly fragmented landscape, isolated colonies that may become extirpated due to sylvatic plague stand little chance of natural recolonization.

In Montana, plague-infected fleas were found on black-tailed prairie dogs by the 1940s (U. S. Department of the Interior 2000). Possible epizootics in Montana occurred during the 1930s and 1970s, with documented epizootics taking place in the late 1980s and early 1990s (Restani et al. 2001, C. Knowles, FaunaWest, personal communication). Presently a plague epizootic is occurring on the Fort Belknap Indian Reservation and neighboring south Phillips County (M. Restani, personal communication). The Northern Cheyenne Indian Reservation, in southeastern Montana, experienced a plague epizootic from 1991 - 1996, which resulted in a large reduction in size of most prairie dog colonies.

The goal of this study was to measure the recovery of black-tailed prairie dog colonies following a sylvatic plague epizootic on the Northern Cheyenne Indian Reservation. Specific objectives were to estimate density of prairie dogs on a number of colonies that have had different recovery times since the epizootic. I examined several factors such as colony spacing, colony size, and plague history, which may be affecting variations in colony density. I hypothesized that densities of prairie dogs would be higher on colonies that are recovering from the plague, compared to colonies that escaped the plague. In addition, I also examined factors that may explain why some colonies contracted sylvatic plague when others did not. If plague was transmitted by movement of infected fleas from one colony to another via prairie dogs or other mammalian species, factors such as distance to nearest neighbors, the type of habitat between neighbors, or the existence of migration corridors between colonies would be related to the probability of a colony contracting sylvatic plague. I predicted that colonies would be more likely to

contract plague if distances between neighboring colonies were small, the habitat between colonies facilitated dispersal, or colonies were on or near migration corridors.

STUDY AREA

I conducted fieldwork in the Tongue River drainage of the Northern Cheyenne Indian Reservation in southeastern Montana (45°32'N, 106°25'W). Forested hills confined the prairie dog colonies to the eastern half of the reservation. Vegetation on the study area was consistent with the native big sagebrush-wheatgrass plains community typical in this region of the Northern Great Plains (Johnson and Larson 1999). Several intermittent streams flowed eastward across the study area into the Tongue River. This study involved only those colonies located on tribally controlled lands, which included most of the prairie dog colonies in the area. The landscape was divided into grazing units, which were used on a rotational basis by horses and cattle. I seldom saw livestock on the prairie dog colonies included in this study.

During 2000 and 2001 all colonies were open to recreational shooting year-round by tribal members. During the course of the study, evidence of shooting was found on several colonies, but only 3 groups of shooters were actually observed. However, I found only 1 prairie dog shot in two years and <15 skeletal remains from the study colonies. In regions of the state with higher shooting pressures, dead prairie dogs were much more common, and skeletal remains more abundant than found on the study area (personal observation). Thus, I believe that the shooting pressure was insignificant as compared to other regions of the state.

The Bureau of Indian Affairs mapped prairie dog colonies on the Northern Cheyenne Reservation in 1989 and 1990 by hand-plotting colonies onto USGS 7.5 minute quadrangle maps. Each year, from 1994 – 2001, mapping personnel used a global

positioning system (GPS) to estimate the size of prairie dog colonies. Mapping of colonies took place during the summer months over a two-week period. For mapping purposes, an individual colony was defined as a continuous area of occupied burrows (those burrows with prairie dogs and/or fresh droppings, Biggins et al. 1993) in a matrix of clipped vegetation. Colony boundaries were assumed to be at the approximate margin between clipped vegetation and non-clipped vegetation.

Before 1991, the reservation had approximately 3000 - 4000 ha of active prairie dog colonies. Since the mapping techniques used in 1989 and 1990 were less accurate than in later years, I used the average estimate from these two years as an estimate of the area of prairie dog colonies present (Fig. 1). Most of the occupied area was contained in a few large colonies that were evenly distributed across the eastern half of the reservation. In 1991 sylvatic plague was detected on the northern prairie dog colonies (P. Young, University of Arizona, personal communication). From 1991 - 1996, the disease spread south, infecting nearly every colony. By 1995, the reservation's prairie dog colonies had undergone a large reduction in area and had become fragmented into smaller colonies. In that year, prairie dog colonies covered only 151 ha (Fig. 1). By 2000, many of the northern colonies had recovered in size ($\bar{x}$ = 12.9 ha, SD = 22.8, n = 76), while the southern colonies remained relatively small ($\bar{x}$ = 4.2 ha, SD = 4.9, n = 33) and isolated. In 2000, the reservation had approximately 109 prairie dog colonies, totaling 834 ha (Fig.1). Colonies ranged in size from <1 to 134 ha ($\bar{x}$ = 10.3 ha, SD = 19.6, n = 109).