APPENDIX O

BIOLOGICAL EFFECTS OF BLACK-TAILED PRAIRIE DOG MANAGEMENT ALTERNATIVES ON ENDANGERED AND THREATENED SPECIES

BIOLOGICAL EFFECTS OF BLACK-TAILED PRAIRIE DOG MANAGEMENT ALTERNATIVES ON ENDANGERED AND THREATENED SPECIES

on units of the

Nebraska National Forest:

Buffalo Gap and Fort Pierre National Grasslands, South Dakota
Oglala National Grassland, Nebraska

Prepared by:

/s/John G. Sidle **June 17, 2008**
John Sidle, Fish and Wildlife Biologist **Date:**

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The purpose of this report is to examine the likely effects of black-tailed prairie dog (prairie dog) (*Cynomys ludovicianus*) management in the interior management zone (IMZ) on Nebraska National Forest (NNF) units (Buffalo Gap, Fort Pierre, and Oglala national grasslands) (national grasslands) for federally listed species and proposed species under the Endangered Species Act (ESA). This report is being conducted in conjunction with an environmental impact statement (EIS) analyzing the situation.

1. BACKGROUND

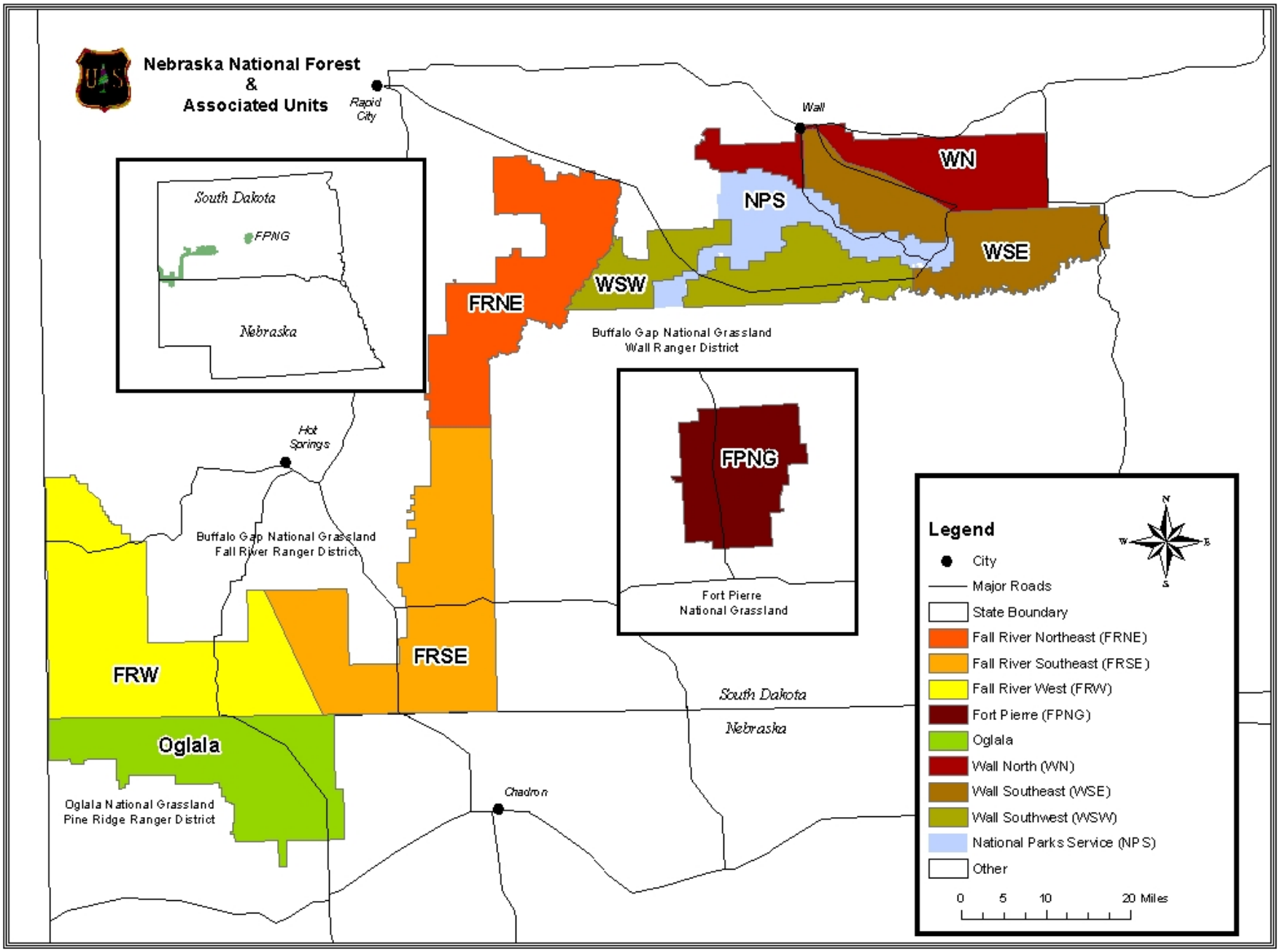
The 2001 Forest Plan did not set acre objectives for prairie dog colonies outside the Boundary management Zone (BMZ), and it limited rodenticide use to very specific situations. The 2005 *Record of Decision for Black-tailed Prairie Dog Conservation and Management on the Nebraska National Forest* (Amendment 2) (USDA Forest Service 2005e) focused on the encroachment of prairie dog colonies from national grasslands onto adjoining private or tribal lands, where ranchers and farmers are concerned about losses in agricultural production, costs of managing prairie dogs, effects on land values, and risks to health and safety. That effort dealt with the prairie dog colonies near NNF boundaries or boundary management zone (BMZ) and the impacts as colonies expanded onto non-Forest Service lands. For South Dakota national grasslands, the BMZ has been defined on the Buffalo Gap National Grassland as less than one-half mile from private land and less than a quarter mile on the Fort Pierre National Grassland. On the Oglala National Grassland in Nebraska, the BMZ is less than one-half mile from private land.

The purpose of the action is to determine the techniques and objectives for managing prairie dog colonies in the IMZ of the Oglala, Buffalo Gap, and Fort Pierre national grasslands in an adaptive fashion through the following:

- Setting objectives for desired acres of prairie dog colonies within the interior of the national grasslands to move toward desired prairie dog acres, and to maintain or move toward desired vegetation cover, protect top soil, and prevent the establishment of noxious and invasive species.
- Managing black-tailed prairie dog habitat designated as a black-footed ferret management area (MA 3.63) in the 2001 Forest Plan to sustain populations of black-footed ferrets and associated species.

2. AREA AFFECTED

Geographic Areas (GAs) are administrative units on the national grasslands. Their administrative boundary encompasses federal land and non-federal lands (mostly private) (see Figures 1 and 2 for examples of GAs, depictions of IMZ, BMZ, and extent of prairie dog colonies; see maps of other GAs in Appendix F). Portions of three GAs, Wall Southeast, Wall Southwest, and Fall River Southeast, are designated as Management Are 3.63 (MA 3.63) for black-footed ferret conservation (Figure 4).


Nebraska National Forest
&
Associated Units
Rapid City
Wall
South Dakota
FPNG
Nebraska
WN
NPS
WSE
WSW
FRNE
Buffalo Gap National Grassland
Wall Ranger District
FPNG
Fort Pierre
National Grassland
Hot Springs
Buffalo Gap National Grassland
Fall River Ranger District
FRW
FRSE
South Dakota
Nebraska
Oglala
Oglala National Grassland
Pine Ridge Ranger District
Chadron
Legend
City
Major Roads
State Boundary
Fall River Northeast (FRNE)
Fall River Southeast (FRSE)
Fall River West (FRW)
Fort Pierre (FPNG)
Oglala
Wall North (WN)
Wall Southeast (WSE)
Wall Southwest (WSW)
National Parks Service (NPS)
Other
0 5 10 20 Miles

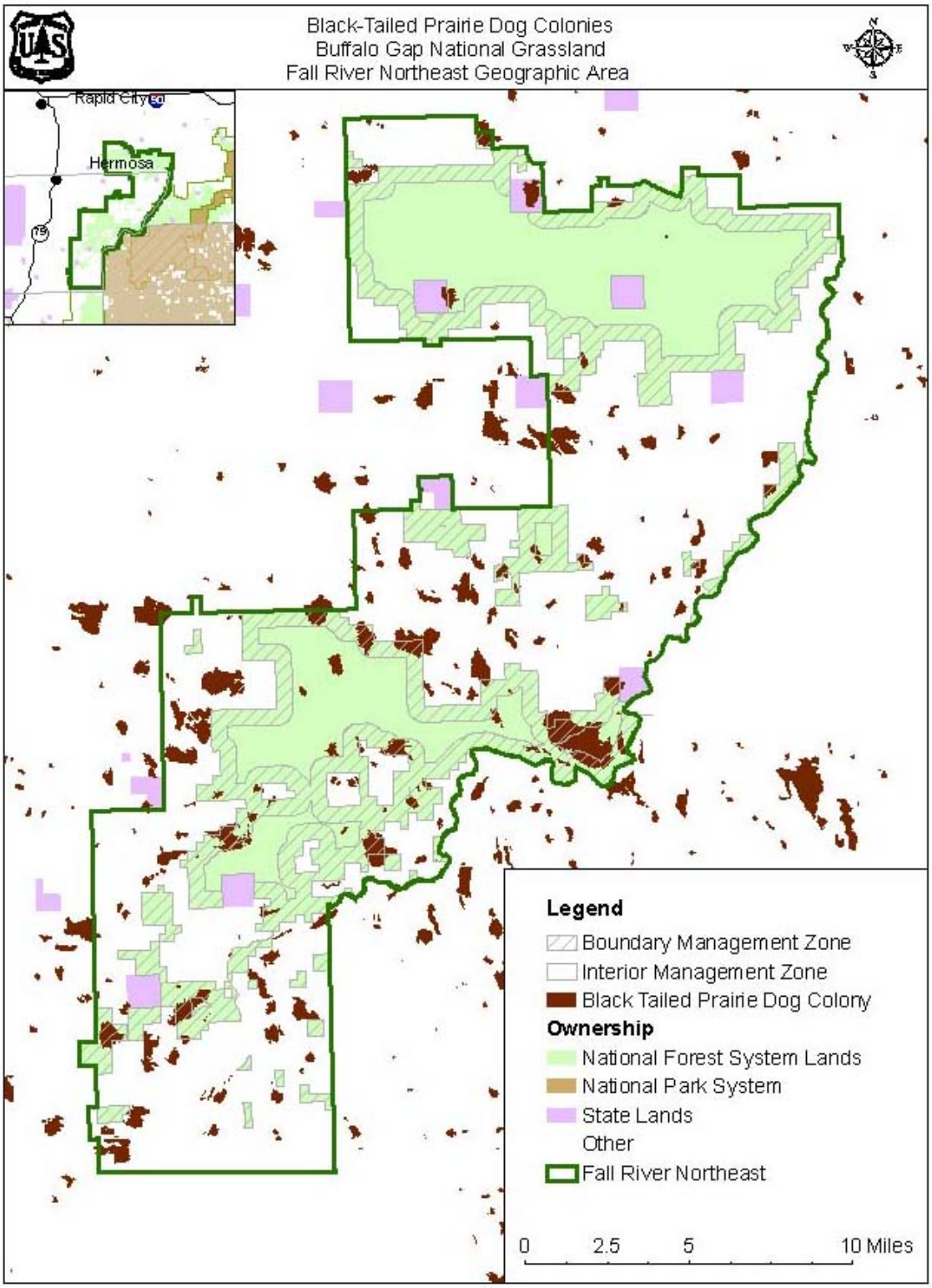


Figure 1. An example of a Geographic Area (GA) showing the extent of black-tailed prairie dog colonies on and in the vicinity of Buffalo Gap National Grassland (Fall River Northeast GA), South Dakota, in 2007 (Nebraska National Forest Geographic Information System, Kempena 2007).

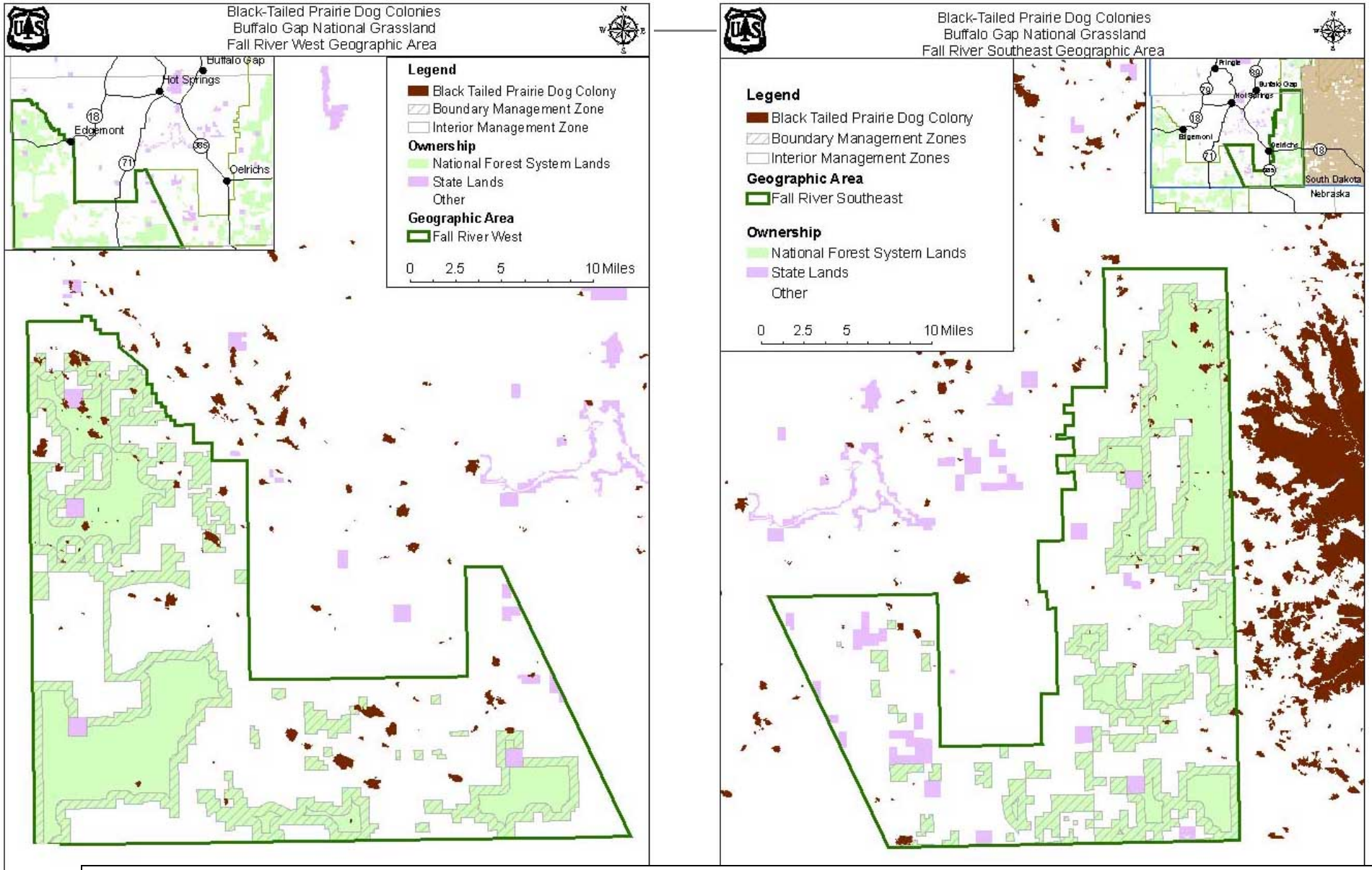


Figure 2. The extent of black-tailed prairie dog colonies on and in the vicinity of Fall River Southwest and Fall River Southeast GAs, Buffalo Gap National Grassland, South Dakota, in 2007. The large prairie dog colonies on the Pine Ridge Reservation (far right) have been affected by plague but vast colony acreages remain suitable for black-footed ferret reintroduction (Nebraska National Forest Geographic Information System, Kempena 2007).

Buffalo Gap National Grassland and Geographic Areas. The Buffalo Gap National Grassland (Buffalo Gap) is located in southwestern South Dakota and includes more than 589,000 acres of land that borders private, state, Indian reservation, and national park lands. The eastern half of this unit extends from near Kadoka to the Cheyenne River on the west, north to U.S. Highway 14, and south to the Pine Ridge Indian Reservation. The Wall Ranger District (WRD) at Wall, administers the eastern half. The WRD is divided into three GAs (Wall North, Wall Southeast, and Wall Southwest). Wall Southeast contains a 3,910-acre area designated as a MA 3.63 for black-footed ferret reintroduction. Wall Southwest contains Conata and Scenic Basins, a 73,243-acre are with emphasis on black-footed ferret habitat (MA 3.63). Black-footed ferrets have been successfully reintroduced into this area. For clarity, the 3,910 and 73,243 acres are combined as the 77,155-acres Conata Basin MA 3.63.

The western half of Buffalo Gap extends from the Cheyenne River on the east to the Wyoming and Nebraska borders on the west and south, respectively, and is administered by the Fall River Ranger District (FRRD), Hot Springs. The FRRD is divided into three GAs (Fall River West, Fall River Southeast, and Fall River Northeast). Fall River Southeast contains Smithwick, a 25,307-acre MA 3.63 for black-footed ferret reintroduction. No black-footed ferrets have been reintroduced.

Fort Pierre National Grassland and Geographic Area. The Fort Pierre National Grassland (Fort Pierre) (116,053 acres) lies south of Pierre, South Dakota, north of Interstate 90, and west of the Lower Brule Indian Reservation. The Fort Pierre consists of mixed-grass vegetation on a rolling hill landscape just west of the Missouri River.

Oglala National Grassland and Geographic Area. The 94,484-acre Oglala National Grassland lies in Dawes and Sioux counties of northwestern Nebraska and contains mostly mixed-grass vegetation. Topography consists of rolling hills and badlands. The grassland is administered by the Pine Ridge Ranger District, Chadron, Nebraska.

Existing Condition – Prairie Dog Colonies

Prairie dog colonies occur throughout the GAs but are most numerous in the Wall Southwest GA, especially Conata Basin (Table 1; Figure 3), an area dedicated to large complexes of prairie dog habitat for black-footed ferret recovery. Much smaller acreages of prairie dog colonies occur in the other GAs. The number, density, and distribution of colonies in non-black-footed ferret areas on national grasslands in southwest South Dakota are similar to that found on private land in the same area. Maps of prairie dog colonies, potential prairie dog habitat, and buffer zones are in Appendix F. Please review these maps to understand the extent of prairie dog colonies and suitable prairie dog habitat.

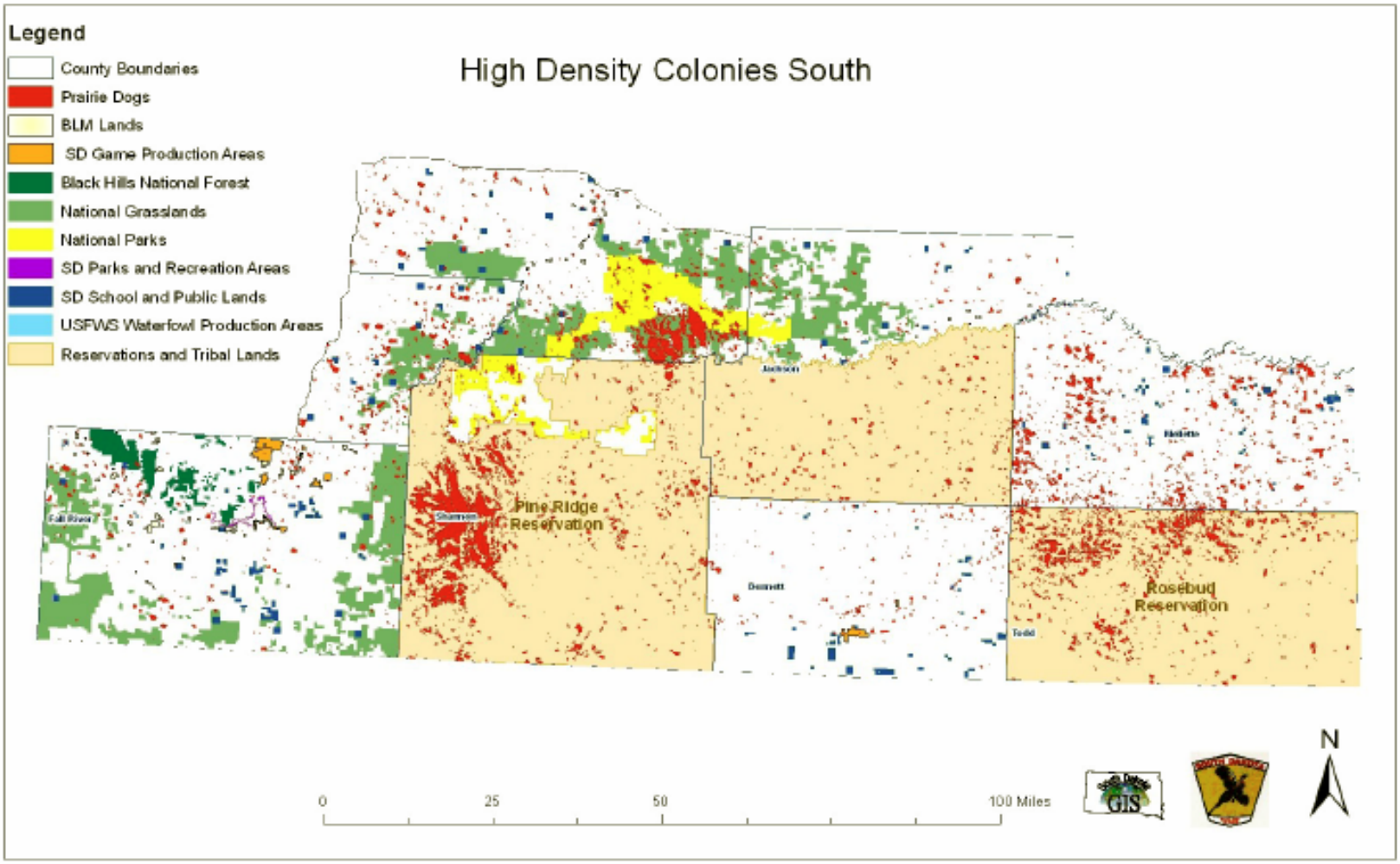


Figure 3. Distribution of black-tailed prairie dog colonies in southwestern South Dakota (Kempema 2007). Most of the prairie dog colony acreage is located on reservations and tribal lands (extensive tribal lands in Mellette and Bennett counties are not depicted). The large red areas in the center of the map are colonies in Conata Basin, Buffalo Gap National Grassland. This map places prairie dog colony acreages (blackfooted ferret habitat) into perspective. For example, Fall River County (the most southwest county) is 1,122,286 acres in size. About 16,855 acres or 1.5% of Fall River County is prairie dog colony. The Buffalo Gap National Grassland in Fall River County contains 2,855 of the 16,855 acres. Most of the remaining acreage occurs on private land.

Table 1. The extent of black-tailed prairie dog colonies (black-footed ferret habitat) during 2002 and 2006. Also displayed are the extents of the BMZ, IMZ, and suitable habitat (Source: Nebraska National Forest, Geographic Information System).

Geographic and Management Areas	***Total Non-NFS Acres in Geographic and Management Areas***	***2002 Prairie Dog Colony Acreage (% of non-NFS acres in GA)***	***2006 Prairie Dog Colony Acreage***	***Total NFS Acres in Geographic Area***	***Total Suitable NFS Acres for Prairie Dogs***	***Total Acres in BMZ***	***Total Acres Suitable for Prairie Dogs in BMZ***	***Acres of Prairie Dog Colonies Poisoned in BMZ, 2006***	***Total Acres in IMZ***	***Total Suitable Acres (IMZ)***	***2002 Prairie Dog Colony Acreage (% of NFS acres in GA)***	***2006 Prairie Dog Colony Acreage (% of NFS acres in GA)***
Oglala	*121,274*	*NA*[1]	*NA*	*94,484*	*62,347 (66%)*	*64,902 (69%)*	*43,701*	*1,011*	*29,582*	*18,646*	*2,192 (2.3%)*	*1,125 (1.2%)*
Fall River Northeast	*119,265*	*5,008 (4%)*	*4294 (3.6%)*	*91,298*	*78,806 (86%)*	*51,334 (56%)*	*45,328*	*1,998*	*39,964*	*33,478*	*3,851 (4.2%)*	*1,130 (1.2%)*
Fall River West	*192,868*	*2,438 (1.2%)*	*2112 (1%)*	*119,951*	*116,434 (97%)*	*70,088 (58%)*	*68,014*	*780*	*49,863*	*48,420*	*1,358 (1.1%)*	*210 (0.17%)*
Fall River Southeast	*189,165*	*821 (0.4%)*	*722 (0.4%)*	*86,666*	*84,142 (97%)*	*61,515 (71%)*	*59,448*	*411*	*25,151*	*24,694*	*1,509 (1.7%)*	*42 (0.04%)*
Smithwick MA 3.63	*1*	*0*	*0*	*25,307*	*24,187 (95%)*	*7,658 (30%)*	*7,177*	*68*	*17,649*	*17,010*	*990 (4%)*	*503 (2%)*
Wall North	*76,450*	*426 (0.5%)*	*454 (0.6%)*	*69,437*	*63,894 (92%)*	*53,418 (77%)*	*49,093*	*940*	*16,019*	*14,801*	*397 (0.5%)*	*454 (0.6%)*
Wall Southeast	*86,107*	*975 (1%)*	*982 (1%)*	*90,840*	*79,017 (87%)*	*58,000 (64%)*	*51,132*	*1,370*	*32,840*	*27,885*	*1,312 (1.4%)*	*1,414 (1.5%)*
Wall Southwest	*57,810*	*1,231*	*1,701*	*28,580*	*15,125 (53%)*	*14,456 (50%)*	*8,432*	*279*	*14,124*	*6,693*	*186 (0.6%)*	*214 (0.7%)*
Conata Basin MA 3.63	*353*	*81*	*77*	*77,155*	*68,183 (88%)*	*25,149 (37%)*	*21,784*	*5,251*	*52,006*	*46,399*	*22,530 (29%)*	*26,484 (34%)*
Fort Pierre	*74,921*	*130 (0.17%)*	*163 (0.2%)*	*116,053*	*108,409 (93%)*	*50,639 (44%)*	*47,195*	*621*	*65,414*	*61,214*	*1,346 (1.1%)*	*1,735 (1.5%)*
Total (Fall River Northeast through Fort Pierre)	*918,214*	*11,110*[2] *(1.4%)*	*10,505*[2]*(1.3%)*	*799,771*	*700,544 (87%)*	*457,159*	*401,304*	*12,729*	*342,612*	*299,240*	*35,671 (4.4%)*	*33,311 (4.1%)*

[1]No information is available on the extent of prairie dog colonies on non-NFS lands in the Oglala GA.

[2]Based upon total non-NFS acres (796,940) in Fall River Northeast, Fall River West, Fall River Southeast, Smithwick MA 3.63, Wall North, Wall Southeast, Wall Southwest, Conata Basin MA 3.63, and Fort Pierre.

3. THE ALTERNATIVES ANALYZED IN THE FEIS

The action is to amend current management direction in the NNF LRMP to: 1) specify the desired range of acres of prairie dog colonies in the IMZ on Buffalo Gap, Fort Pierre, and Oglala national grasslands; and 2) allow toxicants in the IMZ if the acreage exceeds the desired range and for multiple use objectives. The effects considered in this analysis are:

- Effects of setting minimum and maximum acres of prairie dog colonies for each GA.
- Effects of rodenticide application in the IMZ on black-footed ferrets and whooping cranes, the two species listed under the ESA that are known to occur or may occur in all or some of the GAs.

Below is a summary of each alternative. Refer to Chapter 2 of the FEIS for more details on each alternative. The alternatives propose a range of prairie dog colony acres by GA and MA (Table 2). The "no action" alternative, Alternative 2, does not specify any specific range of acres, however, estimated acreages are provided based upon observed colony expansion rates. Alternative 4 only proposes a range of acres for the Conata Basin MA 3.63. Alternatives 1, 3, and 4 also provide for use of rodenticide to reduce prairie dog density if a threshold based on Similarity Index or Desired Vegetation Condition is exceeded.

ALTERNATIVE 1

This alternative employs adaptive management in emphasizing a mix of multiple uses while sustaining black-footed ferrets within MA 3.63. This alternative is based on a moderate objective for prairie dogs while incorporating adaptively applied active and passive management tools. Alternative 1 strives for a more balanced allocation between social/economic and biological issues while also sustaining black-footed ferrets. In the Conata Basin MA 3.63 where black-footed ferrets currently exist, this alternative prioritizes black-footed ferrets and the associated need for prairie dog colonies over other multiple uses. This alternative utilizes an Adaptive Response Protocol (See FEIS Appendix H- Implementation Plan) to help make implementation decisions at the site-specific level.

Outside of MA 3.63, maximum prairie dog colony acres are 3% of the total aggregate acres of national grassland within each GA. The minimum acres reflect an objective to establish one prairie dog colony complex on each GA that does not include 3.63 Black-footed Ferret Reintroduction Habitat. By definition, a prairie dog colony complex is a minimum of 1,000 acres of prairie dogs in 10 or more colonies with inter-colony distances not exceeding 6 miles. Higher acreages of active prairie dogs will be maintained in the 3.63 Black-footed Ferret Reintroduction Habitat.

ALTERNATIVE 2

This alternative is the current prairie dog management as defined in the 2001 Forest Plan and 2005 amendment. The 2001 Forest Plan did not set specific acreage objectives (caps) for prairie dog colonies. The current management objective for prairie dogs located in the IMZ is to regulate and manage prairie dog populations through non-lethal methods and limited rodenticide use where public health and safety risks are present or where damage to private and public

facilities is occurring. Otherwise, prairie dog colonies are allowed to grow and contract. In addition, managers may use a suite of tools to expand prairie dog colonies.

The 2001 Forest Plan continued the black-footed ferret reintroduction project begun with the 1994 Conata Basin/Badlands black-footed reintroduction FEIS and Record of Decision authored by the Forest Service, National Park Service, and USFWS. To briefly review the history, the Reintroduction Area (three units) in 1994 was about 42,000 acres (Figure 12). The Non-Essential Experimental Population Area is about 1.2 million acres. In 1994, there were about 8,000 acres of black-tailed prairie dog colonies on Forest Service lands and several thousand acres on Badland National Park. Other colonies occurred outside the units. The 1994 Record of Decision designated 206,300 acres of Buffalo Gap National Grassland outside the Reintroduction Area as dispersal habitat for black-footed ferrets that move outside the Reintroduction Area. USFWS et al. (1994) envisioned that black-footed ferrets would not simply remain within the three units illustrated but rather would move to other colonies and that greater acreages of prairie dog colonies would be required. USFWS (1992; cited in USFWS et al. (1994) recommended that a site with 11,700 to 23,500 acres (or more) of active prairie dog colonies with an average prairie dog density of 5 prairie dogs per acre represents habitat for sustaining a population of 95 breeding black-footed ferrets.

The 2001 Forest Plan encapsulated the black-footed ferret reintroduction project by establishing the Conata Basin MA 3.63 (Figure 4). In effect, the 2001 Forest Plan included the 1994 Reintroduction Area and also much of the 1994 206,300 acres of dispersal habitat by deciding not to limit the extent of prairie dog colonies outside of the Conata Basin/Badlands MA 3.63. The Plan also established another black-footed ferret reintroduction site, Smithwick MA 3.63.

The theme or purpose of the MA 3.63 areas is uniquely black-footed ferret reintroduction habitat, providing prairie dog colonies to support a viable black-footed ferret population. Livestock grazing and other uses may occur in the 3.63 areas but fundamentally the emphasis is on habitat of the black-footed ferret. Specific acreages of prairie dog colonies were not enumerated in the 2001 Plan because of uncertainties surrounding black-footed ferret habitat requirements and population size. The 2001 Plan afforded flexibility in managing an endangered species.

Under the 2001 Plan, "black-tailed prairie dog colony complexes are to be actively and intensively managed as reintroduction habitat for black-footed ferrets." Desired conditions are "large prairie dog colony complexes established and maintained as suitable habitat for black-footed ferret reintroductions. Land uses and resource management activities are conducted in a manner that is compatible with maintaining suitable black-footed ferret habitat. The Forest Service works with other agencies and organizations to pursue conservation agreements or easements with adjoining land jurisdictions to achieve black-footed ferret recovery objectives. Where landownership patterns are not conducive to effective and successful prairie dog and black-footed ferret management, landownership adjustments with willing landowners may also be used to help resolve management issues." Moreover, the Forest Service "authorizes only those uses and activities that do not reduce the suitability of the area as black-footed ferret reintroduction habitat." All prairie dog colonies within this area "are managed as though they are occupied by black-footed ferrets." In addition, "Relocation of prairie dogs to establish new colonies and accelerate growth of prairie dog populations in selected areas may occur only after consultation with appropriate state and federal wildlife agencies." To help expand and maintain suitable black-footed ferret habitat, prairie dog shooting is prohibited.

In 2005, the Plan was amended and a boundary management zone (BMZ) was established within 0.5 miles of private and tribal lands where control of prairie dogs may occur. The BMZ effectively removed 25,149 acres (21,784 acres suitable for black-tailed prairie dogs) from the Conata Basin MA 3.63, assuming that all adjoining landowners would file valid complaints when prairie dogs expanded onto or approached their land. The BMZ effectively removed 7,658 acres (7,177 acres suitable for black-tailed prairie dogs) from the Smithwick MA 3.63, again assuming that all adjoining landowners would not tolerate colonization by prairie dogs from the national grasslands. The BMZ also eliminated most suitable prairie dog habitat from the non-MA 3.63 areas (Table 1; Figures 1 and 2).

The 2001 Forest Plan's prairie dog expansion model estimated 24,400-39,800 acres of prairie dog colonies on the NNF by 2012. The 2005 Forest Plan amendment estimated 29,600-41,400 acres by 2012. There are currently 33,310 acres of occupied prairie dog colonies. Observed annual growth rates on the NNF indicate an average expansion rate of 25 percent, the rate used in the current FEIS to predict acres on the NNF in the next 10 years. This rate includes recent years when extended drought conditions have facilitated prairie dog colony expansion, although prairie dog populations have not necessarily increased. The 2001 Forest Plan has allowed black-footed ferret habitat (prairie dog colonies) to increase consistent with the priority of MA 3.63 areas and allowed for extensive black-footed ferret dispersal to non-MA 3.63 areas by not capping prairie dog colony acreage.

ALTERNATIVE 3

This alternative ensures that there is not a disproportionate share of prairie dog colony acres in any county containing federal lands. In South Dakota, this alternative only allows a maximum prairie dog colony acreage of 3% of the total aggregate federal ownership in each county. Any minimum numbers are essentially set by the vegetative condition of each prairie dog colony based on a NRCS Ecological Site Similarity Index threshold (Natural Resource Conservation Service – USDA 2006). If the similarity index falls below 25%, the prairie dogs will be reduced to 10% of the active colony acreage. On the Oglala National Grassland, Nebraska, the range of acres of active prairie dog colonies is 100-900 acres.

ALTERNATIVE 4

This alternative is derived from the South Dakota State Prairie Dog Plan (Cooper and Gabriel 2005). It calls for 8,000-12000 acres of prairie dog colonies in Conata Basin. The State Plan did not specify colony acreage outside of Conata Basin. The Plan set objectives at the state-wide level for tribal and non-tribal acreage and did not set specific acreage objectives for all federal lands included in this analysis.

ALTERNATIVE 5

This alternative emphasizes prairie dogs and black-footed ferrets. In non-MA 3.63 areas, prairie dog colony acreage represents 10% of the total acres in the GA as a minimum and 20% as a maximum. In the 3.63 Black-footed Ferret Reintroduction Habitat in Conata Basin the maximum acreage objective is based on what is required to maintain 200 breeding adult ferrets (using average black-footed ferret home range data collected in Conata Basin and adjusted for unoccupied areas (Livieri 2007a, c)), and includes a range of acres based on prairie dog densities. During drought, prairie dog colonies expand but there are fewer prairie dogs per acre. This low density of prairie dogs leads to larger home ranges of black-footed ferrets. During wet periods

prairie dog colonies exhibit higher densities of prairie dogs and black-footed ferret home ranges contract. The minimum acre objective for Conata Basin is based on what is required to maintain 120 breeding adult black-footed ferrets. The prairie dog colony acre objective for the Smithwick black-footed ferret area is based on what is required to maintain 50 breeding adult ferrets during wet and dry periods.

Table 2. Minimum and maximum prairie dog colony acres by alternative and the percentage of national grasslands that such acres occupy in each Geographic Area.

Geographic and Management Areas	Alt. 1	Alt. 2[1]	Alt. 3	Alt. 4[2]	Alt. 5
Oglala	*1,000-2,800 (1-3%)*	*1,125-13,097 (1.1-14.7%)*	*100-900 (0.1-0.9%)*	-	*9,500-18,900 (10-20%)*
Fall River Northeast	*1,000-2,800 (1-3%)*	*1,130-13,155 (1.2-14.4%)*	*2,700 (3%)*	-	*9,100-18,300 (10-20%)*
Fall River West	*1,000-3,600 (0.8-3%)*	*210-2,445 (0.1-2%)*	*3,600 (3%)*	-	*12,000-24,000 (10-20%)*
Fall River Southeast	*No acreage objective*	*42-489(0.05-0.5%)*	*2,500 (2.8%)*	-	*8,700-17,300 (10-20%)*
Smithwick MA 3.63	*2,100-5,000 (8-19.7%)*	*503-5,856 (2-23%)*	*800 (3%)*	-	*9,600-17,000 (38-67%)*
Wall North	*1,000-2,100 (1.4-3%)*	*454-5,285 (0.6-7.6%)*	*2,100 (3%)*	-	*6,900-13,900 (10-20%)*
Wall Southeast	*1,000-2,900 (1.1-3%)*	*1,414-16,461 (1.5-18%)*	*2,700 (3%)*	-	*9,100-18,200 (10-20%)*
Wall Southwest	*No acreage objective*	*214-2,491 (0.7-8.7%)*	*830 (3%)*	-	*2,600-5,100 (9-20%)*
Conata Basin MA 3.63	*12,500-19,000 (16-24%)*	*26,484-46,400 (34-60%)*	*2,200 (2.8%)*	*8,000-12,000 (10-15.5%)*	*27,000-46,400 (35-60%)*
Fort Pierre	*1,000-3,500 (0.8-3%)*	*1,735-20,198 (1.5-17.4%)*	*3,470 (3%)*	-	*11,600-23,200 (10-20%)*
Total	*20,600-41,200 (2.5-5.1%)*	*33,311-125,877 (4.1-15.7%)*	*21,800 (2.7%)*	-	*106,100-202,300 (13.2-25.2%)*

[1]Alternative 2 is the current Forest Plan which does not restrict the growth of prairie dog colonies. The Plan does not set minimum and maximum acres of prairie dog colonies. The numbers listed under Alternative 2 are the current acreage and what is projected to occur there in ten years based upon current prairie dog colony expansion rates, however, many factors determine if Alternative 2 maximum acreages will be achieved especially now that plague exists in the planning area.

[2]Alternative 4 represents the State of South Dakota's desire's for Conata Basin MA 3.63. The State did not suggest any prairie dog colony acreages for the Geographic Areas or Smithwick MA 3.63.

4. ENDANGERED SPECIES CONSIDERED IN THE ANALYSIS

On April 5, 2007 a list of species to be evaluated was received from USFWS. Four species, the least tern, piping plover, Ute Ladies' Tresses, and pallid sturgeon do not occur on any units of the Nebraska National Forest nor is there any suitable habitat that could be affected, and therefore these species are not analyzed further. Two federally-listed species are analyzed in

detail in this report: black-footed ferret and whooping crane, which are known to occur or may be present on the Nebraska National Forest (Table 3).

Table 3. Species listed as endangered under the Endangered Species Act and located in the Project's Geographic Areas (K = Known occurrence; P = Possible but unconfirmed occurrence).

	Buffalo Gap National Grassland						Fort Pierre National Grassland	Oglala National Grassland
	Fall River West	Fall River SE	Fall River NE	Wall North	Wall SW	Wall SE		
Black-footed ferret[1]	---	---	---	---	K	K	---	---
Whooping crane	P	P	P	P	P	P	P	P

[1]Non-essential experimental population (USFWS 1994)

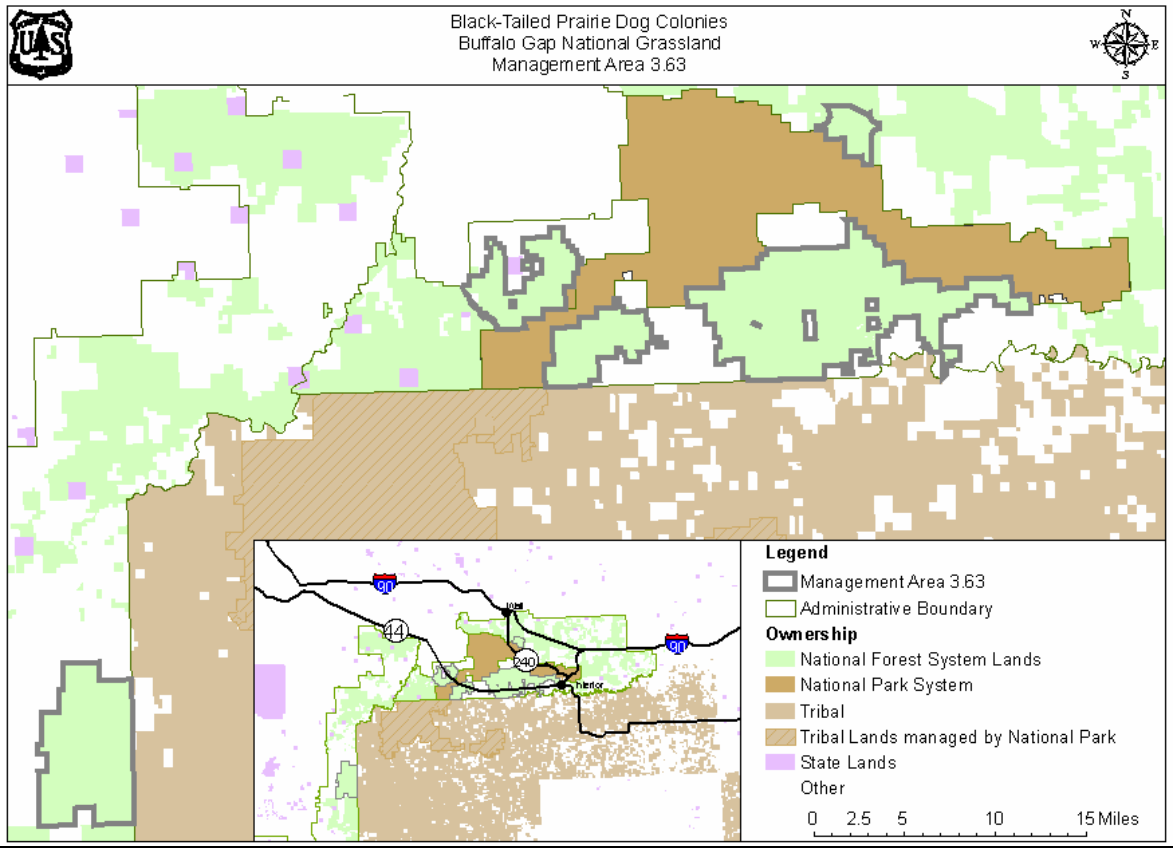


Figure 4. The **Conata Basin and Smithwick Management Areas 3.63** (outlined in grey above). Conata Basin is in the center and occurs in the Wall Southwest and Wall Southeast Geographic Areas. Smithwick is in the lower left corner and occurs in the Fall River Southeast geographic Area. About 88% (68,182 acres) of Conata Basin 3.63 is suitable habitat for prairie dog colonies (black-footed ferret habitat). The 2005 Boundary Management Zone (BMZ) decision changed suitable habitat for prairie dog colonies from 68,182 acres to 49,687 acres, a 27% reduction. Almost all colonies in the BMZ are controlled in response to a valid complaint and determination by the Forest Service. The 2005 BMZ decision changed suitable habitat for prairie dogs in the Smithwick from 24,187 acres to 17,649 acres, a 27% reduction. There are currently about 26,000 acres of prairie dog colonies in Conata Basin 3.63, leaving another 23,687 acres for potential expansion or colonization as prairie dog colony extent shifts from current locations.

The Conata Basin/Badlands Reintroduction Area was designated as non-essential experimental population under Section 10(j) of the ESA (59 Federal Register 42682-42694; August 18, 1994) (Figure 12). A 10(j) black-footed ferret population is not afforded the same level of protection as a fully endangered species but is treated as a "proposed" species for the purposes of ESA Section 7 consultation on National Forest System lands. ESA Section 9 prohibitions still apply to the deliberate take of a black-footed ferret. On National Park Service lands, the species' status is considered threatened. The relaxed standards associated with a 10(j) designation are sometimes necessary to provide management flexibility while attempting to establish the population and also to sustain support for reintroduction efforts at the state and local level. Any black-footed ferrets occurring outside of the 10(j) area would have endangered status.

5. BLACK-FOOTED FERRET STATUS AND DISTRIBUTION

ESA Status	**Conservation Status** (http://www.natureserve.org)
Endangered	G1, N1; Nebraska – SH; South Dakota - S1

The black-footed ferret is the 11th rarest mammal in the world and was listed in 1967 as endangered under the Endangered Species Preservation Act of 1966, and in 1970 under the Endangered Species Conservation Act of 1969, forerunners to the ESA of 1973. Critical habitat has not been designated for the species. Nebraska and South Dakota list the species as endangered. The black-footed ferret is listed as extirpated by Canada and a recovery team and plan have been established (http://www.cosewic.gc.ca; http://www.speciesatrisk.gc.ca). Mexico has cooperated with the re-introduction of black-footed ferrets into northern Mexico. The U.S. Government is a state member of the International Union for the Conservation of Nature and Natural Resources (IUCN) which lists the black-footed ferret as extinct in the wild (IUCN 1996; http://www.iucn.org/themes/ssc/redlist2006/redlist2006.htm).

The Canada/Mexico/United States Trilateral Committee for Wildlife and Ecosystem Conservation and Management has identified the black-tailed prairie dog as a species of common conservation because of its role in the conservation of the black-footed ferret. The North American Agreement on Environmental Cooperation calls for action to encourage conservation of wildlife and wildlife habitat, and specifically, the protection of species in danger of extinction (http://www.cec.org). The black-footed ferret is listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Appendix I lists species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research.

Distribution and Status. Our understanding of historic black-footed ferret distribution derives from the literature and museum specimens. Black-footed ferrets from Arizona, Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Wyoming, Alberta, and Saskatchewan have been collected since the late 1800s (Anderson et al. 1986). The black-footed ferret formerly occurred at colonies of three species of prairie dogs (Anderson et al. 1986). Over 84 percent of black-footed ferrets occurred at black-tailed prairie dog colonies, the species with the largest range of any prairie dog species (Ernst et al. 2006).

The black-footed ferret was probably common, although its secretive habits (nocturnal and often underground) made it difficult to observe (Anderson et al. 1986, Clark 1989, Forrest et al. 1985). Given the historic extent of prairie dog colonies, Anderson et al. (1986) estimated that 500,000 to 1,000,000 black-footed ferrets once populated prairie dog colonies. For most of the twentieth century, however, the species was believed almost extinct due to the near eradication of prairie dogs, especially complexes of thousands of acres of prairie dog colonies. The first opportunity to study black-footed ferrets was during 1964-1974 at black-tailed prairie dog colonies in Mellette County, South Dakota. This remnant population was disappearing and removed black-footed ferrets died in captivity during captive breeding attempts. Black-footed ferrets were discovered in 1981 in white-tailed prairie dog colonies near Meeteetse, Wyoming (Clark et al. 1986, Miller et al. 1996). In 1985, sylvatic plague, a lethal disease to prairie dogs and black-footed ferrets, struck the prairie dogs at Meeteetse killing most prairie dogs.

Lethal canine distemper also was discovered in the Meeteetse black-footed ferrets. In 1986, the remaining eighteen Meteetse black-footed ferrets were removed to protect them from distemper and to start a captive breeding program (Miller et al. 1996). Seven of the black-footed ferrets were successfully bred in captivity (Garrelle et al. 2006, Hutchins et al. 1996). The extant population today, both captive and wild, descends from these seven "founder" animals. Several thousand black-footed ferrets have been produced in captivity (Conservation Breeding Specialist Group 2004). A goal of the breeding program is to retain as much genetic diversity as possible, although intensive searches throughout the black-footed ferret's range have not discovered any wild black-footed ferrets since the Meeteetse find. It is very unlikely that any undiscovered wild populations remain (Hanebury and Biggins 2006, Lockhart et al. 2006).

There are about 250 breeding adult black-footed ferrets in the wild. About 89 breeding adults occurred in Conata Basin in 2006. The number of breeding adults is the standard for measuring the status of black-footed ferret populations. Figure 5 displays black-footed ferret populations, including kits, at the various reintroduction sites. The current wild population is well short of the objective to ensure the immediate survival of the species by establishing 1,500 breeding adults in 10 or more populations by 2010 (USFWS 1988). Since 1991, black-footed ferrets have been reintroduced into twelve sites including one site in Mexico. Two sites have failed to sustain a black-footed ferret population while other sites display varying results. The largest populations currently exist at Shirley Basin, Wyoming, Conata Basin, South Dakota and Cheyenne River Sioux Reservation, South Dakota. Wild animals from Conata Basin and Cheyenne River have been translocated to other reintroduction sites. To achieve black-footed ferret recovery goals, large self-sustaining populations are needed.

There are few successful black-footed ferret sites, that is, sites free of plague and containing large prairie dog colony acreages. In 2006, Wind Cave National Park, South Dakota and northwestern Kansas were selected in preliminary black-footed ferret allocations. These sites and Lower Brule Sioux Reservation are much smaller than previous reintroduction sites. Such sites are being tapped because there are no large complexes available for reintroduction. They may not be self-sustaining but provide an opportunity for new sites east of the current plague line, cooperative efforts with new partners to produce wild-born kits, and potential refugia in the event of increased plague activity.

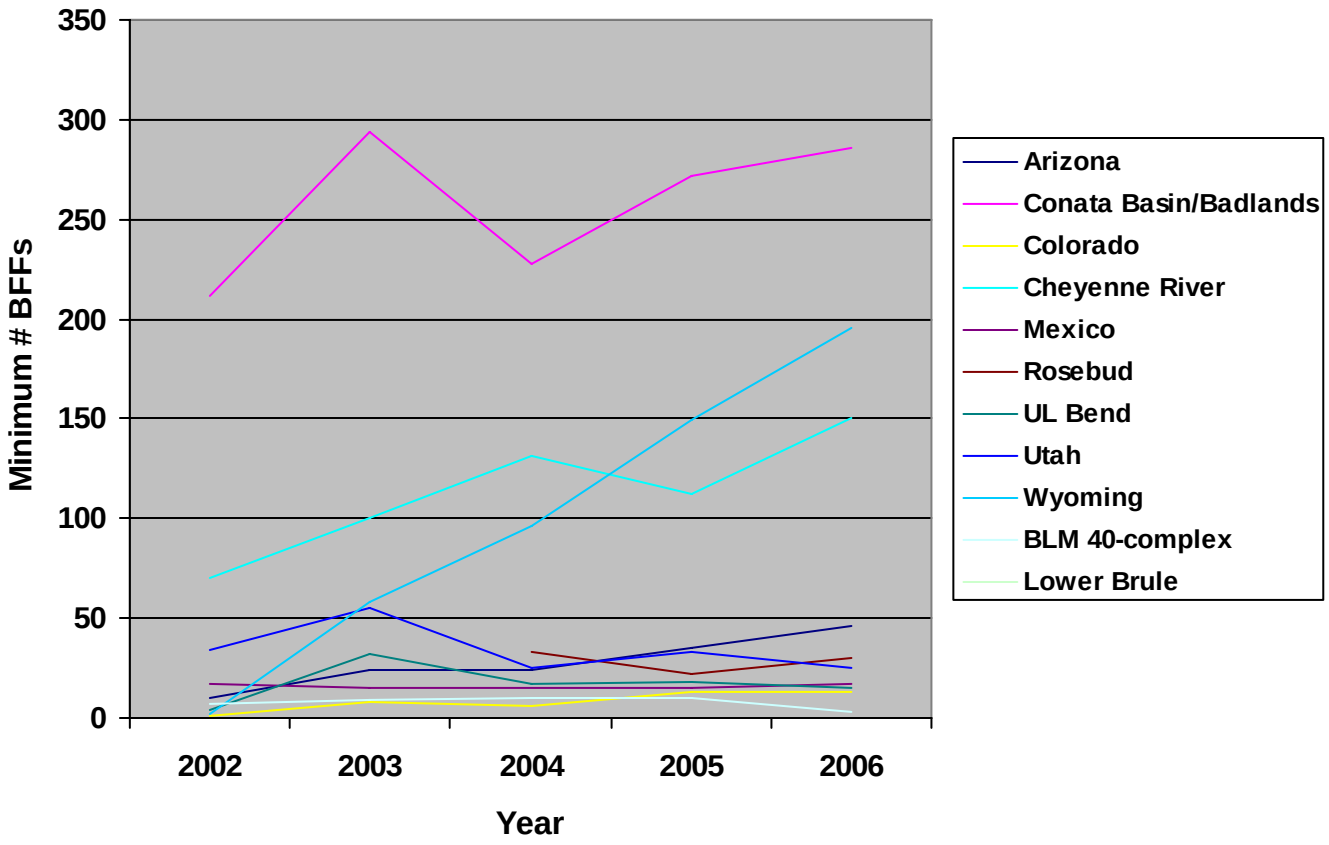


Figure 5. The minimum number of black-footed ferrets (BFF), including kits, through 2006 at reintroduction sites.

6. RECOVERY AND CONSERVATION PLANNING

More populations of black-footed ferrets are needed to enhance overall species' viability and reduce the risk of extinction. In the past, the black-footed ferret had an enormous range in the center of North America and perhaps up to one million existed (Anderson et al. 1986). The black-footed ferret is like other small animal populations facing a particularly high risk of extinction in the modern world (Gaggiotti and Hanski 2004). Although the black-footed ferret has been listed for nearly 40 years, recovery is still problematic given severe habitat limitations and disease (Conservation Breeding Specialist Group 2004). Challenges facing black-footed ferret conservation include unknown influence of low genetic diversity; canine distemper hazard; direct effects of plague on prairie dog populations and on black-footed ferrets; and minimal suitable habitat for reintroduction (Seal et al. 1989, Roelle et al. 2006). Consequently, reintroductions at most black-footed ferret recovery sites have not succeeded in establishing self-sustaining populations (Figure 5).

Recovery plans developed under Section 4 of the ESA delineate actions which the best available science indicates are required to protect and recover listed species. They provide guidance to state and federal agencies and others. The goal of the black-footed ferret recovery plan is to

recover the endangered black-footed ferret to the point where reclassification to threatened status, and eventually delisting, are possible. The recovery priority number for the black-footed ferret is 2 on a scale of 1-18, with 1 equaling the highest priority. This indicates that the black-footed ferret faces a high degree of threat. The ranking also reflects the black-footed ferret's taxonomic status as a full species.

To reclassify the black-footed ferret from endangered to threatened status, recovery criteria have been established in the 1988 recovery plan (USFWS 1988):

- maintain a core breeding population of a minimum of 240 adults (90 males, 150 females)
- establish a pre-breeding census population of 1,500 free-ranging black-footed ferret breeding adults in 10 or more populations with no fewer than 30 breeding adults in any population by 2010; and
- encourage the widest possible distribution of reintroduced black-footed ferret populations.

USFWS recommends the following actions:

1. Maintain a captive black-footed ferret population of optimal size and structure to support genetic management and reintroduction efforts.
2. Reduce disease-related threats in wild populations of black-footed ferrets and associated species.
3. Ensure sufficient habitat to support a wide distribution of self-sustaining black-footed ferret populations.
4. Establish free-ranging populations of black-footed ferrets to meet reclassification and delisting goals.
5. Promote partner involvement and adaptive management through regular programmatic review and outreach.

The recovery plan is being revised and recovery of the black-footed ferret may require a pre-breeding census population of 3,000 free-ranging black-footed ferret breeding adults in 30 or more populations with no fewer than 30 breeding adults in any population, and at least 10 populations with 100 or more breeding adults (Scott Larson, USFWS, personal communication).

Section 7(a) (1) of ESA requires all federal agencies to further the purposes of the ESA by carrying out programs for the conservation of endangered species. The Forest Service, National Park Service, and their partners host the most successful black-footed ferret reintroduction efforts at Conata Basin/Badlands (Figure 5). Conata Basin has been a donor site for translocation of wild kits to other reintroduction projects on tribal lands in South Dakota, and in three other states.

The Forest Service has also identified three other potential black-footed ferret reintroduction sites: Smithwick, Buffalo Gap National Grassland; Horse Creek, Little Missouri National Grassland, North Dakota; and Cheyenne River, Thunder Basin National Grassland, Wyoming. Implementation of reintroduction projects at these sites would improve recovery, but planning and implementation efforts are incomplete. Moreover, the Forest Service manages the widest extent of federal land ownership across Great Plains states east of the plague line which were

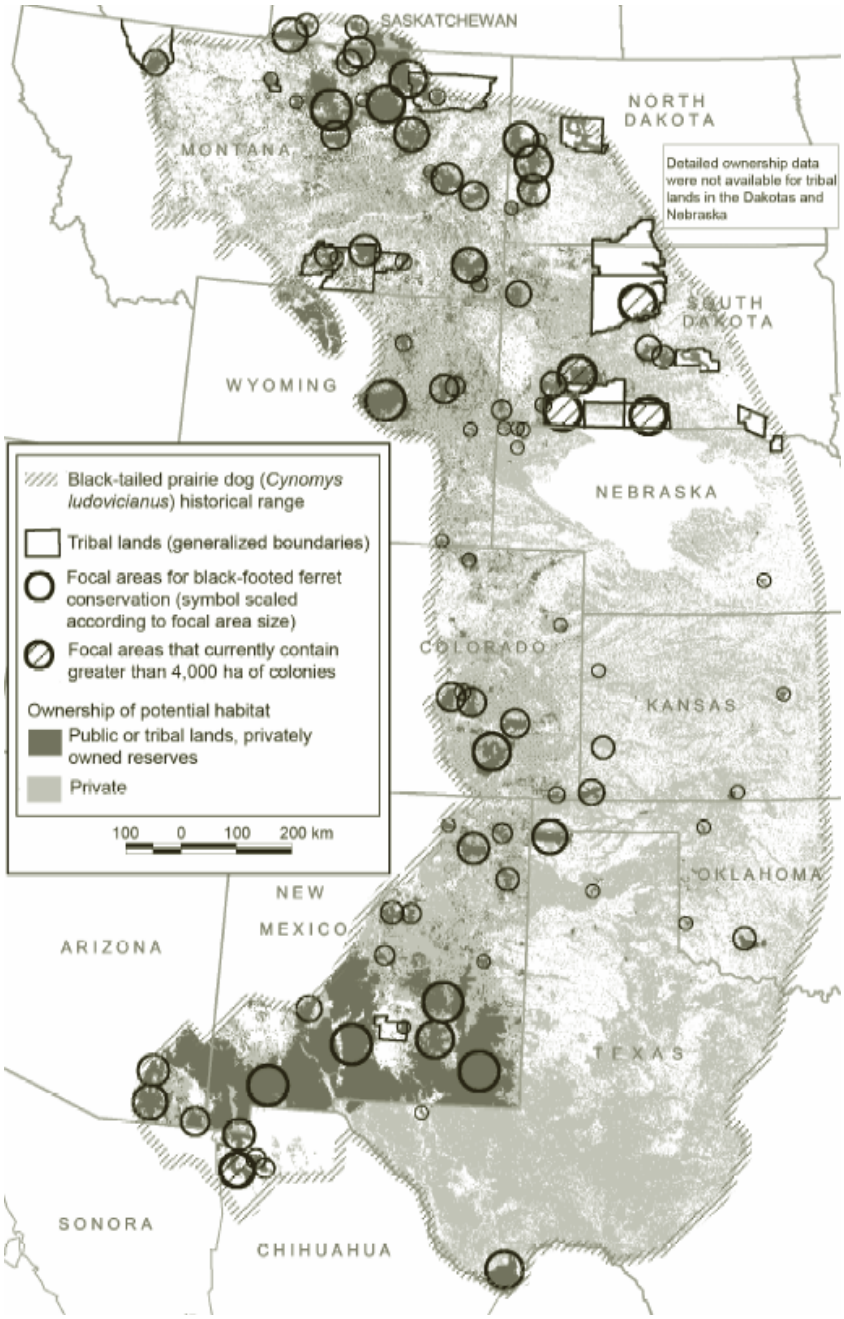


Figure 6. Focal areas for black-footed ferret conservation (Proctor et al. 2006b). Note that these areas include the Oglala National Grassland, Buffalo Gap National Grassland Geographic Areas and the Fort Pierre National Grassland.

formerly occupied by black-footed ferrets and could establish recovery projects elsewhere in North Dakota, South Dakota, Colorado, Kansas, Oklahoma, Texas and New Mexico.

The Forest Service has the capability of more rapidly and effectively improving the number and distribution of wild black-footed ferret populations than any other federal agency, and more recovery attention is needed on all national grasslands with potential to support black-footed ferret populations (Mike Lockhart, former USFWS black-footed ferret coordinator, personal communication, 2007). Even with development of more recovery sites across national grasslands, the amount of habitat that would be needed to manage prairie dog and black-footed ferret populations would represent a small fraction of the 3.8 million acres of national grasslands.

In addition to agency efforts to identify black-footed ferret reintroduction sites, others have used a geographic information system (GIS) to identify areas with restoration potential within the former range of the black-tailed prairie dog, a species for which there are existing models of habitat suitability (Proctor, 1998, Proctor et al. 2006). Focal areas for black-footed ferrets have been identified by prairie dog and black-footed ferret scientists. Such focal areas include Fort Pierre, Buffalo Gap (GAs in addition to Conata Basin MA 3.63), and Oglala national grasslands (Figure 6). Given the difficulty of establishing black-footed ferrets on private lands and given that most of the Great Plains is privately owned, and that opposition to prairie dogs is very strong, it is therefore not surprising that Great Plains federal lands feature prominently in recent scientific analyses of potential reintroduction sites for black-footed ferrets.

In 2007, the USFWS and the Forest Service met to discuss black-footed ferret recovery opportunities on national grasslands across the central plains. In an exchange of letters (letters in the administrative record), the Forest Service conveyed that despite the Forest Service's important contributions to the national recovery program to this point, recovery of the black-footed ferret still remains tenuous at best and that opportunities likely remain for the Forest Service to continue to be a leader in the national recovery effort.

Limitations on recovery program efforts caused by declining budgets and redirected priorities over many areas are a critical concern. The March, 2007 letter from the USFWS to the Forest Service not only highlights again the importance of Conata Basin but beckons the Forest Service to establish more black-footed ferret reintroduction sites on national grasslands. More detailed information on the status and recovery needs of black-footed ferret is presented by the U.S. Geological Survey (Roelle et al. 2006).

7. THE BLACK-FOOTED FERRET'S ECOLOGY, PRAIRIE DOG HABITAT, REINTRODUCTION, POPULATION VIABILITY, AND ADAPTIVE MANAGEMENT

Black-footed Ferret *Mustela nigripes*

The black-footed ferret is in the Order Carnivora, Family Mustelidae, Genus *Mustela*, and Subgenus *Putorius* (Hillman and Clark 1980). The species is one of five *Mustela* in North America that include the ermine (*M. erminea*), long-tailed weasel (*M. frenata*), least weasel (*M. nivalis*), and American mink (*M. vison*) (Wilson and Ruff 1999). The black-footed ferret is the only ferret species native to the Americas.

Other ferret species in the genus include the Siberian polecat (*M. eversmanni*) and the European ferret (*M. putorius*). The black-footed ferret is most closely related to the Siberian polecat, from which ancestral black-footed ferrets arose (Anderson et al. 1986, Hillman and Clark 1980). The earliest fossil record of the black-footed ferret is from approximately 100,000 years ago (Anderson et al. 1986). The black-footed ferret was formally described in 1851 by J.J. Audubon and J. Bachman (Anderson et al. 1986, Clark 1986).

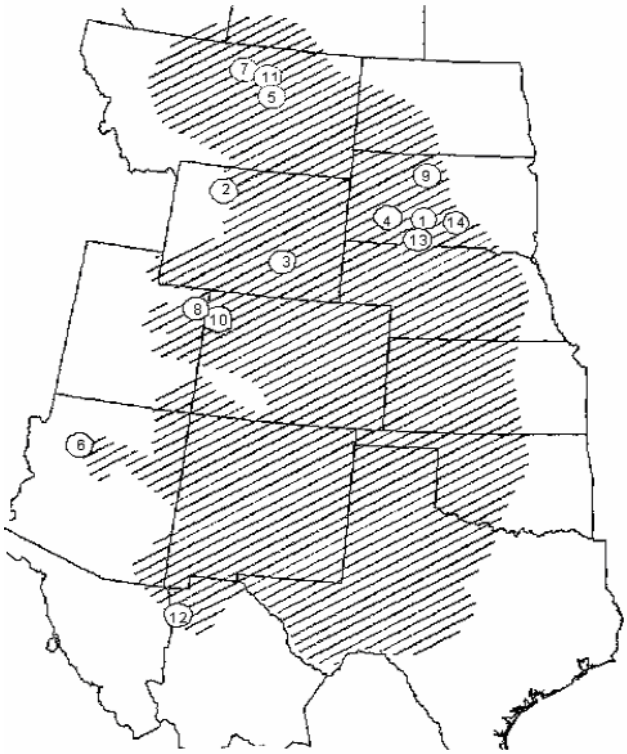


Figure 7. Probable historic range of black-footed ferrets as defined by composite ranges of black-tailed (*Cynomys ludovicianus*), white-tailed (*C. leucurus*) and Gunnison's prairie dogs (*C. gunnisoni*). Numbers 1 and 2 are the Mellette County, South Dakota and Meeteetse, Wyoming populations that no longer exist. Other numbers are re-introduction sites that are referenced in the table on the following page (USFWS 2006b).

The black-footed ferret is a medium-sized mustelid weighing 1.4-2.5 pounds and measuring 19-24 inches in total length. Upper body parts are yellowish buff, occasionally whitish; feet and tail tip are black; and a black "mask" occurs across the eyes (Anderson et al. 1986, Hillman and Clark 1980).

Prairie Dog Habitat of the Black-footed Ferret. The black-footed ferret inhabits exclusively prairie dog colonies. The exact acreage of prairie dog colonies that once existed is unknown and debate on the issue continues (Vermeire et al. 2004). Historical information on species is almost always lacking. Anderson et al. (1986) estimated a 90 percent decrease in occupied habitat for all species of prairie dogs. Recent estimates of prairie dog occupied habitat include 1,600,000 acres of black-tailed prairie dog occupied habitat (69 Federal Register 51217-51226, August 18, 2004; Manes 2006; Van Pelt 2007). The existence of an obligate carnivore, the black-footed

ferret, suggests strongly that prairie dog colonies were once numerous and extensive. Moreover, using the USFWS (2004) current estimates for prairie dogs, the declining population trend is clear whether there were once 40,000,000 ha, 30,000,000 ha, 20,000,000 ha, or 10,000,000 ha of colonies. Respectively, these figures indicate declines of roughly 98%, 97%, 96%, or 92% (Miller et al. 2007).

The black-footed ferret is known to inhabit almost exclusively large complexes of prairie dog colonies of thousands of acres. Colonies provide the black-footed ferret with shelter and its only food source, prairie dogs. As prairie dog colonies and suitable habitat declined due to conversions from native prairie rangeland to cropland, poisoning and plague during the late 19th century and the first half of the twentieth century, black-footed ferret populations likewise declined (Biggins 2005, Cully 1993, Cully et al. 2006, Fagerstone and Biggins 1986, Lockhart et al. 2006). A typical landscape with prairie dogs in the Great Plains today contains widely scattered colonies of less than 50 acres each. Large complexes of thousands of acres of prairie dog colonies are uncommon and are found almost entirely on tribal and federal lands. Over 100 years ago Merriam (1902) described a 25,000 square mile prairie dog colony in the north Texas short grass prairie. He also noted that colonies 20-30 miles long were common. Colonies of this magnitude no longer exist. Poisoning, plague, and land fragmentation confine black-footed ferret habitat to small areas. Grassland continues to be converted to cropland. Conversion of grassland that had no prior cropping history to cropland in South Dakota, for example, was 54,404 acres in 2005 and 47,167 acres in 2006 (U.S. Government Accountability Office 2007).

Black-footed ferret habitat, that is, the prairie dog colony, is a unique feature in the Great Plains. The colonies are easily visible on the ground, to aircraft, and even to orbiting, imaging satellites because they are fundamentally different from surrounding grassland. The U.S. Geological Survey's vegetation mapping program classifies prairie dog colonies as the "black-tailed prairie dog town grassland complex." This complex occurs widely throughout the Great Plains.

Visible features (conditions) at prairie dog colonies include, bare areas, short-statured vegetation, numerous dome burrow mounds (up to 2.5 m in diameter) and crater mounds barren of vegetation. Prairie dogs are diurnal and short vegetation, barren mounds, and bare areas greatly facilitate the detection of predators. In addition, prairie dogs feed on grasses and forbs. Prairie dogs are attracted to livestock and other ungulate grazing. Such grazing along with prairie dog herbivory helps establish and even expand prairie dog colonies by increasing the amount of short-statured vegetation and bare areas. Drought restricts plant growth leading to expansion of prairie dog colonies, more short-statured vegetation, and more bare areas than during times of normal precipitation. Prairie dog densities decrease because food resources decrease during drought leading to an increase in the home range sizes of black-footed ferrets and other carnivores.

Fundamentally, the clipping and foraging habits of prairie dogs create a unique habitat (unique conditions) of bare ground and short, sparse vegetation (Archer et al. 1987, Natural Resources Conservation Service 2003). Some species such as the mountain plover require prairie dog colonies containing from 40-60% bare ground (Knowles et al. 1982). Prairie dog colonies can contain from near 0% bare ground to 80% bare ground (Magle 2003) depending upon precipitation, grazing, and colony age. Vegetation species diversity and per cent bare ground changes under different levels of impacts such as grazing and drought (Whicker and Detling 1988). Plant biomass production and forage quality is positively correlated to precipitation. Black-footed ferrets occur even in large areas of bare ground in colonies (Travis Livieri, personal

communication), however, the relationship between productivity of black-footed ferrets and plant biomass production and forage quality is not well understood.

Black-footed ferret habitat (prairie dog colonies) is located on a wide variety of soils, including clay, clay loam, silty loam and some sandy loam soils deposited following erosion from adjacent uplands, including badlands formations. Soils are deep, structured and not easily eroded. This type is found on level sites along drainages, in broad valleys, on gentle to moderately sloping hills, and flats on tables and buttes (Von Loh et al. 1999). Prairie dogs create extensive burrows in their towns. Large volumes of soil are moved, improving filtration, hastening the incorporation of organic matter, facilitating nutrient cycling, and increasing the spatial heterogeneity of vegetation, soils, and other ecosystem components (Whicker and Detling 1988).

Although several plant species are consistently found in black-footed ferret habitat, overall vegetation characteristics are highly variable depending upon size and age of the town and its position on the landscape. The vegetation in all colonies usually tends toward a prostrate growth form because of intensive grazing by prairie dogs and livestock. The overall pattern of vegetation appears in relatively concentric zones relating to the outward expansion of town boundaries over time. Vegetation cover varies from <25% to almost 100%.

Bison and livestock may be attracted to black-footed ferret habitat, and may preferentially graze them (Coppock et al. 1983, Coppock and Detling 1986, Day and Detling 1990). The forage on the prairie dog colonies is more nutritious than off, with higher nitrogen content and younger shoots, apparently because animal waste products are deposited there. In turn, the presence of bison and livestock waste products further increases soil fertility and forage quality (Knight 1994).

Plant species diversity is increased by the small-scale disturbances caused by the digging of prairie dogs, and animal species diversity may also increase because of the habitat provided for the badger, rattlesnake, burrowing owl, black-footed ferret, and cottontail, in addition to the bison and pronghorn (Knight 1994). Prairie dog colonies can also move over time, expanding and contracting, and, as larger colonies can cover thousands of acres at a time (Augustine et al. In Press), the effect on the landscape is substantial. The plant community types on a prairie dog colony are roughly indicative of the extent of herbivore disturbance and reflect the cumulative impact of grazing intensity, grazing duration, activities of other animals, soil characteristics, and weather (Whicker and Detling 1988). Early stages of the colony may have a typical mixed grass or shortgrass prairie type. With continued grazing and age of the colony, the composition may shift to a mix of annual species and dwarf-shrubs. Species richness appears to be highest under moderate levels of disturbance, because grass species have not yet begun to disappear, but forb species begin to increase. In general, in the mixed grass prairie, prairie dog colonies reduce plant productivity and plant species richness by reducing cool-season perennial grasses and litter, and increasing bare ground (Johnson-Nistler et al. 2004).

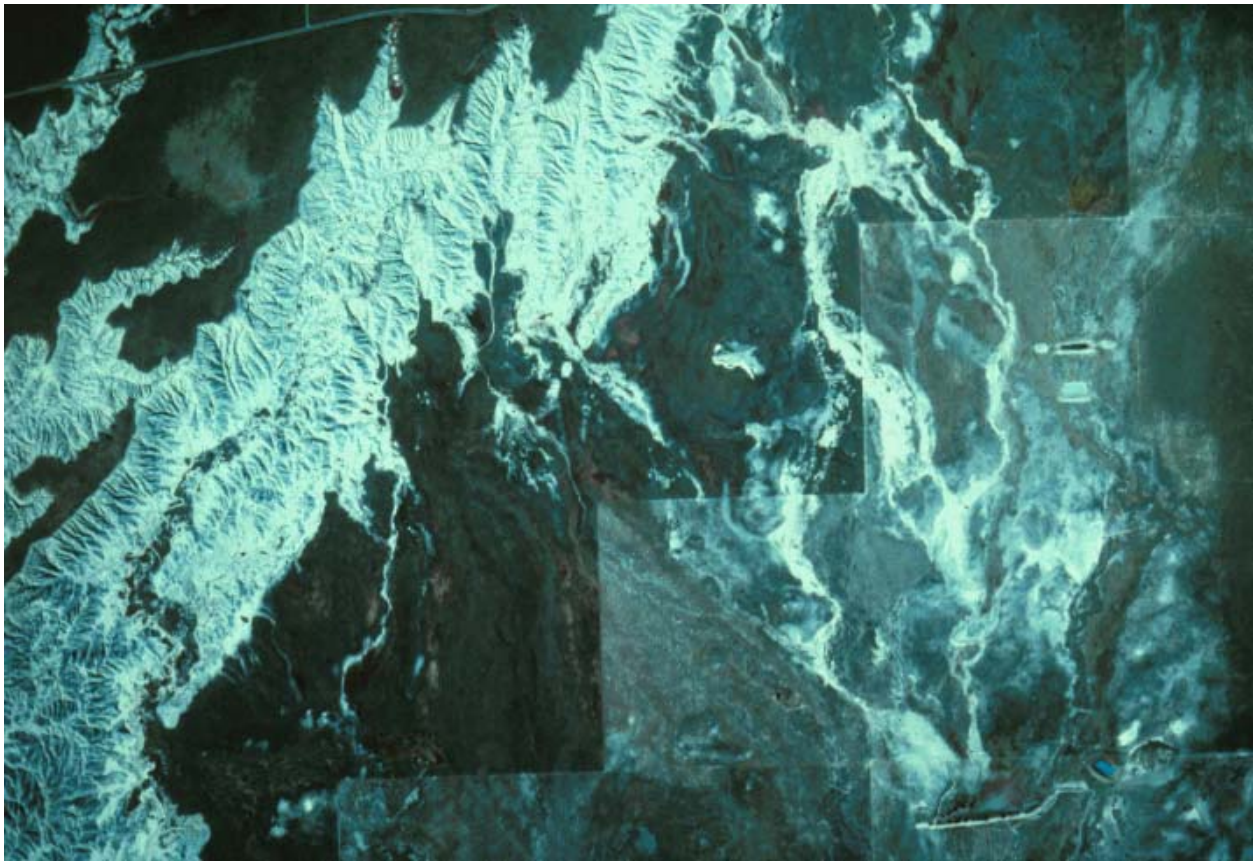
The role of livestock grazing in creating black-footed ferret habitat has been evident at the boundary of Buffalo Gap National Grassland and Badlands National Park. Badlands National Park contains a comparatively small acreage of prairie dog colonies because much of the Park is comprised of Badlands topography and because little ungulate grazing occurs in the Park (Figure 8). About 4,000 acres of colonies existed in Badlands National Park during the 1994 reintroduction. Colony acreage has increased from 5,629 to 7,867 during 2003-2006.

Black-footed ferret habitat exhibits considerable antiquity. Carbon dating of burrow mounds at Wind Cave National Park, South Dakota indicates that prairie dog colonies have existed there for about 400 - 800 years and other areas for several thousand years (White 1986, Carlson and White 1987), suggesting that despite periodic drought and varying levels of domestic and native ungulate grazing, black-footed ferret habitat persists in the same locations.

Prairie Dog as a Keystone Species in Creating Habitat for the Black-footed Ferret. Paine (1969) developed the keystone species concept when species composition and physical appearance of the ecosystem is greatly modified by the activities of a single native species high in the food web (Mills 2007). Populations of such species are the "keystone of the community's structure, and the integrity of the community and its unaltered persistence through time are determined by their activities and abundances." The keystone concept can promote conservation not only for the prairie dog, but also for its grassland ecosystem (Kotliar 2000, Miller et al. 2000, Soulé et al. 2003). Soulé et al. (2005, 2007) labeled the prairie dog as a "strongly interacting species" in an ecosystem. They viewed essential prairie dog population densities or levels that maintain interaction effectiveness rather than mere persistence at minimal numbers.

Miller et al. (2007) summarize the unique role played by prairie dogs in creating black-footed ferret habitat. Like cattle, prairie dogs graze, but prairie dogs represent much more than just grazers (Kotliar et al. 2006). They also move soil (Detling and Whicker 1988, Detling 1998), influence nutrient cycling (Coppock et al. 1983a; Detling and Whicker 1988; Whicker and Detling 1988, 1993; Detling 1998), increase nitrogen content of soil and plants (Holland and Detling 1990, Detling 1998), change vegetation structure and community dynamics (Coppock et al. 1983a, Whicker and Detling 1988, Weltzin et al. 1997, Detling 1998, Fahnestock and Detling 2002), aerate the ground (Whicker and Detling 1988, Outwater 1996, Detling 1998), alter soil chemistry (Munn 1993), and deepen water penetration (Outwater 1996, Detling 1998). They provide a ready source of prey to many predators and burrows for shelter to other animals and insects (Goodrich and Buskirk 1998, Kotliar et al. 1999, Shipley and Reading 2006). This combination of effects gives the prairie dog its role as a highly interactive (keystone) species in the ecosystem, creating a matrix of different habitats that increases diversity across the grassland (Kotliar et al. 1999, 2006; Miller et al. 2000).

Figure 8. The boundary and fence line between Badlands National Park and Buffalo Gap National Grassland in part of Conata Basin during the early 1990s is illustrated by a different color tone. The stair-stepped lighter areas in the lower right are black-tailed prairie dog colonies on Buffalo Gap. The white areas, located mostly in the left section of the photograph, are Badlands topography in Badlands National Park. The stair-stepped lighter areas in the lower right are black-tailed prairie dog colonies on Buffalo Gap. The white areas, located mostly in the left section of the photograph, are Badlands topography in Badlands National Park. Extensive livestock grazing on Buffalo Gap fosters prairie dog colony development. No livestock grazing and a small bison herd in Badlands do not create the conditions for extensive prairie dog colonies required by black-footed ferrets. Buffalo Gap prairie dog colonies stop at the fence line. In recent drought years, there have been some prairie dog colony incursions into Badlands.



Kotliar et al. (2006) describe the prairie dog as a keystone species because the species has a unique, significant, disproportionately large impact on its ecosystem. The species' influence on grassland ecosystems varies with its abundance and certain keystone functions also vary with abundance. Even though small, isolated colonies of prairie dogs are better than no colonies at all in the Great Plains, they cannot support the full complement of species that naturally associate with prairie dogs (Kotliar 2000, Lomolino et al. 2003, Johnson and Collinge 2004). About 100 years ago, both large and small colonies occurred throughout the prairie dog's geographic range (Proctor et al. 2006). A similar combination of small and large colonies (e.g., Conata Basin) is probably a good mechanism for maintaining today's prairie dogs and their keystone functions (Lomolino et al. 2003; Trudeau et al. 2004). Lomolino and Smith (2003) found that while species richness per se was not necessarily higher in prairie dog colonies, they harbored significantly more rare and imperiled species than paired sites in the adjacent landscape.

Agricultural interests have dictated artificially small limits on prairie dog populations for more than 100 years (Schenbeck 1981, 1985; Miller et al. 1990; Lamb et al. 2006, Miller and Reading 2006). Indeed, few prairie dog populations today are sufficiently large to support viable populations of black-footed ferrets. A healthy grassland ecosystem includes areas with and without prairie dogs, allows for dispersal among colonies, and promotes colonization of new areas and recolonization of sites where prairie dogs lived in the recent or distant past.

Regarding herbivory, redundancy (i.e., consumption of plants by several species rather than by a single species) is important for the persistence of ecosystems (Walker 1991; Ehrlich and Walker

1998). As redundancy decreases (e.g., following the drastic declines of American bison and prairie dogs from the grasslands of western North America), the vulnerability of an ecosystem increases.

In summary, the prairie dog is a keystone species because its effects on its ecosystem are unique, significant, and disproportionately large relative to its abundance (Kotliar et al. 2006):

- Prairie dogs influence the grassland ecosystem via three primary pathways: grazing, burrowing, and as prey. Numerous species use colony-sites for food and shelter. Black-footed ferrets, mountain plovers, burrowing owls, and at least 6 other species clearly depend on prairie dogs for survival and reproduction; at least 20 species opportunistically benefit at colony-sites; and at least 117 additional species have a natural history that suggests a benefit from associating with prairie dogs.
- Besides vertebrates, other types of organisms that associate with prairie dogs include numerous species of protozoans, arachnids, and insects, and at least four plant species.
- Burrowing by prairie dogs mixes subsoil and topsoil, redistributes nutrients and minerals, and promotes penetration and retention of moisture. The combination of burrowing, foraging, and clipping alters floral species composition and affects the concentration of nitrogen in the soil and the rate of nitrogen uptake by plants. Prairie dogs reduce vegetation biomass, but, especially at young colonies, they often enhance digestibility, protein content, and productivity of grasses and forbs.
- The prairie dog's influence on plant and animal communities is substantial and unique, disproportionately large relative to its abundance, and critical to the integrity of grassland ecosystems. The prairie dog is therefore a legitimate keystone species. Because some of its ecological functions are directly proportional to its abundance (e.g., nutrient cycling), the prairie dog is also a foundation species.
- Because it is a keystone and foundation species, conserving the prairie dog will help promote a healthy grassland ecosystem. The concepts of keystone and foundation species thus are helpful for conservation.

Grazing, Forage Competition, and Black-footed Ferret Habitat. The “Purpose of and Need for Action” in Chapter 1 of the FEIS lists the information, resource conditions, and socio-economic concerns that are the basis for the action. They include:

- The Forest has received requests to limit the amount of prairie dogs on the National Grasslands (Rittberger letters 2007) to limit competition with livestock for forage and to limit encroachment from federal on to private lands.
- Control efforts on state and private land have limited prairie dog dispersal and expansion to smaller areas on the National Grasslands. Concentrating prairie dogs on the National Grasslands can heighten the potential impacts to the animal, plant, and soil resources. This is especially true when large acreages of prairie dog colonies are needed for black-footed ferret habitat and there is a limited amount of national grassland surrounding the colony, with livestock and prairie dogs competing for the vegetation.

Studies of cattle-prairie dog interactions clearly show a synergistic relationship between cattle grazing and black-footed ferret habitat (prairie dog colonies) (Belak 2001). Osborn and Allen (1949) credited regenerating tall vegetation in a fallow pasture for the elimination of a small

prairie dog colony located in tall-grass prairie. Snell and Hlavachick (1980) found that elimination of cattle grazing during the growing season within and around a large colony in Kansas and the resulting vegetation growth was associated with a 90% decrease in the size of the colony. Knowles (1982), studying prairie dog distribution in eastern Montana, concluded that prairie dog distribution was mainly influenced by heavy livestock grazing pressure and other land disturbances created by humans. Uresk et al. (1982) found that the burrow densities within Conata Basin increased twice as fast in areas grazed by cattle vs. ungrazed areas. Cincotta (1985) reported that prairie dog colony expansion on the adjacent Badlands National Park was greater in heavily grazed areas and areas previously disturbed by homesteading activity. This was corroborated by Langer (1998) using a GIS analysis based on comparison of old homestead records with known prairie dog distributions. Cincotta et al. (1988) built a linear regression model to predict prairie dog establishment adjacent to existing colonies. They found that population density, visibility through vegetation, and the interaction of these two terms were significantly associated with colony expansion. These studies indicate that black-footed ferret habitat consist of areas with reduced vegetation density created by grazing pressure.

Some of the Alternatives severely limit black-footed ferret habitat in most GAs (Table 2) in part because black-footed ferret habitat reduces forage for livestock. However, as indicated in the "Purpose of and Need for Action" in Chapter 1 of the FEIS" whether black-footed ferret habitat (prairie dog colonies) competes with livestock or other ungulates depends upon the extent of colonies. Also relevant is the scale of management. For example, one thousand acres of prairie dog colonies on a 1,200-acre fenced livestock grazing allotment on a 100,000-acre Geographic Area may lead to competition on the 1,200 acres. However, competition is unlikely if 1,000 acres of prairie dog colonies are scattered throughout a 100,000-acre Geographic Area.

It is important to understand the ecological definition of competition between two species. The mere fact that two species such as prairie dogs and livestock consume the same vegetation does not convey competition. Molles (2005) defines interspecific competition as competition between individuals of two species that reduces the fitness of both species. He adds: "The effects of competition on the two competitors may not be equal, however. The individuals of one species may suffer greatly reduced fitness while those of the second are affected very little." For example, competition in the environment may be severe as exemplified by broom snakeweed (*Gutierrezia sarothrae*) (Holechek et al. 2004) which severely restricts production of associated grasses, and the alleopathic smooth brome (*Bromus inermis*) affecting the Fort Pierre National Grassland. Competition is similarly defined in other texts (Purves and Orians 1983, Huston 1994, Ricklefs and Miller 2000, Gurevitch et al. 2002, Allaby 2005) (see Attachment 1 for further discussion on competition between livestock and prairie dogs, the sole prey of the black-footed ferret).

History of the Conata Basin/Badlands Black-footed Ferret Reintroduction Area. Conata Basin/Badlands has a long history of an unknown amount of bison grazing and prairie dog colony extent and a recent and better understood history of heavy livestock grazing, large prairie dog colonies, prairie dog poisoning, and drought. Conata Basin/Badlands was not settled until the late 1880s, relatively late compared with other areas in the Great Plains. Some reasons for the delay in settlement were harsh climate, remoteness, relative lack of year-round transportation, and relatively poor soils. The American Indian presence also provided a legal barrier to settlement. However, by the 1880's reservation boundaries were reduced and European settlement increased. The Conata Basin/Badlands area, mostly Conata Basin, was seen as good

summer range for livestock from the south. Most of the economic growth was in cattle and sheep ranching.

Railways simplified the export of movement of cattle to markets. For a time, during the 1890's, Belle Fourche, northwest of Rapid City, was the busiest livestock shipment point in the nation. Many cattle grazed the Conata Basin area as a stop over for shipment to Belle Fourche for several years because this was open rangeland. The area was used as a holding area for livestock. In the early 1900's the Milwaukee Railroad came across the basin from Kadoka to Interior and on to Scenic and Rapid City. The town of Conata developed and became a major shipping point for livestock. This was still open range and many cattle arrived from the south via cattle drives and were shipped from Conata until about 1920. Around 1920, the homestead and land patent processes had progressed to the point where much of the land in Conata Basin/Badlands was in private ownership. This ended the era of open range and past livestock grazing practices, and shipment of livestock to market. Small farms and agricultural practices were employed throughout much of the Basin and Conata became a ghost town. Due to drought and economic depression of the 1930s much of Conata Basin was purchased back from homesteaders by the federal government and ultimately became Buffalo Gap National Grassland to be managed by the U.S. Forest Service. Grazing practices from the late 1880s to the 1980s were heavy as indicated by plant species (Dan Uresk, pers. commun.). The dominant plant was buffalo grass followed by some blue grama. Western wheatgrass was sparse. Some areas had sparse vegetation with soil exposed. This area was classified as a short grass prairie (Kuchler 1964).

For most of the 20th century routine poisoning allowed only a small acreage of prairie dog colonies (Figures 9 and 10). In 1972, existing poisons such as strychnine were banned by the federal government but intensive livestock grazing continued and prairie dog colonies increased from 2,800 to 34,600 acres by 1978 (Fagerstone and Ramey 1996). Also, the Forest Service pitted thousands of acres in the early 1970s and prairie dogs rapidly invaded those areas because of the soil disturbance (Gregory L. Schenbeck, pers. commun., 2007). Pitting (disking) was used to increase grass production by breaking the sod (buffalo grass), and soil crust, to encourage water infiltration and decrease water runoff.

Poisoning did not begin again until 1978 with the approved rodenticide, zinc phosphide. However, with this poisoning campaign, livestock numbers were reduced and some poisoned areas were deferred from grazing for several years. After the poisoning, stocking rates of cattle decreased and some areas changed from a matted buffalograss to western wheatgrass. As a result, the vegetation composition changed from a short grass prairie type to a mid grass type with needle grasses and western wheatgrass dominating the landscape. Blue grama and buffalograss were minor components of the overall vegetation. Decreased poisoning during the 1990s, expanding prairie dog colonies, black-footed ferret reintroduction, changing agency directives, prairie dog management via a new Forest Plan in 2002, and especially drought during the 2000s have combined to change the vegetation again.

Prairie dog colony acreage in Conata Basin had grown to about 26,000 acres by 2006 (Figures 9 and 11). With the absence of plague and poisoning, with the presence of livestock grazing, and with a healthy prairie dog population initially, near ideal habitat conditions have developed for the black-footed ferret in Conata Basin. Although some may view the Conata Basin prairie dog colony acreage as large, the acreage is small by historical standards and represents just 0.6 of 1% of the national grasslands in the Great Plains and only 4.4% of Buffalo Gap National Grassland. Fundamentally, the major forces creating black-footed ferret habitat on Great Plains prairie were,

and are, drought, fire and grazing that established large complexes of prairie dog colonies (Sauer 1950, Stebbins 1981, Anderson 1982).

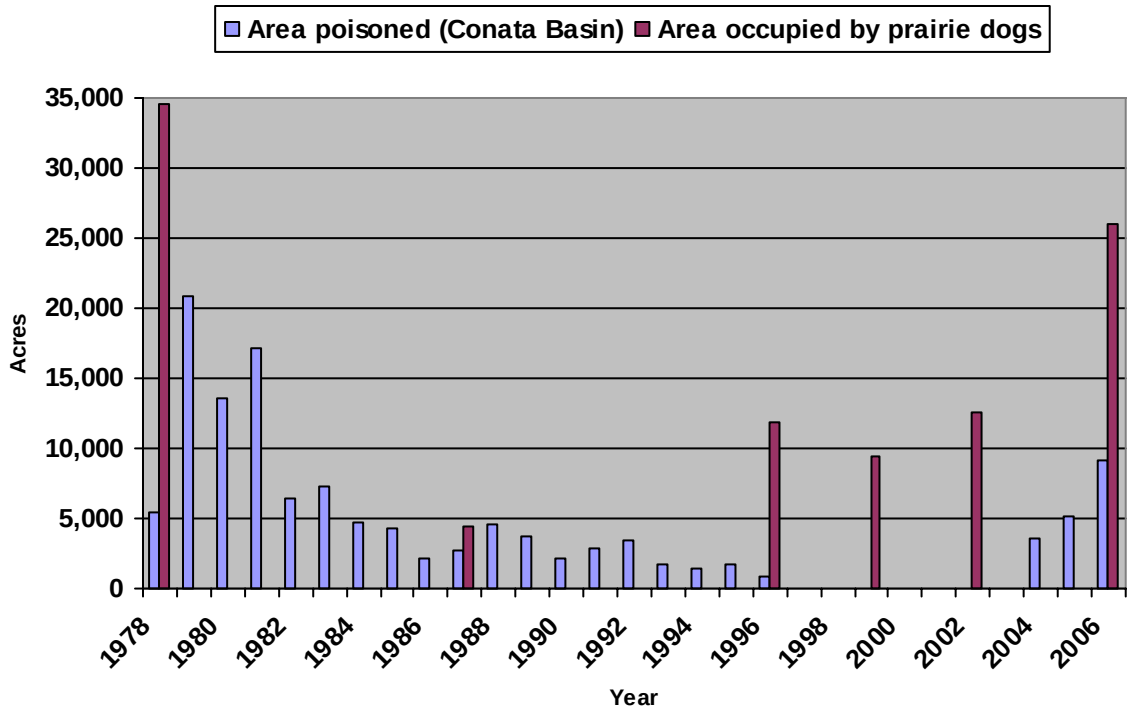


Figure 9. Extent of black-tailed prairie dog colonies and extent of poisoning in Conata Basin, Buffalo Gap National Grassland, South Dakota.

Although prairie dog colonies contracted during the late 1990s in Conata Basin due to above average or normal precipitation, the drought of the 2000s has led to further expansion of colonies not only in Conata Basin but throughout the Great Plains (Sidle et al. 2006). However, the 26,000 acres of colonies in Conata Basin are less than the 34,600 acres present there in the 1970s after the ban on poisoning in 1972 (Fagerstone and Ramey 1996). In contrast, Badlands National Park contains a comparatively small acreage of prairie dog colonies because much of the Park is comprised of Badlands topography and because little ungulate grazing occurs there (Figure 8). For over 20 years prairie dog colonies on the National Grassland in Conata Basin stopped at the fence line with the Park, although with severe drought some incursions of colonies into the Park have occurred.

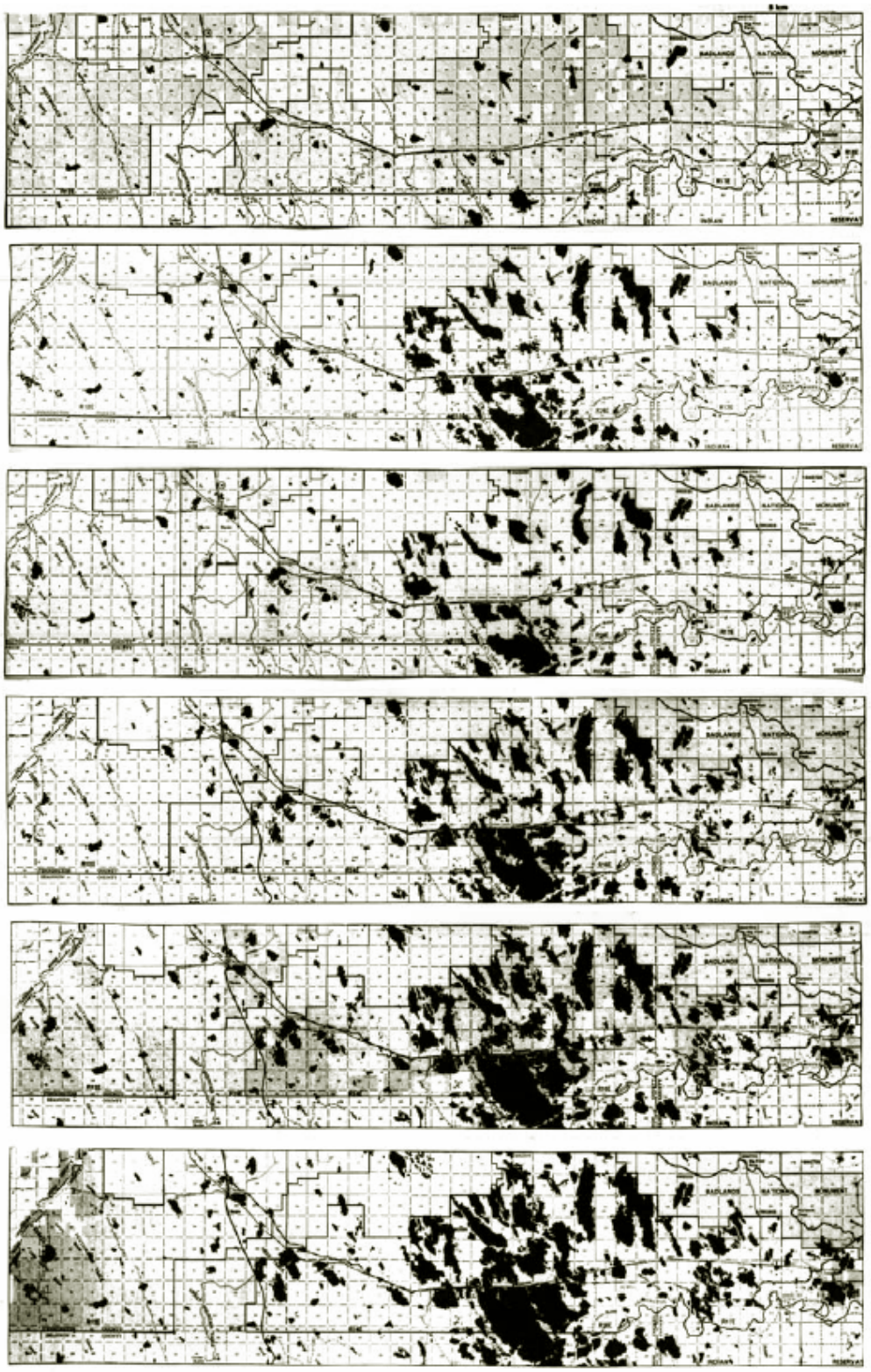
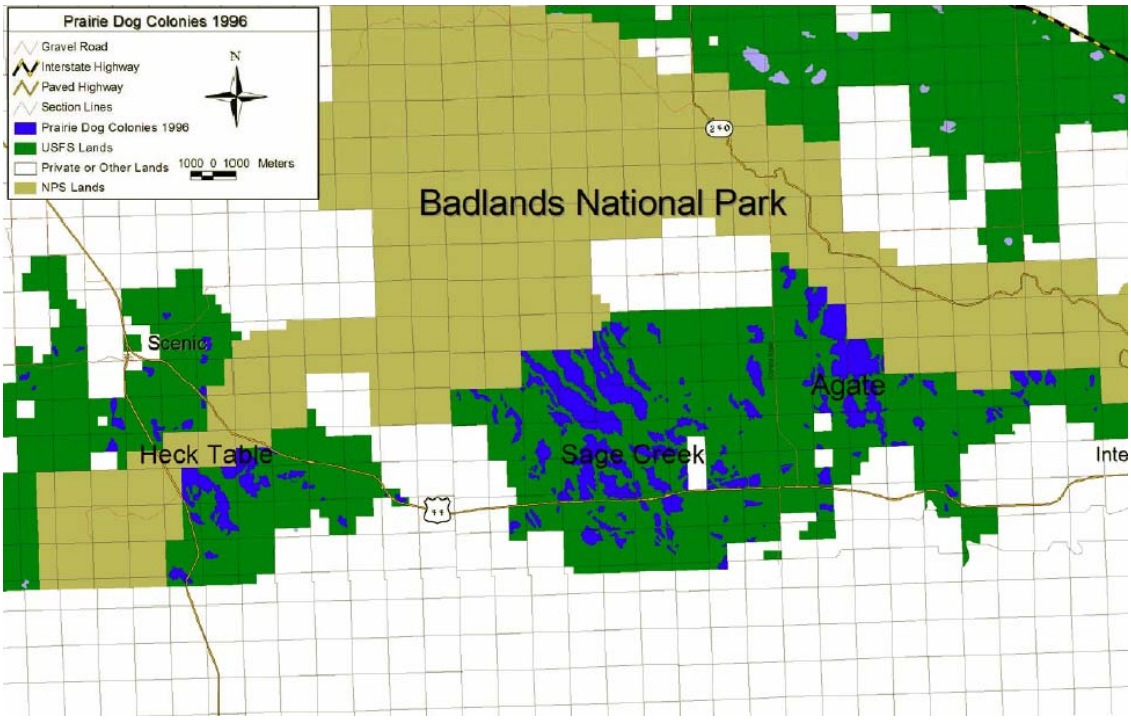
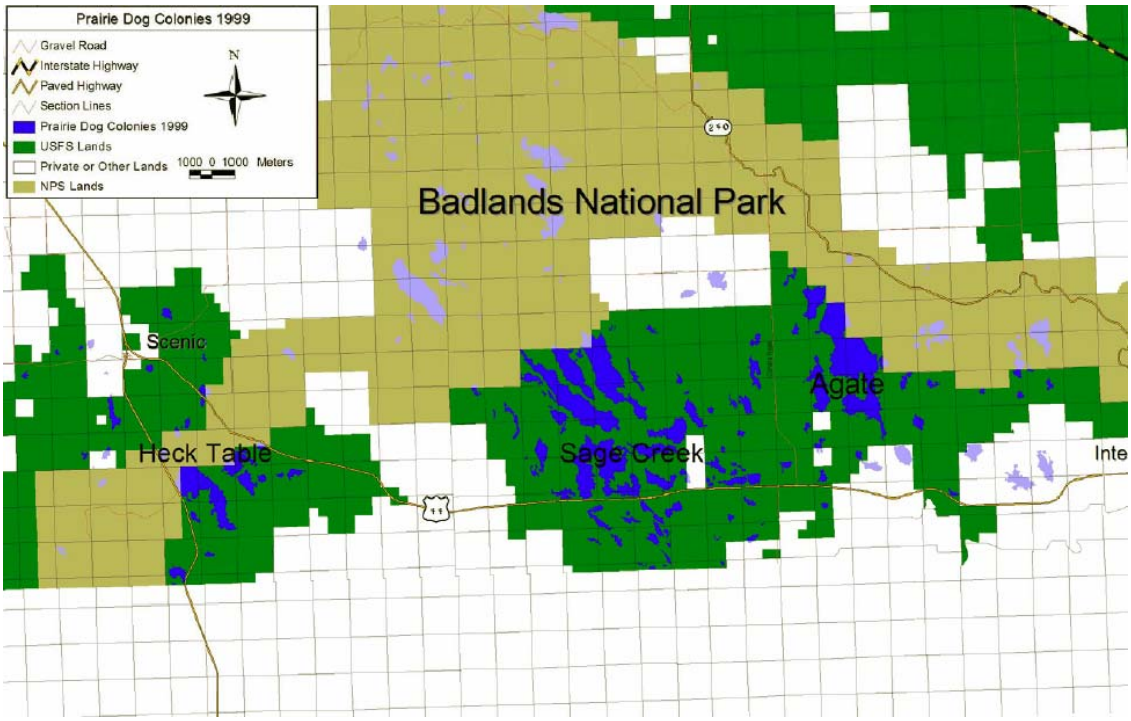
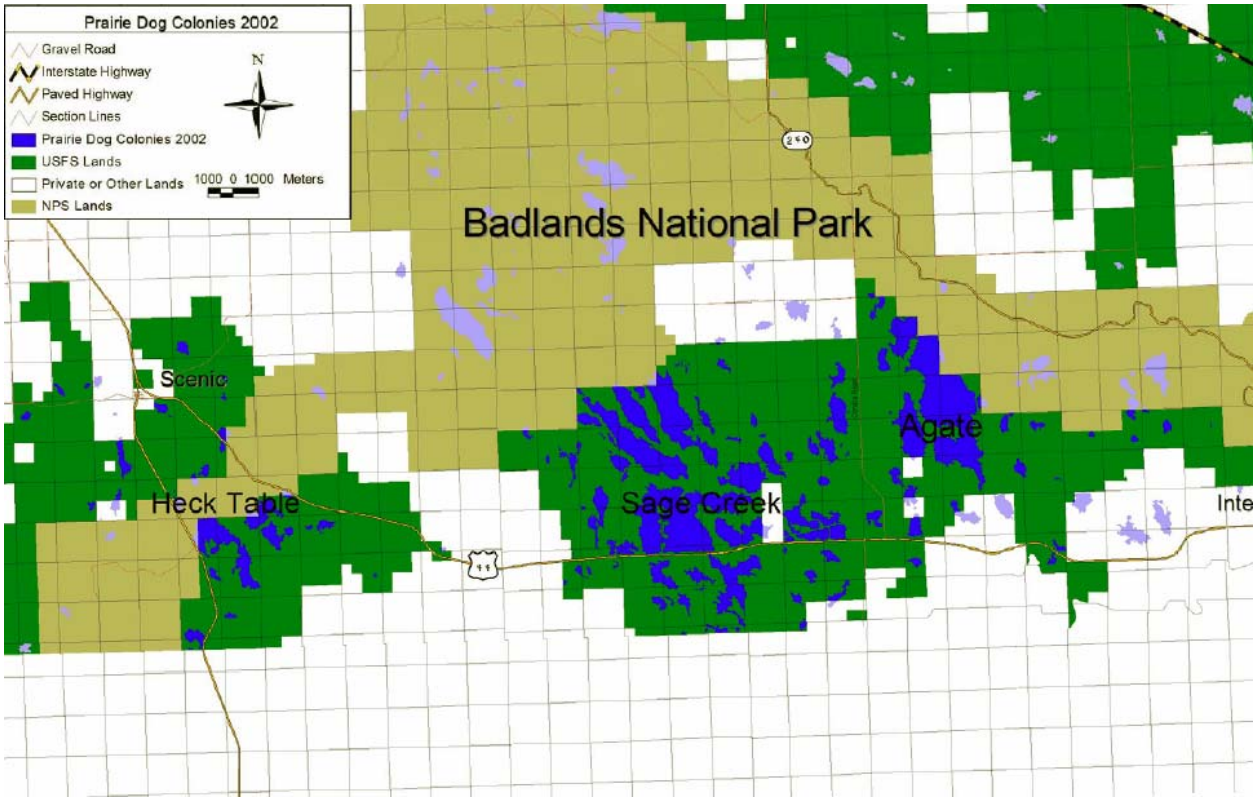


Figure 10. Extent of black-tailed prairie dog colonies in Conata Basin during 1968 (top), 1974, 1975, 1976, 1977 and 1978 (bottom) (Fagerstone and Ramey 1996; Fagerstone et al. 2005)

Figure 11. The extent of black-footed ferret habitat (prairie dog colonies) in Conata Basin, 1996-2005.






Prairie Dog Colonies 2002
Gravel Road
Interstate Highway
Paved Highway
Section Lines
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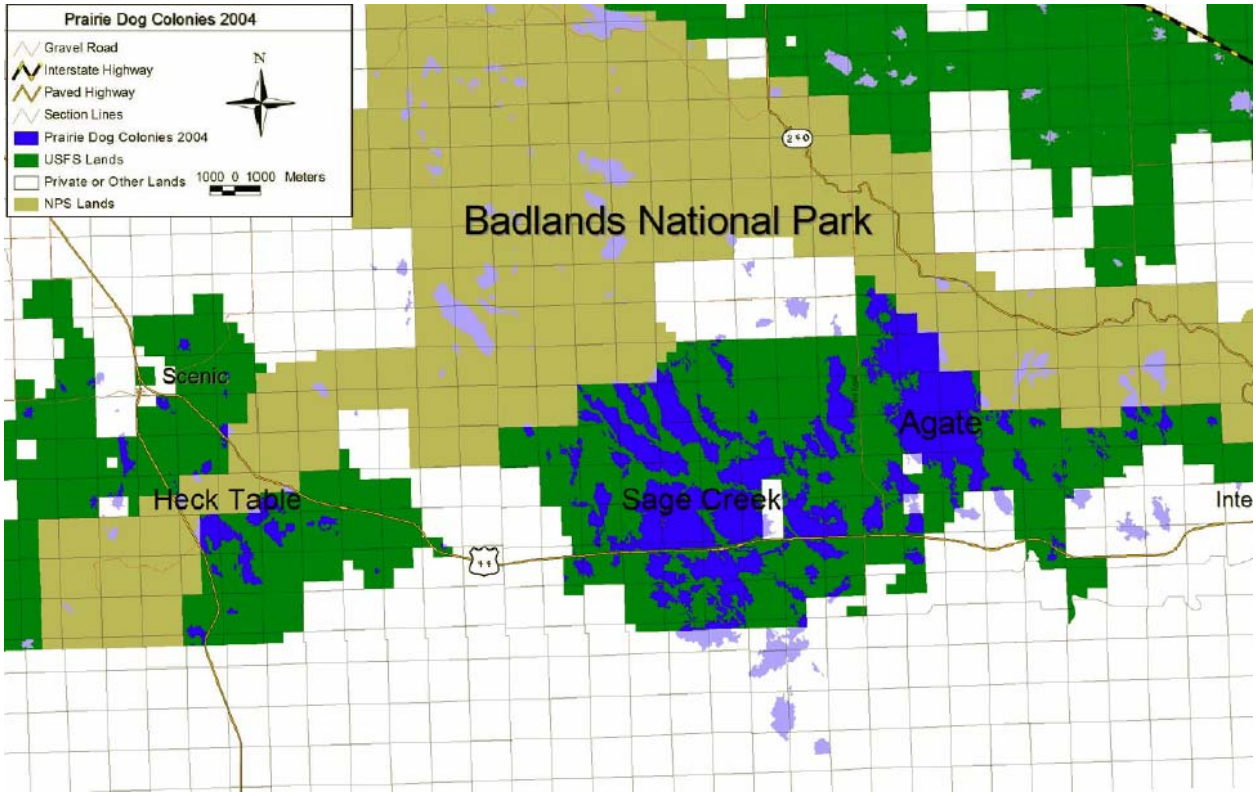
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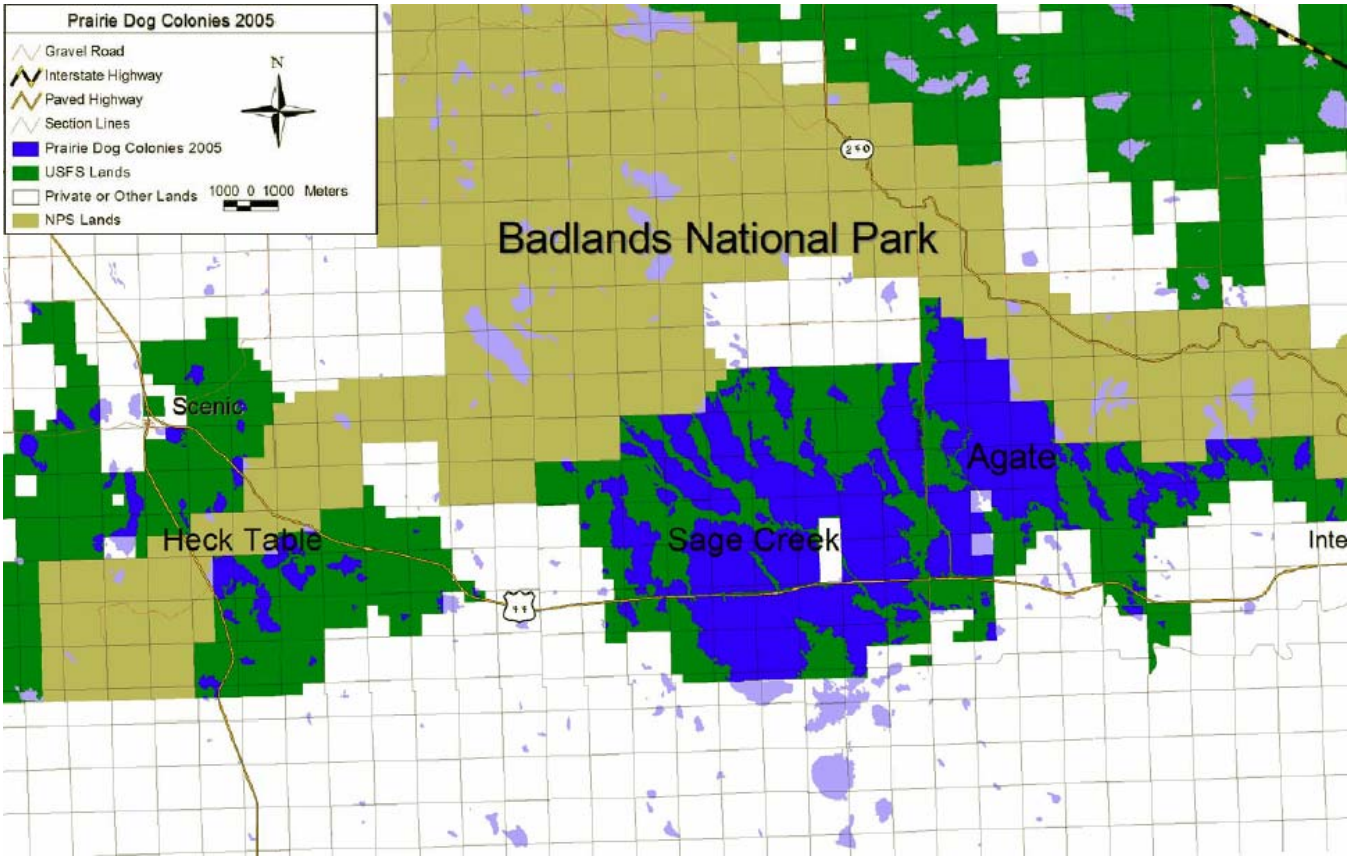


Black-footed Ferret Reintroduction Process at Conata Basin/Badlands. Reintroducing any species is difficult. Success rates of recovery efforts in the wild are low. Only 11% of reintroduction programs worldwide have been successful (Frankham et al. 2002, 2004), that is, reintroduced populations that reach at least 500 individuals free of human support. Low success rates for reintroductions are not surprising given the short time that reintroduction science has existed. Some programs have been cursory, animals have been left to fend for themselves, resources have dwindled to support reintroductions, and genetic management of released populations has been inadequate.

Much of the discussion in this section draws from the 1994 final environmental impact statement on black-footed ferret reintroduction and the Forest Service record of decision on the reintroduction of black-footed ferrets into the Conata Basin/Badlands Reintroduction Area. The 1994 environmental impact statement was authored by three federal agencies (USFWS, National Park Service, and U.S. Forest Service 1994). A re-introduction area containing about 4,000 acres of prairie dog colonies on Buffalo Gap and 4,000 acres on the Badlands National Park was designated in 1994 (see Figure 12 for description).

The primary consideration in deciding to make Buffalo Gap National Grassland areas available for black-footed ferret reintroduction is the Forest Service's responsibilities under the ESA. The ESA Section 7 (a) (1) directs "…that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of the Act." The terms "conserve," "conserving," and "conservation" mean to use and the use of all methods and procedures which are necessary to bring any endangered species or

threatened species to the point at which the measures provided pursuant to this Act are no longer necessary. This is the mandate of the ESA operating on federal agencies and that was a prominent driver for the Forest Service, National Park Service, and the USFWS to evaluate and initiate black-footed ferret reintroductions at Conata Basin/Badlands.

During 1996-1999, 150 captive-reared black-footed ferrets were released into Conata Basin. The minimum number of Conata Basin adult black-footed ferrets was about 89 in 2006 and has been as high as 110 (Table 4). From 1996 to 2004, there have been 489 litters totaling 1054 black-footed ferret kits born in the wild in Conata Basin. About 68 kits have been translocated to other black-footed ferret re-introduction sites. Livieri (2006) chronicles the evolution of black-footed ferret and prairie dog populations in Conata Basin. In Badlands, 217 black-footed ferrets have been released since 1994. The total wild born production has been 32 litters with 73 kits. Surveys conducted in 2006 indicate that 9 black-footed ferrets remain in Badlands.

Table 4. Black-footed ferret population numbers for Conata Basin, South Dakota. Numbers in parentheses represent sex ratio (male.female). Minimum number of adults is recorded in the fall.

Year	Conata Basin Releases (Kits)	Conata Basin Releases (Adults)	Minimum Population Size	# of Litters	# of Adults	# of Kits	Spotlight Hours	# of Kits Translocated Within	# Kits Translocated Out
1994-95	-	-	1 (1.0)	0	0	1 (1.0)	~100	-	-
1995-96	-	-	1 (1.0)	0	1 (1.0)	0	~100	-	-
1996-97	33 (19.14)	2 (0.2)	12 (5.7)	0	1 (1.0)	11 (4.7)	~80	-	-
1997-98	38 (21.17)	-	47 (24.23)	4	6 (2.4)	41 (22.19)	683	-	-
1998-99	41 (23.18)	-	116 (59.57)	22	41 (19.22)	75 (40.35)	1618	6 (3.3)	-
1999-2000	35 (21.14)	9 (0.9)	179 (75.104)	33	53 (15.38)	126 (60.66)	4622	19 (10.9)	-
2000-01	1 (1.0)	5 (2.3)	209 (84.125)	60	93 (32.61)	116 (52.64)	2504	4 (3.1)	16 (7.9)
2001-02	1 (0.1)	-	197 (82.115)	66	97 (31.66)	100 (51.49)	3269	9 (4.5)	-
2002-03	1 (0.1)	-	203 (80.123)	59	88 (29.59)	115 (51.64)	2024	7 (4.3)	-
2003-04	1 (0.1)	-	287 (120.167)	73	110 (37.73)	177 (81.96)	1992	23 (9.14)	20 (10.10)
2004-05	-	-	228 (93.135)	70	104 (34.70)	124 (59.65)	1328	11 (5.6)	7 (4.3)
2005-06	-	-	257* (109.148)	52	89 (37.52)	168 (72.96)	1798	0	25 (10.15)
Total	150 (85.65)	16 (2.14)		439		1054	20118	79 (38.41)	68 (31.37)

Dispersal Habitat for Black-footed Ferrets. An additional 206,300 acres of Buffalo Gap National Grassland outside the reintroduction area were designated as dispersal habitat because USFWS et al. (1994) reasoned that black-footed ferrets would disperse beyond the discrete reintroduction areas (Figure 12). Dispersal is defined as the movement of organisms away from their place of birth or away from areas of high population concentration (Ricklefs and Miller 2000). Dispersal is an action performed by an individual. An animal disperses or it remains within its maternal range (Caughley and Sinclair 1994). If it disperses, it may move only that distance sufficient to bring it to the nearest unoccupied and suitable area within which to establish its own home range (Caughley and Sinclair 1994). Howard (1960) proposed innate dispersal, a tendency of young animals to leave their natal areas and prevent inbreeding and environmental dispersal, a behavioral response to stresses such as shortages of food or space. The effects of dispersal include (1) maintenance of genetic variability within the species; (2) repopulation of depleted areas; and (3) colonization of new areas when suitable habitat becomes available (Bolen and Robinson 2003).

Dispersal is important to metapopulation dynamics and many factors are at play in dispersal. Population density is naturally a prominent factor for most individual dispersal decisions because it is both an indication of intraspecific competition (density as an ultimate cause) and as a sign of habitat quality (density as proximate cue) (Clobert et al. 2004). In general, there are two types of dispersers: those individual movements that are completed by settlement in an already occupied patch (re-enforcement) and those that end up in an unoccupied patch (colonization). In the case of colonization, dispersal success declines with decreasing habitat and increasing fragmentation of the landscape. Dispersal success exhibits a threshold response to habitat amount. The rate of decline in dispersal success can accelerate if the amount of habitat falls below 10-20% in some studies (With 2004).

Dispersal habitat was established for black-footed ferrets that dispersed outside the three reintroduction areas but remained within the experimental population area (Figure 12). Dispersal habitat generally corresponds to Conata Basin MA 3.63 and Wall North, Wall Southeast, Wall Southwest GAs, and some of Fall River Northeast.

No special considerations for black-footed ferret management and recovery were prescribed for dispersal habitat, but any black-footed ferret found in dispersal habitat would be left alone and not relocated except under circumstances described in the 1994 FEIS (USFWS et al. 1994). The 1994 Record of Decision on the reintroduction stated: "my decision supports the Forest Direction Goal on page III-3 of the Forest Plan to 'provide special emphasis for protecting and improving the habitat of threatened and endangered plant and animal species.' This direction applies equally to the BGNG areas within the reintroduction area and to the BGNG areas designated as dispersal habitat." In 2002, the Forest Service designated most of Conata Basin and another site, Smithwick, as MA 3.63 for black-footed ferret conservation (Figures 13 and 14). The designated dispersal habitat was not eliminated by the 2001 Forest Plan.

Basis of Original Black-footed Ferret Viability in Conata Basin/Badlands. During the early 1990s, comparatively little was known about the biology and ecology of black-footed ferrets prior to reintroduction into Conata Basin/Badlands in 1994. The species had been briefly studied on black-tailed prairie dog colonies in Mellette County, South Dakota (Hillman 1968, Hillman and Linder 1973, Hillman et al. 1979, Hillman and Clark 1980) and on white-tailed prairie dog colonies at Meeteetsee, Wyoming (Wood 1986). Seal et al. (1989) and others summarized approaches to black-footed ferret conservation, including population viability analysis, allowing

the USFWS et al. (1994) to establish two primary objectives to represent the population viability standards for a reintroduced population:

- Manage for a 95 percent or greater probability that the population would persist under demographic and environmental variability for a minimum of 100 years (30 generations); and
- Maintain genetic fitness of the population by striving for a genetically effective population size of 50.

Four criteria (genetics, population demographics/environment, spatial requirements, and prey base) were selected to assess whether different alternatives would meet the above objectives.

Regarding genetics, a genetically effective population size of less than about 50 can lead to inbreeding and loss of genetic variation that may threaten persistence of a black-footed ferret population (Brussard and Gilpin 1989). Groves and Clark (1986) estimated that 214 breeding black-footed ferrets are needed in a population to maintain a genetically effective population of 50 for short-term viability. They also estimated that the minimum area requirements for black-footed ferrets in white-tailed prairie dog colonies would be about 26,000 acres. However, they recognized that until there was better information on black-footed ferret genetic diversity, combining genetic considerations with demographic and environmental variability should provide a reasonable estimate of minimum viable population.

Demographic uncertainty results from random events affecting the survival and fertility of a population, while environmental uncertainty can be due to random or unpredictable changes in factors such as weather, food supply, and competitor, predator, and parasites at a site. Natural catastrophes such as floods, fires and drought can also significantly affect a population. The Harris et al. (1989) model was used in 1994 to estimate the number of breeding adult black-footed ferrets needed for persistence of a population over time. The model used natality, disappearance rates, and sex-ratio data from the Meeteetsee black-footed ferret population under different levels of environmental variability. The simulations indicated that a population should contain at least 100 breeding adults to have a 95 percent probability that a population would persist for 100 years. Smaller populations are especially vulnerable to extinction from the large seasonal fluctuations in numbers (especially over-winter mortality) that are characteristic of the black-footed ferret.

One hundred breeding adult black-footed ferrets were used by USFWS et al. (1994) as the minimum population viability standard to compare against the carrying capacities for black-footed ferrets available under different alternatives for black-footed ferret reintroduction. The 100 black-footed ferrets do not represent a critical population size at which the population is guaranteed to persist. Demographic and environmental variability (plague, extended drought) in excess of that used in the simulation model of Harris et al. (1989) would require a larger population size to cope and remain viable (Shaffer 1987). Indeed, Harris et al. (1989) indicated that breeding populations of less than 100 adults are vulnerable to chance extinctions largely because of the pronounced seasonal fluctuations in numbers that characterize the species. Hence, the required number of breeding adult black-footed ferrets would be greater than 100.

Prey was judged to be sufficiently abundant in Conata Basin/Badlands in 1994 to meet energetic requirements of a black-footed ferret population. Therefore, the total area of available habitat was assumed to be the limiting factor that determines the number of black-footed ferrets that can

be supported in the population. Notably, the Biggins et al. (1993) model (commonly called ferret family rating) evaluates the prey base and provides an index of maximum carrying capacity for black-footed ferrets based solely on the prey available at a site in relation to the minimum food needs of black-footed ferrets. The model is sensitive to changes in prairie dog densities and assumes that changes in prairie dog densities always translate to changes in the number of black-footed ferrets that is projected to be supported at a site. This is the case even if the total acreage of available habitat does not change.

Because the Biggins et al. (1993) model did not incorporate spatial requirements of black-footed ferrets, the results derived from the model represented a useful but only initial step for an estimate of black-footed ferret carrying capacity. Biggins et al. (2006) revised the model to include spatial features. The limited evidence from the Meeteetsee, Wyoming black-footed ferret population indicated that when food was in excess of that needed to meet the basic energetic requirement of black-footed ferrets, changes in prairie dog densities alone did not seem to influence the size of area used by individual black-footed ferrets. USFWS et al. (1994) reasoned that when the minimum food needs are met, the need for space by black-footed ferrets replaces food as the limiting factor and becomes the more realistic determinant of population size supported at a site. Agencies believed that if reintroduction was successful then follow up studies and monitoring of black-footed ferrets in Conata Basin/Badlands would reveal the spatial needs of black-footed ferrets.

Nevertheless, the standard used for spatial requirements of black-footed ferrets in 1994 was one black-footed ferret family per 75 acres based upon data from Mellette County, South Dakota (Hillman et al. 1979). This value was a conservative estimate of spatial needs because Hillman et al. (1979) recommended that 98 acres of habitat be available for each black-footed ferret family. The estimates of black-footed population size that were derived from the use of 75 acres probably represented the maximum number of black-footed ferrets that could reside within the total area of habitat, estimated at about 8,000 acres in 1994 in the three reintroduction areas in Conata Basin/Badlands. Again, future studies and monitoring of black-footed ferrets and modeling of black-footed ferret populations would hopefully better reveal the spatial and population needs of black-footed ferrets.

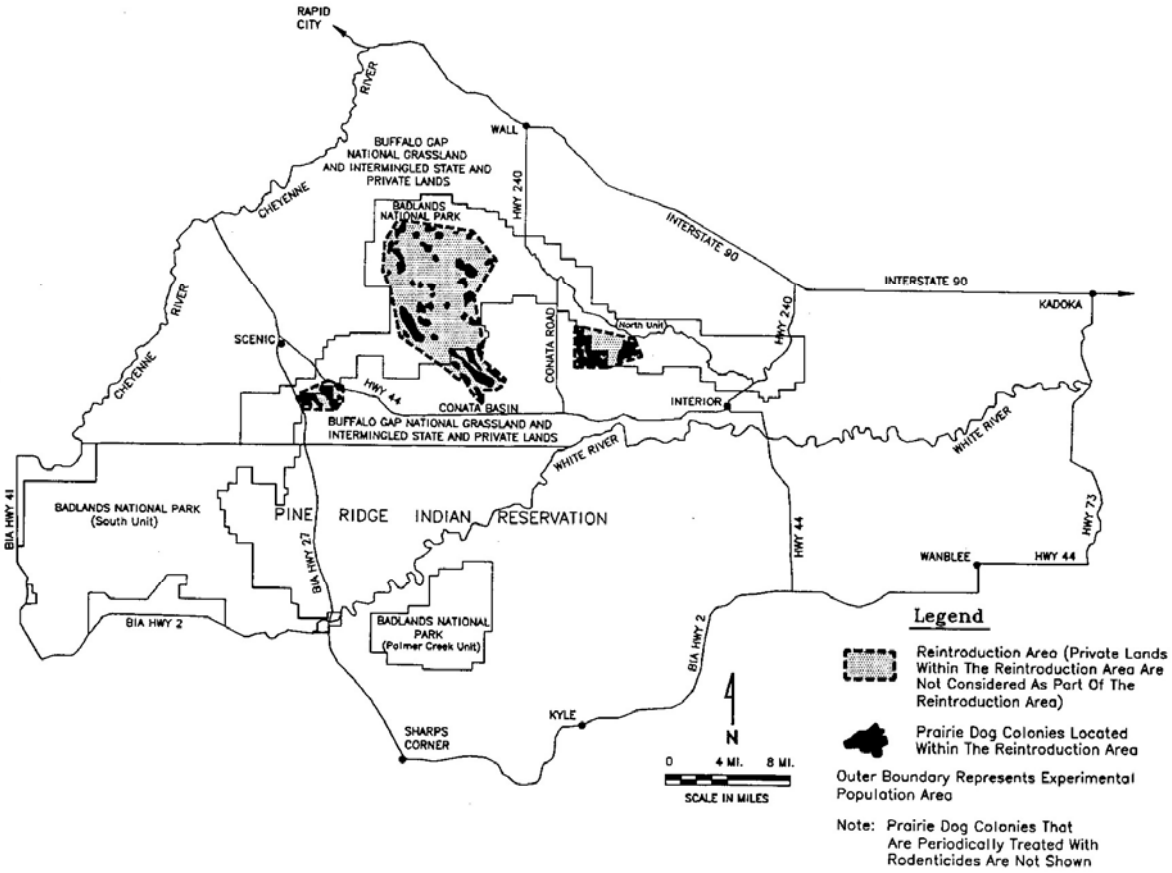


Figure 12. The Conata Basin/Badlands Black-footed Ferret Reintroduction Area and Experimental Population Area (outer boundary) in 1994; the Reintroduction Area was selected by the U.S. Forest Service (31 May 1994 Record of Decision) and based upon USFWS et al. (1994). The Reintroduction Area (three units) is about 42,000 acres. The Experimental Population Area is about 1.2 million acres. In 1994, there were about 8,000 acres (much of the acres in Badlands National Park) of black-tailed prairie dog colonies in the three units. Other colonies occurred outside the units. The 1994 Record of Decision designated 206,300 acres of Buffalo Gap National Grassland outside the Reintroduction Area as dispersal habitat for black-footed ferrets that move outside the Reintroduction Area. The dispersal habitat is not illustrated above but it generally corresponds to NFS lands in Conata Basin MA 3.63, and Wall North, Wall Southeast, Wall Southwest, and some of Fall River Northeast Geographic Areas (see frontispiece). USFWS (1992; cited in USFWS et al. (1994)) recommended that a site with 11,700 to 23,500 acres (or more) of active prairie dog colonies with an average prairie dog density of 5 prairie dogs per acre represents habitat having a 95 percent chance of sustaining a population of 95 breeding-age black-footed ferrets for 50 to 100 years. These acreage recommendations were also based on the average density of one black-footed ferret per 124 acres of habitat at Meeteetse, Wyoming (white-tailed prairie dog colonies).

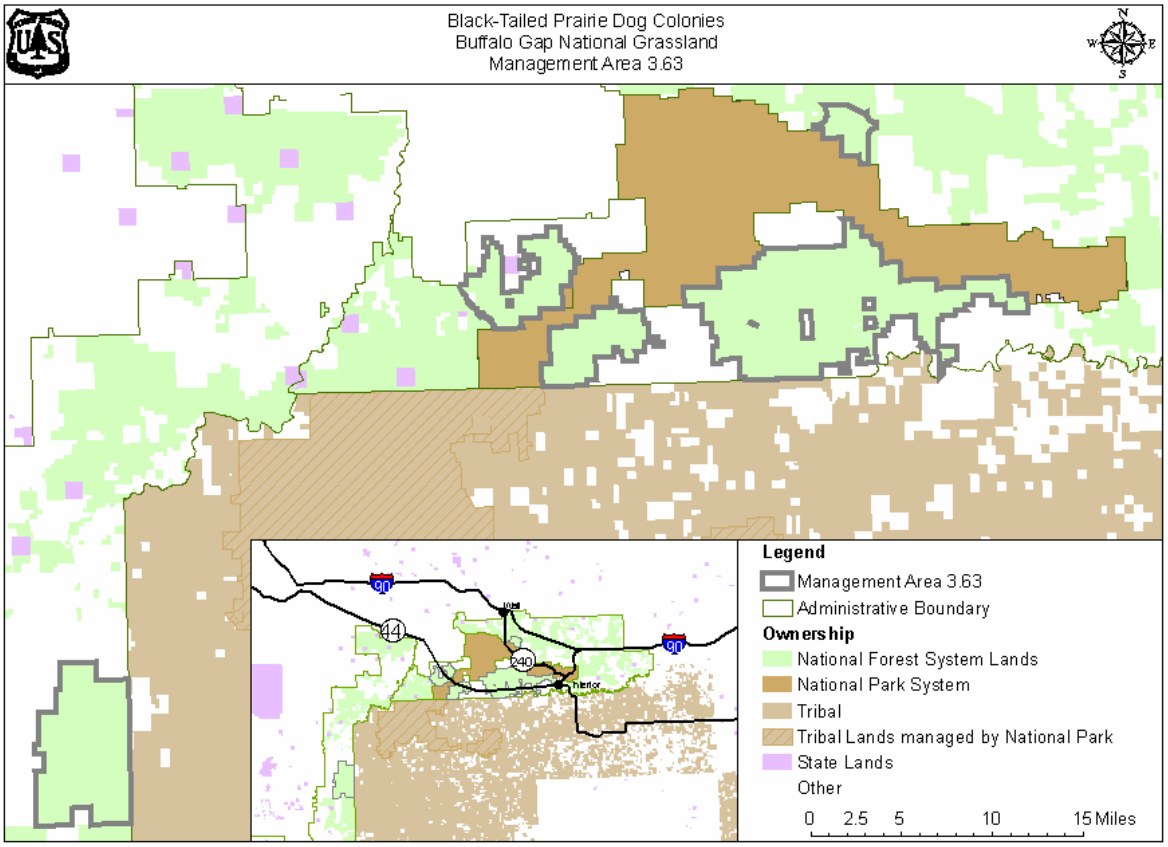


Figure 14. The **Conata Basin Management Area 3.63** (outlined in grey above; 77,155 (68,183 acres suitable for black-tailed prairie dogs) was established on Buffalo Gap National Grassland by the Forest Service's 2002 Land and Resource Management Plan.. The 3.63 Area encapsulates the 1994 Reintroduction Area and much of the dispersal habitat on Buffalo Gap into the Land and Resource Management Plan. The **Smithwick Management Area 3.63** (outlined in grey above in the lower left corner; 25,307 acres (24,187 acres suitable for black-tailed prairie dogs)) was established on Buffalo Gap National Grassland by the Forest Service's 2002 Land and Resource Management Plan. Black-footed ferrets do not yet occur at Smithwick. There have been no efforts to reintroduce black-footed ferrets. Like Conata Basin Management Area 3.63, the theme or purpose of the Smithwick Area is uniquely black-footed ferret reintroduction habitat, that is, existing and re-occurring black-tailed prairie dog colonies to meet the needs of a viable black-footed ferret population. Livestock grazing and other uses may occur in the 3.63 Area but fundamentally the Area exists for black-tailed prairie dog colonies, the habitat of the black-footed ferret. Specific acreages of prairie dog colonies were not enumerated in the 2002 Plan because of uncertainties surrounding black-footed ferret habitat requirements and population size. The 2002 Plan thus afforded flexibility in managing an endangered species. Under the Land and Resource Management Plan, "black-tailed prairie dog colony complexes are to be actively and intensively managed as reintroduction habitat for black-footed ferrets. Desired conditions are "large prairie dog colony complexes established and maintained as suitable habitat for black-footed ferret reintroductions. Land uses and resource management activities are conducted in a manner that is compatible with maintaining suitable black-footed ferret habitat. The Forest Service works with other agencies and organizations to pursue conservation agreements or easements with adjoining land jurisdictions to achieve black-footed ferret recovery objectives. Where landownership patterns are not conducive to effective and successful prairie dog and black-footed ferret management, landownership adjustments with willing landowners may also be used to help resolve management issues." The Forest Service "authorizes only those uses and activities that do not reduce the suitability of the area as black-footed ferret reintroduction habitat." All prairie dog colonies within this area "are managed as though they are occupied by black-footed ferrets." In addition, "Relocation of prairie dogs to establish new colonies and accelerate growth of prairie dog populations in selected areas may occur only after consultation with appropriate state and federal wildlife agencies. To help expand and maintain suitable black-footed ferret habitat, prohibit prairie dog shooting. Coordination and consultation with the state wildlife agency will occur prior to any Forest Service actions regarding prairie dog shooting restrictions." In 2005, the Plan was amended and a boundary management zone (BMZ) was established within 0.5 miles of private and tribal lands where control of prairie dogs may occur. The BMZ effectively removed 25,149 acres (21,784 acres suitable for black-tailed prairie dogs) from the Conata Basin 3.63. The BMZ effectively removed 7,658 acres (7,177 acres suitable for black-tailed prairie dogs) from the Smithwick 3.63.

Recent Population Viability Assessment. Since the 1994 environmental impact statement on black-footed ferret reintroduction (USFWS et al. 1994), more information on black-footed ferrets in Conata Basin/Badlands has accumulated to allow a review of the status of the species. Issues about captive breeding efficiency, potential genetic effects on captive and wild black-footed ferret populations, evaluation of reintroduction progress and the need to critically examine and model various program management applications indicated a need for further program analyses. The USFWS and the Black-footed Ferret Recovery Implementation Team collaborated with the Conservation Breeding Specialist Group (CBSG), a division of the World Conservation Union's Species Survival Commission, and held a workshop on black-footed ferret population management in 2003 (CBSG 2004). CBSG was instrumental in the development of the original captive breeding and black-footed ferret recovery recommendations of 1987.

The 2003 CBSG workshop focused on captive breeding and a *VORTEX* model (Lacy 2000) that emulates black-footed ferret population growth in Conata Basin during 1996-2002. *VORTEX* is a population viability analysis (PVA) tool that assesses the risks of extinction or quasi-extinction over a defined time period for a given population (Gilpin and Soulé 1986). The use of PVA has grown considerably in conservation biology, although some caution about the use of PVA over extended time frames and the lack of spatial data often associated with PVA. Nevertheless, managers require PVA tools that can help guide conservation of small populations in the absence of large amounts of spatial data (Holmes and Semmens 2004).

VORTEX models demographic stochasticity (the randomness of reproduction and deaths among individuals in a population), environmental variation in the annual birth and death rates, the impacts of sporadic catastrophes, and the effects of inbreeding in small populations. *VORTEX* also allows analysis of the effects of losses or gains in habitat, harvest or supplementation of populations, and movement of individuals among local populations. The reliability of a *VORTEX* exercise is dependent upon the level of detail in the inputs and many details for the Conata Basin/Badlands black-footed ferret population are unknown.

CBSG Modelling. CBSG examined several aspects of black-footed ferret population dynamics and management:

- constructed a baseline model that emulated black-footed ferret population growth at Conata Basin from 1996-2002.
- modeled harvest to understand how many black-footed ferret kits could be removed for translocation without significantly decreasing population persistence.
- modeled variable black-footed ferret reintroduction cohort sizes and carrying capacities to determine the minimum number of ferrets and minimum prairie dog complex size required to achieve a reasonable expectation of population persistence.
- investigated supplementation strategies to maintain a black-footed ferret population with a reasonable expectation of persistence.

Again, it is important to note that *VORTEX* requires numerous inputs. However, many inputs are lacking for Conata Basin black-footed ferrets. There are no data on inbreeding depression, lethal equivalents, and environmental variation in reproduction and survival, all of which would reduce displayed CBSG persistence times. Furthermore, the quality of some inputs, such as male and female survival, is marginal or carries large standard deviations. The carrying capacity of Conata Basin for black-footed ferrets is largely unknown. At the time of the modeling, home range information was deficient. CBSG did not explore catastrophes (plague, canine distemper,

severe drought, failure of an age class, severe winter, increased predation rates and others). The probability and effects of these catastrophes are largely unknown, although plague has already rapidly affected 9,000 acres of prairie dog colonies in Conata Basin in just a few months. Catastrophes could affect black-footed ferrets in two ways: first is the effect upon prairie dogs, thus reducing the prey base for black-footed ferrets and second is the direct effect upon black-footed ferrets (e.g. plague is fatal to black-footed ferrets). In light of the above, CBSG model results, such as population persistence, display a best case scenario. Moreover, modeling efforts should not be examined for true numbers but rather for relative effects of management actions.

Baseline Model. The baseline model for the Conata Basin black-footed ferrets produces an annual average growth rate of 0.038 over a simulation period of 100 years. With this growth rate, the population can increase in size from an original number of 100 breeding individuals to about 160 in a short period of time, owing to density dependent growth in the model. Once a larger population size is reached, higher density dependent mortality is imposed and the growth rate declines until a stable population size is reached. Because of this rather strong opportunity for growth, the population has a low probability of extinction of just 0.012 over the 100-year simulated timeframe. Extinction typically occurs when, at higher population densities, very high mortality is randomly imposed through the inclusion of environmental variability in demographic rates, and the population rapidly declines to a very low level. Following this decline, the population can readily become extinct. Declines of smaller magnitude are not as severe since, through the inclusion of density-dependent mortality in the models, the low population densities that result lead to lower mortality levels and greater overall growth rates.

Harvest. A major thrust of the CBSG model was an understanding of the amount of black-footed ferret kit harvest for translocation that could be tolerated in this population. In the absence of harvest, the baseline model shows an annual growth rate of nearly 4%, with an extinction risk of just over 1%. When 30% of the kits are removed annually, the population stabilizes at about 100 breeding-age individuals throughout the course of the simulation. In contrast to the no-harvest baseline, the annual variability in population growth rate is substantially reduced, a result of the reduced overall population size and elimination of high-density mortality. When harvest is increased to 40%, overall mean population growth rate declines, extinction risk increases, and average final population size drops as well. This harvest analysis is just a beginning of our understanding of this aspect of black-footed ferret management. Large numbers of black-footed ferrets are removed each year by the USFWS but there has been no assessment of such removals on the black-footed ferret population in Conata Basin/Badlands.

Population Size and Persistence. The results of modeling (Table 5) indicate that very small black-footed ferret populations – for example, those with N<40, are highly susceptible to extinction within 30 – 50 years in the absence of intensive management. Larger populations show a much greater degree of persistence, with growth rates ranging from 3% to 4% per year and extinction risks less than 10% over 40 years and less than 20% over 100 years. When black-footed ferret populations have an opportunity to grow to a larger carrying capacity (second number under K in table below), the growth rates increase, extinction probabilities decrease, and general population stability is enhanced. However, these simulations clearly demonstrate the susceptibility of very small black-footed ferret populations to random extinction through

unpredictable variability in demographic rates – even when those demographic rates are expected to show long-term population growth.

CBSG estimates that 120 breeding adults are needed to sustain a black-footed ferret population with >90% probability of persistence over 100 years. Typically, PVA tools recommend at least a 95% probability of persistence over 100 years and this is recognized by USFWS et al. (1994) Such a probability of persistence would require from 125-130 breeding adults. USFWS et al. (1994), recognized the need for >100 breeding adult black-footed ferrets in Conata Basin, a population projection now estimated by CBSG (2004). In addition, to remove the black-footed ferret from the endangered species list the draft recovery plan requires at least 10 sites with 100 or more breeding adults (USFWS 2006a).

N	K	R_s(SD)	P(E)	N_{100}(SD)	T(E)
15	15	0.000 (0.407)	0.998	8 (--)	12
	30	0.040 (0.439)	0.814	19 (8)	39
20	20	0.018 (0.462)	0.990	14 (6)	22
	40	0.038 (0.430)	0.506	26 (10)	45
40	40	0.031 (0.436)	0.528	27 (9)	43
	80	0.038 (0.416)	0.118	56 (19)	49
60	60	0.034 (0.426)	0.234	40 (15)	50
	120	0.038 (0.416)	0.046	83 (27)	52
80	80	0.033 (0.423)	0.126	54 (19)	46
	160	0.038 (0.411)	0.030	110 (36)	54
100	100	0.032 (0.418)	0.070	68 (23)	49
	200	0.037 (0.412)	0.030	137 (46)	61

Table 5. Demographic results for population persistence models of simulated Conata Basin breeding adult black-footed ferrets (CBSG 2004). Note that probability of extinction declines significantly when more carrying capacity (habitat) is provided. When the population is strictly limited to the precise K that it requires (for example N=100 and K=100) then the probability of extinction is greater than when the population is afforded additional K. Note also that these probabilities represent best case scenarios because many VORTEX inputs such as the effects of stochastic events are not included in the CBSG VORTEX exercise.

N is initial number of breeding adults

K is carrying capacity

R_s(SD) is stochastic population growth rate (standard deviation)

P(E) is the probability of population extinction over 100 years

N_{100}(SD) is the mean size of extant populations after 100 years (standard deviation)

T(E) is the mean time to extinction (years)

Genetics. The black-footed ferret has low genetic diversity. For species with so few populations with reduced genetic diversity, the only options are to improve their environment and minimize risks associated with changed environments (especially disease) and small population size (Frankham et al. 2002, 2004). A species' evolutionary potential and fitness plummets with low genetic diversity and there is a high probability that a species such as the black-footed ferret can not cope with environmental changes such as plague and extensive poisoning of prairie dog colonies in areas the black-footed ferret inhabits.

One of the objectives of the black-footed ferret reintroduction at Conata Basin/Badlands is to maintain genetic fitness of the population by striving for a genetically effective population size

of 50. Groves and Clark (1986) estimated that 214 breeding black-footed ferrets are needed in a population to maintain a genetically effective population of 50 for short-term viability. USFWS et al. (1994) estimated that perhaps 184 breeding adults could be established in Conata Basin. The agencies did not anticipate that Conata Basin/Badlands habitats over the current, short, or long term would provide a genetically viable population of black-footed ferrets. They anticipated that initial reintroduction efforts at Conata Basin/Badlands would concentrate on ensuring the successful survival and reproduction of as many released black-footed ferrets as possible. As sufficient numbers of animals became established, genetic concerns would play an increasingly larger role in management efforts.

Genetic fitness of the black-footed ferret has been a concern in the captive breeding program due to the extreme bottleneck that the species passed through (CBSG 2004, Garelle et al. 2006, Groves and Clark 1986, Howard et al. 2006, Hutchins et al. 1996, USFWS 1988, Wisely 2006). The current captive breeding program began with 7 founder equivalents trapped at Meeteetse, Wyoming (Hutchins et al. 1996, Wisely 2006). The magnitude of loss of genetic diversity was exacerbated by the especially isolated nature of the last population at Meeteetse. Meeteetse is located on the periphery of the historical black-footed ferret range and was likely a refugium during the last glacial period that subsequently remained isolated (Wisely 2006).

Two types of genetic effects that can impact a population's survival are: 1) inbreeding depression, caused by increased genetic homozygosity and the subsequent expression of deleterious genes, and 2) genetic drift, the random loss of genetic diversity in small populations (Clark 1989). Genetic diversity of less than 90 percent of that in founder populations of some species has been associated with compromised reproduction due to lower birth weights, smaller litter size and greater neonatal mortality. Genetic diversity in the current black-footed ferret population is estimated to be 87 percent of that in the founder population (Garelle et al. 2006). Some periodic abnormalities observed in captive ferrets (reduced sperm viability, renal aplasia and kinked tails) may be a result of inbreeding (Howard et al. 2006, Hutchins et al. 1996). A primary goal is to optimize genetic management of the captive population by maintaining 80 percent of the genetic diversity present in the founder population for the next 25 years (Marinari and Kreeger 2006).

The use of artificial insemination in black-footed ferret captive breeding programs has been effective and has helped preserve genetic diversity from an underrepresented male lineage (Howard et al. 2006). Over 5,100 ferret kits have been produced (survived to 90 days of age) at captive breeding facilities (Marinari and Kreeger 2006). Wisely (2006) concluded that where ample, plague-free habitat exists, populations appear to flourish despite reduced genetic diversity; and with careful management of remaining genetic resources, the black-footed ferret will likely persist.

Population Viability Assessment Uncertainty. The CBSG (2004) exercise gives clues to black-footed ferret population persistence over time and examines the effects of management practices such as kit harvest and the effects of plague. However, the modeling of minimum population size with a stated probability of persistence for a defined period is problematic. Miller and Lacy (2005) indicate that because so much of a PVA is uncertain, a PVA that provides an estimate of the probability of extinction under a single scenario is of very limited usefulness. It is likely that PVAs will underestimate the vulnerability of most populations to extinction. Thus, one should be circumspect about the reliability of the estimate of the number of adult black-footed ferrets needed for a viable population, and have even less assurance that the

numbers (or acres) of prairie dogs needed to support that many black-footed ferrets can be reliably estimated at this time.

PVA modeling create perhaps more uncertainty for management decisions especially on multiple use federal lands such as national grasslands (Leitzell 1986). However, uncertainty is fundamental to PVA (Soulé 1987). There is environmental uncertainty, partial observability (sampling error in estimating abundance or demographic parameters), and structural uncertainty (ignorance of the "true" functional form for population dynamics) (Williams et al. 2002).

Often PVA estimates minimum viable population (MVP) size with a view that population size is a major consideration in the likelihood of extinction for a population (Caughley 1994). However, long-term population viability is affected by changes in the environment. Even though a population may have increased or decreased for a period of years, the population may not continue on the same trajectory in the future, and no black-footed ferret or prairie dog population can continue to grow indefinitely because of density-dependence (Caughley and Sinclair 1994). Anticipating long term population trends can be problematic.

Although there is often insufficient data to perform PVA with statistical rigor, a PVA model is useful to our understanding of the principal processes that shape a species' dynamics (Boyce et al. 2001). A PVA model can be improved through adaptive management, monitoring our actions and then iterating the model to incorporate new information (Walters 1986, Boyce 1997). PVA is a tool for integrating conservation science and management (Boyce et al. 2001). PVA is the very basis for adaptive management in which the model poses a formal statement of our understanding of the system and hypothesizes the consequences of management actions (e.g., CBSG 2004 plague simulation) (Boyce 1997). Monitoring the results of management actions then provides data that are used to evaluate the model's predictions with consequent revisions to the model and a new set of predictions (e.g., CBSG 2004 estimate of at least 120 breeding adult black-footed

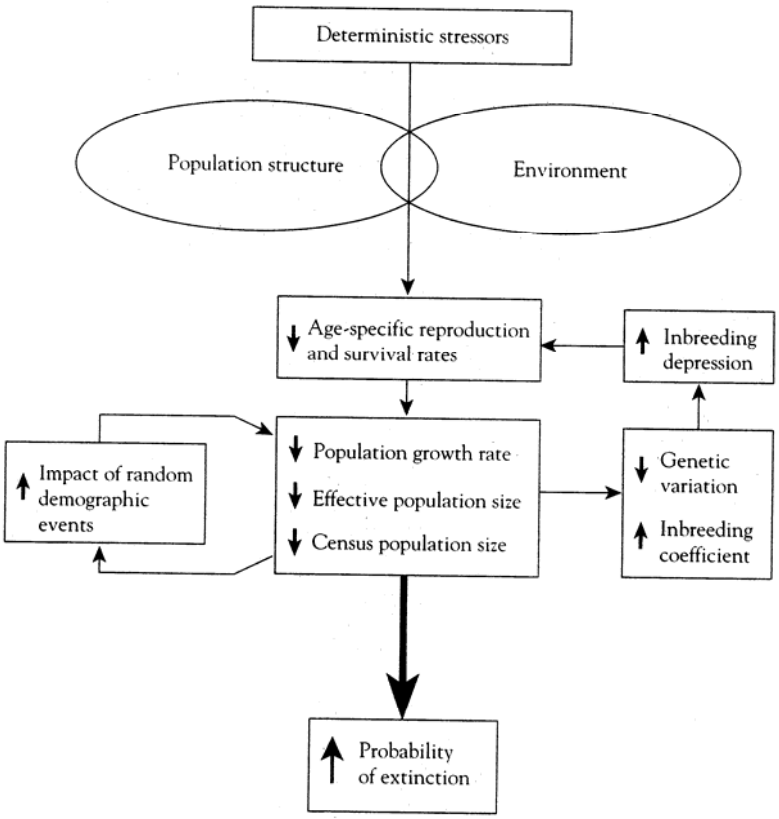


Figure 15. A simplified representation of the extinction vortex (Mills 2007). The effects of deterministic stressors are filtered by the population's environment (habitat as well as variable extrinsic factors such as weather, disease, competition, predators, and by its structure (including age structure, sex ratio, behavioral interactions, distribution, physiological status, and intrinsic birth and death rates. Each turn of the feedback cycle increases extinction probability.

ferrets) (Walters 1986). For now, it is difficult to pin down the exact number of breeding adult black-footed ferrets required for a self-sustaining population in Conata Basin/Badlands now and well into the future. It is equally difficult to specify the correct prairie dog colony acreage required for black-footed ferret habitat. Given our current level of understanding of ecological science and natural resource management, active adaptive management discussed below offers the best, safest, and most rigorous approach toward successful conservation (Boyce 1997, Boyce et al. 2001).

Small Population Size. Overshadowing the above PVA uncertainty discussion is the simple fact that all black-footed ferret populations in the wild are quite small. More populations are needed to enhance overall species' viability and reduce the risk of extinction (Boyce et al. 2002). There were about 89 breeding adult black-footed ferrets in Conata Basin in 2006, and a total of about 150 elsewhere in the wild. In the past, the black-footed ferret had an enormous range in the center of North America and perhaps up to one million existed (Anderson et al. 1986). Fundamentally, most small animal populations face a particularly high risk of extinction in the modern world (Gaggiotti and Hanski 2004). This notion is as old as the writings of Charles Darwin and as recent as today (Holsinger 2000). The high extinction risk of small populations is not surprising because this is the expectation based on several mechanisms of extinction: demographic and environmental stochasticity, Allee effect, inbreeding depression, and so forth. As the different mechanisms tend to make populations ever smaller, they amplify the effect on each other and lead to extinction vortices (Figure 15; Gilpin and Soulé 1986).

In the past, an effective population size of 50 was proposed as a minimum to protect a species against short-term loss of fitness due to inbreeding (Mills 2007). The 50 is the genetic effective size (N_e), which is only about one-fifth to one-third that of the total population size; thus, a N_e value of 50 translates to 150-250 animals. The rule was a short-term guideline for captive breeding based solely on genetic factors, not to the long term survival of wild populations which would have other factors affecting their survival (Mills et al. 2005, Mills 2007). Later, a value of 500 was proposed as the minimum size necessary to ensure long-term maintenance of genetic variation. More recently, population geneticists are recommending 5,000 or more (Frankham et al. 2002). Mills (2007) states that "there is little doubt that the actual population size (as opposed to the genetic effective population size) necessary to maintain evolutionary potential for the long-term should be thousands of individuals and not hundreds." Reed et al. (2003) suggested that conservation programs for wild animal populations need to be designed to conserve habitat capable of supporting approximately 7,000 adult vertebrates in order to ensure long-term persistence. Recovery of the black-footed ferret requires a pre-breeding census population of 3,000 free-ranging black-footed ferret breeding adults in 30 or more populations with no fewer than 30 breeding adults in any population and at least 10 populations with 100 or more breeding adults.

Adaptive Management. There are many uncertainties surrounding the future of the black-footed ferret and it is difficult to reliably estimate the extinction probability for any species (Lebreton and Clobert 1991, Boyce 1992). We simply do not know how many individuals are necessary to prevent population extinction, and there is insufficient empirical and theoretical basis on which to make such extrapolations (Boyce 1997). Small populations may or may not remain viable over long periods of time. Fine tuning the number of acres of prairie dog colonies for a specific number of black-footed ferrets is problematic. Boyce (1997) states:

Although population viability assessment models are weak, "when combined with an iterative process of model improvement and validation, the model can provide a progressively more robust understanding of the dynamics of a species and its habitat; and a model developed in such a way can be a powerful tool for management" (Boyce 1997). Such adaptive management requires robust research and information collection and is suited for the reality of maintaining a black-footed ferret population over time in the midst of socio-political matters, drought, disease, and so forth. Some research has followed the reintroduction of black-footed ferrets into Conata Basin/Badlands. In general, the reintroduction appears to have been successful but we do not know the effects of existing and proposed management actions such as prairie dog control. The extent of research has been inadequate to carry out adaptive management. In 2005, the Forest Plan was amended to allow prairie dog management in the boundary management zone in Conata Basin. Poisoning, fencing, and other control measures cost hundreds of thousands of dollars. Monitoring is now following the effects of such control on prairie dogs but there has been no specific research evaluating the effects of such control on black-footed ferrets.

Adaptive management in regards to the black-footed ferret requires extensive monitoring, research, and evaluation to strengthen nascent population and habitat modeling (Figure 16). Mindful of the body of literature on adaptive management, Conata Basin/Badlands requires a structured approach or umbrella vision to black-footed ferret modeling, empirical research, and management. Such an approach will enhance population and habitat based viability analyses providing the synthesis and analysis stage from which we can design experimental management and guide the collection of data. Only through a rigorous interface between modeling, experimental management, monitoring, and reassessment will we gain reliable knowledge with which to manage the black-footed ferret (Boyce 2001).

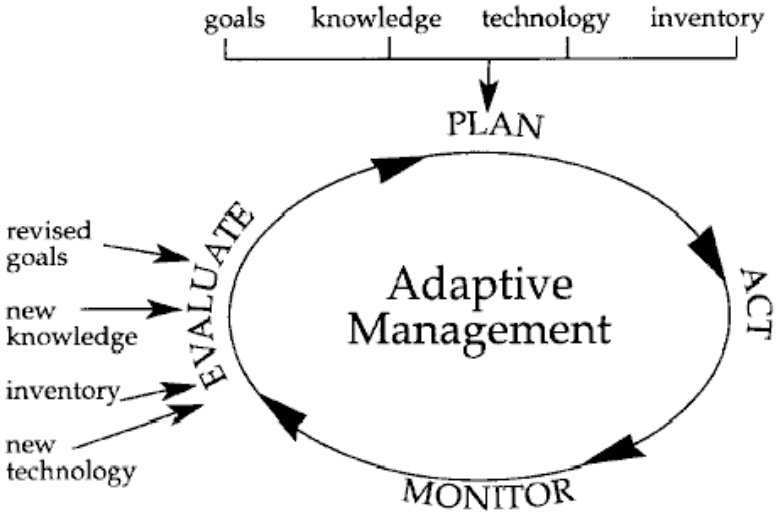


Figure 16. An adaptive management model.

McDonald (2008; Attachment 2) proposes a science-based program to gain reliable knowledge that reduces uncertainty, improves understanding of risk, and facilitates informed management of black-tailed prairie dog and black-footed ferret populations, vegetation, and soil conditions on the Nebraska National Forest. The information gained would be used to refine assumptions and hypotheses about the outcomes of our management of the prairie dog ecosystem. The intent is to ensure that a science-based component of prairie dog management is an integral part of new decisions and their implementation.

Black-footed Ferret Habitat Requirements. Most of Conata Basin has been allocated to prairie dog and black-footed ferret emphasis by the Forest Service via Management Area 3.63 prescription, but questions persist as to what number of adult black-footed ferrets constitutes a

viable population and the area (acres) of prairie dog habitat needed to support persistence over time. As discussed above, there is some uncertainty due to various factors such as drought, prairie dog density, kit production, colony size and, and inter-colony distances, and black-footed ferret spatial use, productivity, and occupancy can be highly variable. Moreover, the black-footed ferret is a little studied animal. One of the reasons for the size (77,155 acres) of the Conata Basin MA 3.63 is to account for uncertainty in habitat requirements and provide flexibility in management as new information becomes available.

Notwithstanding uncertainty about black-footed ferret habitat, a tenet of habitat patch size and extinction is that large habitat patches will have populations with a lower risk of extinction than populations in small patches. Although other things are often by no means equal, and animal population density varies because of variation in habitat quality and for other reasons, a relationship between habitat patch size and extinction risk has typically been observed whenever this relationship has been examined (Hanski 1994a, 1994b, 1999b). This observation has been used in island biogeography (MacArthur and Wilson 1967) and in recent metapopulation research (Ovaskainen and Hanski 2004). In general, the relationship between patch size and extinction risk provides a key rule of thumb for conservation: it is better to conserve a large than a small patch of habitat or to preserve as much of a particular patch as possible.

Various acreages of prairie dog colonies have been suggested for a self-sustaining population of black-footed ferrets and experimental nursery populations of black-footed ferrets. Moreover, acreages of prairie dog colonies have been suggested for other associated species at colonies and acreages of prairie dog colonies have been suggested for mere population persistence of prairie dog. Consequently, a range of prairie dog colony acres exists in published and unpublished reports. Review Attachment 3 for a discussion of minimum and maximum prairie dog colony acreages.

Observations of Conata Basin black-footed ferrets have yielded new information on black-footed ferret ecology, including data relevant to conservation planning. As discussed previously, managing for black-footed ferrets requires an understanding of how black-footed ferrets use prairie dog colonies. How much prairie dog colony area is needed to sustain a viable population of black-footed ferrets estimated by CBSG (2004) to be at least 120 breeding adults? Most data on black-footed ferret movements relate to the Meeteetse, Wyoming black-footed ferret population which survived on white-tailed prairie dog colonies. However, black-tailed prairie dogs are more clustered and dense than white-tailed prairie dogs (Tileston and Lechleitner 1966), hence black-footed ferret movement estimates at Meeteetse may be different from movements in Conata Basin. Nevertheless, evidence from Meeteetse suggests that male black-footed ferrets have larger home ranges than females, a pattern typically observed in solitary animals (Baker 1978, Sandell 1989). Forrest et al. (1985) suggest that male black-footed ferrets select home ranges to maximize access to females and food resources whereas female home ranges represent the area required for physiological needs. Black-footed ferrets likely conform to a typical mustelid spacing pattern with inter-sexual overlap and intra-sexual exclusion (Powell 1979).

Other factors such as age and prairie dog populations may influence home range size. Biggins et al. (2006) postulated that old male social status may competitively exclude younger males. Black-footed ferrets have been observed on large and small prairie dog colonies within Conata Basin, thus colony size may affect home range size. Sandell (1989) found density of conspecifics highly negatively correlated with home range size in solitary carnivores and density is likely related to food abundance. Thus, density of black-footed ferrets and prairie dog

abundance may influence home range size. During drought, prairie dog colonies expand although there are fewer burrows per acre of colony and if drought is severe enough colonies will collapse. On desert grasslands in northern Mexico, drought during 1991-2005 caused a die-off of 20-25% of prairie dog colonies. Prairie dog densities before the drought averaged 6.5 per acre before the drought and fell to 0.8 prairie dogs per acre (Rurik List, pers. commun.). This site harbors an introduced population of black-footed ferrets but their fate is unknown.

Recent Findings in Conata Basin. As a black-footed ferret population began to establish during 1996-2007, there have been increasing opportunities to gain a better understanding of how black-footed ferrets use habitats in Conata Basin. Although systematic long-term studies are still needed and sample sizes continue to develop, there are some new data from individual wild Conata Basin black-footed ferrets. Observations over multiple years can be used in lieu of the predictions relied upon for planning the reintroduction almost 15 years ago.

Jachowski (2007) examined resource selection by black-footed ferrets in relation to the spatial distribution of prairie dogs in Conata Basin and Montana (Figures 17-19). Although we have long mapped the boundaries of prairie dog colonies, the density of prairie dogs can vary considerably within a colony. Within prairie dog colonies, areas with high densities of active and inactive prairie dog burrows form patches and the distribution of these patches change in size, shape and connectivity over time, often a short amount of time (Jachowski 2007). The ability of an area to support a black-footed ferret population may be influenced by the size, availability, and density of high-density patches of prairie dogs (Biggins et al. 2006). Prairie dog distribution shifts likely in response to changes in vegetation species composition and productivity (Coppock et al. 1983, Detling and Whicker 1987). Prairie dog distribution moves to the perimeter of colonies but also back to the interior over time. Jachowski (2007) hypothesized:

> …the relationship between vegetative cover and prairie dog occupancy is likely a dynamic process, where activity areas of prairie dogs shift spatially within colonies over time to enable long-term occupancy of a defined area or burrow system. Thus the inactive portion of prairie dog colonies should not be viewed as low in habitat value over the long term because these sites might again become populated.

Jachowski (2007) found that black-footed ferrets behaved territorially while not defending exclusive home ranges but there can be considerable space use overlap. Livieri (2007, pers. commun.) also considers the black-footed ferret in Conata Basin territorial, not at the 95% home range level but at the 50% core area level. He also observed overlap of home ranges at the 95% level but the 50% core areas appeared to be exclusive. There remains discussion about the nature of territoriality in black-footed ferrets in Conata Basin. Jachowski (2007) stated:

> In looking beyond our findings, which were restricted to the litter-rearing period and time immediately following kit dispersal (June – October), resource selection and space use by ferrets likely varies by season, relatedness and status, similar to other mustelid species (Hellstedt and Henttonen 2006). Ferret space use and factors influencing resource selection likely differ between litter-rearing and non-litter rearing periods. Ferrets generally are thought to be less active above ground outside of the litter rearing season from November through June (Biggins et al. 2006b), with the exception of a pulse of activity around the breeding season (February-March) (Richardson et al. 1987, Forrest et al. 1988). How territories are established or protected outside of the litter rearing period remains little understood. In addition, dominance hierarchies and

> kinship have been found to play key roles in space use by other mustelids (Hellstedt and Henttonen 2006), and are likely to affect ferret spacing patterns.
>
> From a conservation perspective, our study supports the hypothesis that spatial distribution of patches of high prairie dog density is a major determinant of the ability of reintroduction sites to maintain ferret populations. Ferrets have relatively short life spans of 3-5 years (Forrest et al. 1988), experience a high rate of loss due to predation (Forrest et al. 1988, Biggins 2000), and have a low reproductive output relative to other mustelids (Forrest et al. 1985). These factors contribute to the difficulty of ensuring their recovery and underscore the importance of maintaining multiple breeding females at each recovery site. Our findings indicate that the ability of a site to support a greater number of female ferrets, and to achieve a self-sustaining ferret population, can be enhanced by management to create and maintain sufficiently large areas of high prairie dog density that are in close proximity to each other.

Discussions continue of just how much spatial overlap exists and how to separate trespass from sharing, temporal overlap, and kinship effects. Mindful of the above uncertainty, black-footed ferret use of a colony (its use of space) varies according to active prairie dog burrow densities (Figures 17-19). Lower prairie dog densities that are commonly associated with drought as well as disease, poisoning and possibly other unknown factors, lead to an expansion in the black-footed ferret's use of space. Conata Basin has experienced wet and drought years during the past 13 years. Home range estimates for female ferrets ranged from 51.2 – 162 acres during drought (Jachowski 2007). Male home range sizes were considerably larger, averaging 304 acres. Home range size increased as the mean prairie dog utilization distribution value within the home range decreased (Jachowski 2007; Figure 19).

Livieri (2007a, c) estimated the mean home range of female black-footed ferrets on one colony in Conata Basin at 79.3 acres during wet years (1998-2000) and 144.3 acres during a drought (2005), a 82% increase in home range size. Across Conata Basin the mean home range of 11 females was 193 acres and 351.2 acres for the wet and dry years, respectively. Black-footed ferrets are territorial but there is approximately 15% overlap of female home ranges and typically 21.1% of a colony may not be occupied by black-footed ferrets, a difference of 6% over home range overlap. Livieri (2007c) excluded home range overlap area and included unused areas of a colony. That is, it is too simplistic to restrict black-footed ferret spatial requirements to the specific acres of a home range. A 500-acre prairie dog colony containing three black-footed ferrets is not likely to use every acre of that colony but as indicated by Jachowski (2007) over the long and short term the black-footed ferrets will use most of the area. Males may overlap two female black-footed ferret home ranges. Therefore, using home range values, 120 breeding black-footed ferrets, the viable number estimated by CBSG (2004) for >90% population persistence, would require from 16,448 to 29,924 acres during wet and dry years, respectively (80.4 female black-footed ferrets X 193 acres + 6% = 16,448 acres; 80.4 female black-footed ferrets X 351.2 acres + 6% = 29,924 acres). For >95% population persistence 125 breeding adult black-footed ferrets would require from 17,133 to 31,171 acres of prairie dog colonies during wet and dry years, respectively. One-hundred thirty breeding adult black-footed ferrets would require from 17,818 to 32,418 acres of prairie dog colonies (Table 6).

The findings on black-footed ferret home range between wet and dry years at Conata Basin are preliminary, but in general are consistent with patterns observed in many other species, where home ranges are not constant from year to year but typically become smaller when resources are

plentiful. However, larger-than-average home ranges do not alone confirm that insufficient habitat quality or amount alone may be the driving factor (Bolen and Robinson 2003, Ewer 1973, MacDonald 1983). Other factors such as density of conspecifics, body size, competitors, predators and landforms can influence home range size.

In essence, home range is an expression of the optimization process an animal uses to select habitat, a process that involves many factors (Morrison et al. 2006). Providing an area to allow a species to expand their home ranges to meet their resource needs under varying environmental conditions is fundamental to the long-term presence of the species and fundamental to reserve design (Temple and Cary 2002). The black-footed ferret has a large home range and can only achieve a viable population in relatively large areas of habitat. If small areas of habitat were sufficient to sustain black-footed ferrets then one would expect to encounter black-footed ferrets throughout the Great Plains on remaining small patches of habitat, however, such encounters are not known.

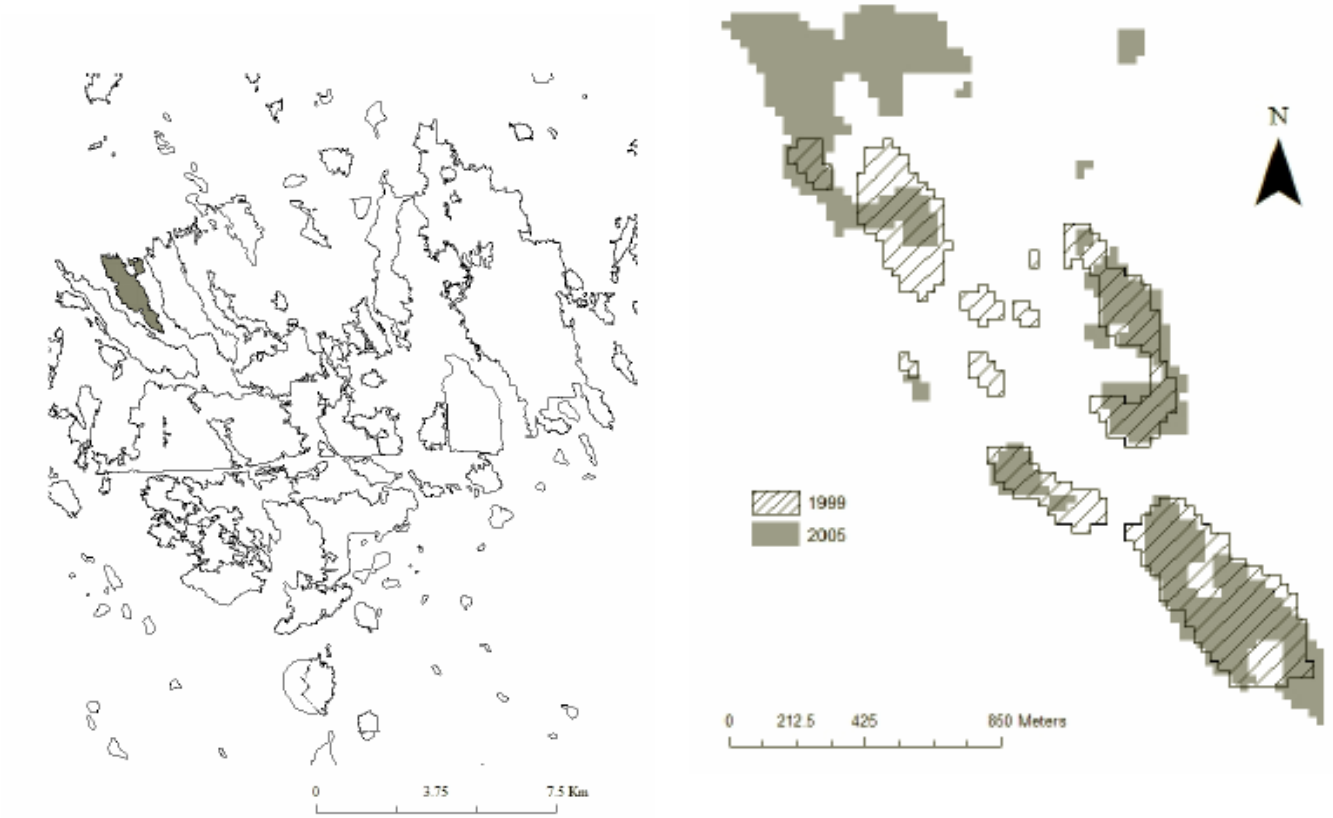


Figure 17. Perimeter map of black-tailed prairie dog colonies in Conata Basin (left). At right are the locations of areas of high densities (Type 4 and Type 5 densities) of active burrows in 1999 and 2005 as illustrated by Jachowski (2007) who classified active burrow distributions into a five-level, ordered factor based upon prairie dog burrow utilization distribution (Type 1 contained the lowest density patches of prairie dog burrows).

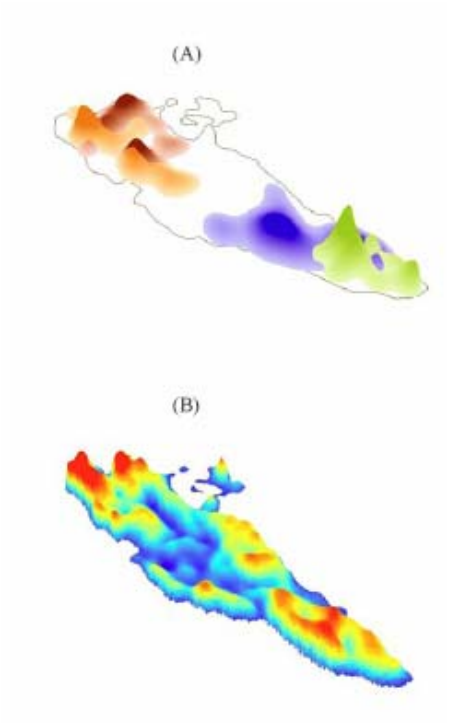


Figure 18. Three-dimensional representation (A) of four female black-footed ferret utilization distributions in 2006 at one large prairie dog colony in Conata Basin, 2006; and the prairie dog utilization (B) at the same colony. The yelow to red colors indicate high densities of active prairie dog burrows (Jachowski 2007).

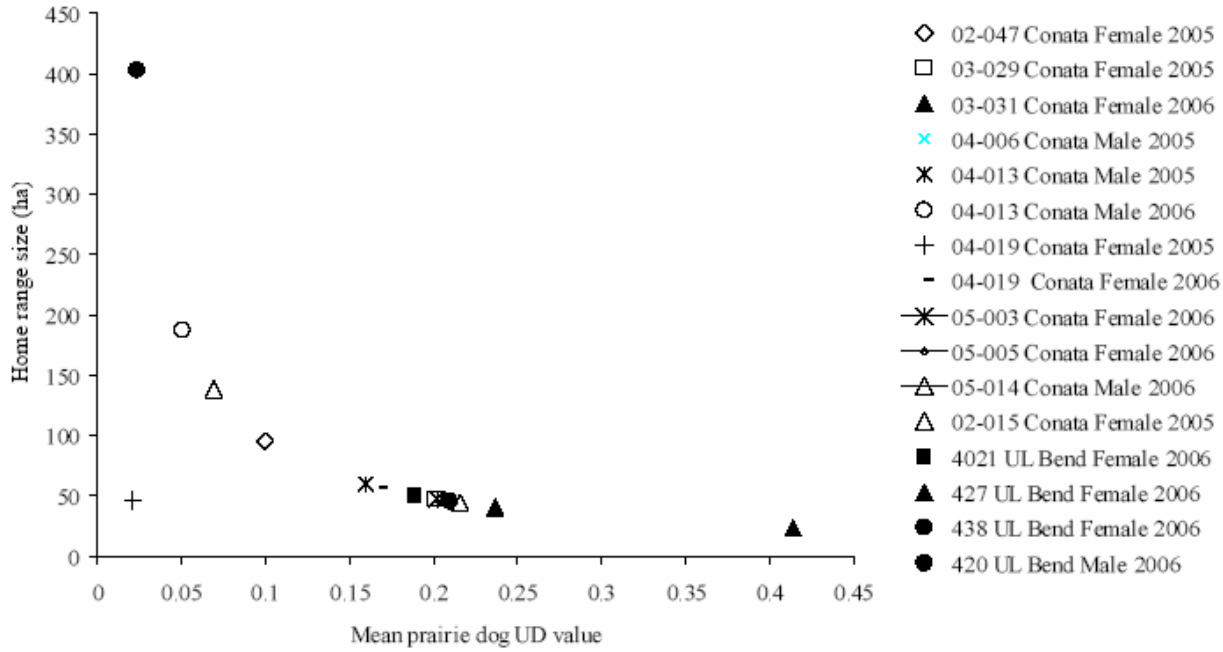


Figure 19. Home ranges of individual male and female black-footed ferrets in UL Bend, Montana and Conata Basin, South Dakota plotted as a function of mean prairie dog utilization distribution (UD) value (± 1 SE) (Jachowski 2007).

Table 6 presents estimates of prairie dog colony acreage associated with different numbers of breeding adult black-footed ferrets using different analytical approaches. Note that some agencies have relied upon the Biggins et al. (1993) model (ferret family rating) and its update (Biggins et al. 2006) to manage and evaluate a black-footed ferret site over time or under different management scenarios. However, the original purpose of the "Biggins model" and the ferret family ratings derived from it was to provide a mechanism for national recovery program personnel to compare and rank the suitability of sites in the national recovery program at broad scales across the historic range of the black-footed ferret. The model's value to site-level modeling and management over time is limited. However, it is a model that has been around for many years and become part of the lexicon in the black-footed ferret recovery arena. Hence, the model and its black-footed ferret family rating outputs are presented for comparative purposes with the outputs from other approaches.

Although Conata Basin sustains many thousands of acres of prairie dog colonies, reintroduction of black-footed ferrets recently has occurred on small areas such as the 2,800 acres of colonies at Wind Cave National Park, South Dakota (National Park Service 2006a, 2006b). Even national grasslands with plague such as Thunder Basin National Grassland, Wyoming are currently planning black-footed ferret re-introduction. USFWS and others (Proctor et al. 2006a, 2006b) have identified over 92 focal areas for the conservation of black-footed ferrets and some are relatively small. This is by no means contradictory to the above discussion on the black-footed ferret's requirements for large complexes of prairie dog colonies. The pursuit of small reintroduction sites arises from the necessity to find more sites for a species that remains functionally extinct in the wild. It is crucial to establish and maintain as many black-footed ferret populations as possible in native habitats, preferably plague-free, even if such sites are less than ideal. In cases where the habitat base is small, or subject to periodic effects of plague for example, more on-going human intervention and management (releases of captive-reared black-footed ferrets) may be required to maintain populations. These populations may also play an important role in establishing nursery stocks which could be exchanged between reintroduction areas to maximize genetic diversity and improve overall survival and health of wild ferret populations (CBSG 2004).

Table 6. Ranges of black-tailed prairie dog colony acreage projected under various models as needed to support 100-200 breeding adult black-footed ferrets.

	Home Range		Adult Female Density		Ferret Family Rating (1993)		Ferret Family Rating (2006) 2005 EIS densities		Ferret Family Rating (2006) Historic densities	
# Breeding Adults	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
100	13,707	24,937	14,848	19,068	12,078	29,333	15,444	29,333	15,004	40,174
120	16,448	29,924	17,729	22,767	14,494	35,200	18,533	35,200	18,005	48,208
125	17,133	31,171	18,615	23,905	15,098	36,666	19,305	36,667	18,755	50,217
150	21,245	38,652	22,161	28,459	18,118	43,400	23,166	44,000	22,506	60,260
175	23,987	43,640	25,929	33,297	21,137	51,333	27,028	51,333	26,257	70,304
200	27,414	49,874	29,696	38,134	24,157	58,666	30,889	58,666	30,008	80,347

Black-footed Ferret Family Rating (FFR): FFR 1993 was calculated using Biggins et al. (1993) and adjusted for incomplete occupancy. This model uses prairie dog densities to calculate the total number of prairie dogs which is then divided by 763 (the estimated number of prairie dogs needed to support one black-footed ferret family and maintain the prairie dog population); 763 is not the number of prairie dogs consumed by a black-footed ferret family annually. Prairie dog density estimates (6.3 – 15.3 prairie dogs/acre) from Livieri and Perry (2005). FFR 2006 (2005 densities) was calculated using Biggins et al. (2006) and adjusted for incomplete occupancy. This model accounts for the estimated effects of territoriality at high prairie dog densities. When prairie dog densities exceed 7.3/acre a curvilinear territorial response is imposed. If prairie dog densities are below 7.3/acre then the calculations are the same as FFR 1993. FFR 2006 (historic densities) was calculated similar to FFR 2006 (2005 densities) and adjusted for incomplete occupancy. The historic high and low prairie dog densities observed at Conata Basin (4.6 – 22.3 prairie dogs/acre) were used. The underlying assumption of all FFR estimates is that number of adult black-footed ferrets is equivalent to one-half FFR (e.g., 200 FFR = 100 adults).

For example, the FFR 1993 maximum for 100 breeding adults was calculated as: 100 adults = 200 FFR; 200 FFR x 763 prairie dogs/FFR = 152,600 prairie dogs; 152,600 prairie dogs / prairie dog density (6.3 prairie dogs/acre) = 24,222 acres; 24,222 acres x 1.211 (for incomplete occupancy) = 29,333 acres.

FFR 2006 (2005 densities) was calculated the same as FFR 1993 for maximum (dry years) but was calculated differently for minimum (wet years) using the territorial adjustment: 100 adults = 200 FFR at 15.3 prairie dogs/acre; 15.3 prairie dogs acres = 0.01568216 ferrets/acre (territorial adjustment from regression); 200 FFR / 0.01568216 ferrets/acre = 12,753 acres; 12,753 acres x 1.211 (for incomplete occupancy) = 15,444 acres.

FFR 2006 (historic densities) was calculated the same as FFR 2006 (2005 densities) but used the historic high and low prairie dog densities observed in Conata Basin (4.6 – 22.3 prairie dogs/acre).

Black-footed Ferret Adult Female Density: Adult female black-footed ferret density in Fall 2003 was calculated by dividing occupied colony size by number of adult female black-footed ferrets present to obtain an estimate of acres per adult female per colony. A weighted average was used to obtain a mean and 95% confidence interval. This estimate was also adjusted for incomplete occupancy. Adult female black-footed ferret density in 2003 averaged 209 acres ($\pm$ 26 95%CI) for 73 females across Conata Basin. The mean is a weighted average (colonies weighted by number of black-footed ferrets) and adjusted by 21.1%. Density estimates were based upon 2:1 ratio (adult females:adult males).

Black-footed Ferret Home Range: Black-footed ferret home ranges are based upon spotlighting locations in Conata Basin from 1998-1999 (wet years) and 2005 (dry year) (Livieri 2007a,c). Home range size was estimated using The Animal Movement Extension v2.0 (Hooge et al. 1999) in ArcView 3.1 at the 95% fixed kernel contour. Adult female home range for 11 wild-born ferrets in 1998-99 averaged 193 acres. To estimate the effects of drought on female home range size the home range of three females occupying the same colony in 1998-99 (wet years) was compared to the home range of four females on the same prairie dog colony in 2005 (dry year). Females in wet years averaged 79.3 acres whereas females in dry years used 144.3 acres (82% increase). The mean for all eleven females in 1998-99 (193 acres) was adjusted by 82% to obtain an estimated home range size of 351.2 acres in dry years. This figure was then adjusted by 6% to account for incomplete occupancy (372.2 acres). Because black-footed ferret population data from Conata Basin suggests a 2:1 ratio of adult females:adult males, mean home range size was adjusted by 67% of the adult black-footed ferret population (e.g. 100 adults is equal to 67 adult females). Typically one male overlaps two females. Therefore, 120 breeding black-footed ferrets, the viable number estimated by CBSG (2004) for >90% population persistence, would require from 16,448 to 29,924 acres during wet and dry years, respectively (80.4 female black-footed ferrets X 193 acres + 6% = 16,448 acres; 80.4 female black-footed ferrets X 351.2 acres + 6% = 29,924 acres).

8. ANALYSIS OF EFFECTS: BLACK-FOOTED FERRET

This section analyzes the direct effects, indirect effects, and cumulative effects of the alternatives on the black-footed ferret. The analysis area includes the geographic extent of the area that would be affected directly or indirectly by the federal action. Direct effects are effects occurring during implementation of an action. For example, application of rodenticide would directly reduce available habitat for black-footed ferrets. Indirect effects are effects occurring later in time. Indirect effects are those that are caused by the action, occur later in time (after the action is completed) but are still reasonably certain to occur. An example is long-term habitat changes that may eliminate capability to provide future ferret habitat.

The effects of the action must be evaluated in the context of cumulative effects. These are defined in the ESA as the effects of future state, tribal, local, or private activities that are reasonably certain to occur in the foreseeable future within the action area. NEPA requires disclosure of c*umulative impacts,* which may result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In the 2002 FEIS for the Revised Forest Plan, the effects of the alternatives on species at risk were analyzed and disclosed. Direct, indirect, and cumulative effects were considered, concluding with a determination of effects for each threatened and endangered species. In addition, a risk assessment was completed to further characterize the anticipated effects of the alternatives on population viability (FEIS p. H-10). The risk assessment culminated in selecting one of six risk outcomes. Each of the alternatives in this FEIS is also assigned a risk outcome. The following is the menu of possible risk outcomes:

- **Outcome I** – Implementation of the alternative will eventually provide habitat of sufficient quality, quantity and distribution on and in the vicinity of the national grassland or forest to help maintain well-distributed populations of the species across its range on the planning unit. The concept of well-distributed must be based on the distribution of potential or suitable habitat on the planning unit. Land uses are managed to avoid or reduce direct and indirect threats, and other factors such as disease, competition, or invasion of exotic species are not recognized as significant threats. There is no need for reintroductions, transplants or supplemental stocking because any unoccupied but suitable habitat will likely be repopulated through dispersal.

- **Outcome II** – Implementation of the alternative will eventually provide habitat of sufficient quality, quantity and distribution on and in the vicinity of the national grassland or forest to help maintain populations of the species distributed across its range on the planning unit. However, some local populations or sub-populations may be at risk in localized areas due to management activities and/or reduced habitat quality and quantity. Land uses are managed to avoid or reduce direct and indirect threats in most areas, and other factors such as disease, competition, or invasion of exotic species may be local concerns but are not recognized as significant and widespread threats. The species will likely repopulate suitable but unoccupied habitats on the planning unit, and there is no need for reintroductions, transplants or supplemental stocking.

- **Outcome III** – Implementation of the alternative will eventually provide habitat of sufficient quality, quantity and distribution on and in the vicinity of the national grassland or forest to help maintain some populations of the species but with significant gaps in the historic distribution across the planning unit. These gaps are likely to remain and will result in some limitation of interactions among local populations. Land uses are managed to avoid or reduce direct and indirect threats in some areas, and threats from other factors such as disease, competition, or invasion of exotic species may be local concerns but are not recognized as significant and widespread threats on the planning unit. Habitat enhancement and reintroductions or transplants may be needed to restore the potential distribution of the species in suitable but unoccupied habitat in the planning unit. Successful reintroductions or transplants of this species have been demonstrated.

- **Outcome IV** – Implementation of the alternative will eventually provide habitat of sufficient quality, quantity and distribution on and in the vicinity of the national grassland or forest to help maintain some populations of the species across its range but with significant gaps in the historic distribution. These gaps are likely to remain and will result in some limitation of interactions among local populations. Land uses are managed to avoid or reduce direct and indirect threats across some of the species' habitat on the planning unit, and threats from other factors such as disease, competition, or invasion of exotic species may be local concerns but are not recognized as significant and widespread threats on the planning unit. Habitat enhancement and reintroductions or transplants may be needed to restore the potential distribution of the species in suitable but unoccupied habitat on the planning unit. Successful reintroductions or transplants of this species have not been demonstrated.

- **Outcome V** – Implementation of the alternative will most likely result in the species eventually existing in refugia on or in the vicinity of the national grassland or forest with strong limitations on interactions among local populations. Land uses may be managed to avoid or reduce direct and indirect threats but only in localized areas, and threats from other factors such as disease, competition, or invasion of exotic species may be recognized as significant and widespread threats on the planning unit. Possible extirpation in response to environmental extremes or stochastic events such as prolonged drought, flooding, or hail cannot be ruled out. Habitat enhancement and reintroductions or transplants will be needed to restore populations and recover the potential distribution of the species in suitable but unoccupied habitat on the planning unit. Successful reintroductions or transplants of this species have been demonstrated.

- **Outcome VI** – Implementation of the alternative will most likely result in the species eventually existing in refugia on or in the vicinity of the national grassland or forest with strong limitations on interactions among local populations. Land uses may be managed to avoid or reduce direct and indirect threats but only in a few localized areas, and threats from other factors such as disease, competition, or invasion of exotic species may be recognized as significant and widespread threats on the planning unit. Possible extirpation from the planning unit as a result of environmental extremes or stochastic events such as prolonged drought, flooding, or hail cannot be ruled out. Habitat enhancement and reintroductions or transplants will be needed to restore populations and recover the potential distribution of the species in suitable but unoccupied habitat on the

planning unit. Neither reintroductions nor transplants have been successfully demonstrated.

The above outcomes from the 2001 Forest Plan are progressively ordered so that Outcome I represents those conditions with the highest probability of providing for well-distributed populations on or in the vicinity of the national grasslands or forests over the next 10 to 15 years, while Outcome VI includes those conditions with the lowest probability of providing for well distributed populations. Under Outcome VI, extirpation of the species from the vicinity of the national grassland or forest could occur as a result of a catastrophic event such as a widespread hailstorm, wildfire, flood or extended and serious drought. For most species, a single outcome was selected, but because of a higher level of uncertainty, two outcomes were identified for some species such as the black-footed ferret. Due to the multiple criteria within each outcome, some criteria in a selected outcome for a species may not apply. The selected outcome simply represents what is believed to be the "best fit" under the management direction prescribed under Alternative 3 of the 2001 Forest Plan. The merits and rationale for the risk assessment under Alternative 3 of the 2001 Forest Plan for each species were evaluated by several Forest Service biologists.

DIRECT EFFECTS - Analysis Assumptions and Evaluation Criteria

Application of rodenticide. Zinc phosphide is not stored in the muscle or other tissue of poisoned animals and therefore there is no true secondary poisoning. Although zinc phosphide remains toxic for several days in the gut of dead rodents, most prairie dogs poisoned with zinc phosphide die in their burrows (Tietjen 1976). No secondary poisoning of black-footed ferrets would be anticipated under any of the alternatives as a result of rodenticide application (Table 10). Under current direction (no action Alternative 2), rodenticide use in the IMZ would occur in limited circumstances in the IMZ regarding threats to public health and infrastructure, but there are no limits placed on the maximum acreage of prairie dog colonies. Prairie dog rodenticide (2 percent zinc phosphide bait) is a highly effective toxicant. When proper procedures are followed, efficacy of zinc phosphide bait is typically 90 percent or higher (South Dakota Department of Agriculture et al. 1994), thus effectively removing prairie dogs, the sole prey of the black-footed ferret and sole creator of its burrow habitat, from treated areas.

Acres of Prairie Dog Colony Habitat. Under the action alternatives, desired minimum and maximum acres of prairie dog colonies would be established for each GA and for the two MA 3.63 areas (Tables 1, 2, 7). Prairie dog colony acreage would remain at or below the maximum level by poisoning or other lethal and non-lethal methods. A consideration in the analysis of potential effects on the black-footed ferret is how the minimum and maximum acreages of prairie dog colonies under each alternative will affect the capability to sustain a viable black-footed ferret population at Conata Basin, the capability to support a future reintroduction into the Smithwick MA 3.63 area, and the capability to support black-footed ferrets that may disperse from MA 3.63 areas (Tables 9 and 10).

Buffalo Gap National Grassland. In the 2001 Forest Plan, the overall risk assessment for Buffalo Gap was Outcome III. The rationale for this was that black-footed ferret habitat would remain fragmented with significant gaps of suitable habitat for successful dispersal, but the development of the nearby Smithwick area would reduce the level of fragmentation in the Buffalo Gap GAs. Such fragmentation would also be reduced because there were no maximum

caps placed on prairie dog colony acreage. If plague should become problematic, then the risk assessment would reflect Outcome V. The effects of setting a range of acres, including a 1,000-acre minimum as well as the percentage by GA will be evaluated for each Buffalo Gap GA.

Conata Basin MA 3.63. The 2001 Forest Plan substantially expanded the size of the black-footed ferret reintroduction area (USFWS et al. 1994), thus exceeding the estimated probability of persistence for a population of 90-100 ferrets over a 50 to 100 year period according to Harris et al. (1989). New information about actual home range size and habitat use in Conata Basin, along with recent population viability modeling, suggests that a population size of at least 120 breeding adult black-footed ferrets is needed to provide a 90% probability of persistence of the population. Most species experts rely upon a 95% probability of persistence which would require at least 125-130 breeding adult black-footed ferrets. About 18,000 to 32,000 acres of prairie dog colonies are estimated to support such a black-footed ferret population (Tables 8 and 9). Each alternative will be evaluated to estimate the black-footed ferret population that could be supported and the likelihood of that population being self-sustaining.

Smithwick MA 3.63. The 2001 Forest Plan established the 25,000-acre Smithwick MA 3.63 with the view to establishing a self-sustaining black-footed ferret population. Each alternative will be evaluated to estimate the black-footed ferret population that could be supported and the likelihood of that population being self-sustaining.

Oglala National Grassland. Under the 2001 Forest Plan, it was acknowledged that it is highly unlikely that wild black-footed ferrets are present. The 2001 Forest Plan directs the establishment of one or more prairie dog colony complexes over the next 10 to 15 years. This action would complement the reintroduction habitat on the adjoining Buffalo Gap, leading to a determination of "not likely to adversely affect" the black-footed ferret (2001 Forest Plan FEIS page H-44). In addition, no cap on prairie dog colony acreage was established. The effects of setting a range of acres, including a 1,000-acre minimum, will be evaluated for each alternative.

Fort Pierre National Grassland. Under the 2001 Forest Plan, it was acknowledged that it is highly unlikely that wild black-footed ferrets are present. However, management direction was established to encourage development of a new prairie dog colony complex in the northeast part of Fort Pierre, which could provide the opportunity to develop new reintroduction habitat in the future. The overall conclusion was that the revised Forest Plan was "not likely to adversely affect" the black-footed ferret on Fort Pierre (2001 FEIS p. H-44).

In addition, since the Forest Plan was completed, the Lower Brule Indian Reservation in conjunction has been releasing black-footed ferrets on tribal lands. Another site on Lower Brule in conjunction with Fort Pierre has been identified as a potential black-footed ferret reintroduction site. The alternatives will be evaluated with respect to Fort Pierre being available as new reintroduction habitat.

Prairie Dog Density. Under the action alternatives, a similarity index threshold would be applied to prairie dog colonies as a trigger for management action. A similarity index compares the kinds and proportion of vegetation present with native vegetation in the absence of disturbance. If the similarity index is exceeded, then action may be taken to reduce prairie dog density using lethal and non-lethal management. This would further reduce the prey base of black-footed ferrets.

Prairie dogs are a natural disturbance agent in the Great Plains. Prairie dog colonies typically may have low to very low similarity indices even in most wet years, although conditions are highly variable across a prairie dog colony. The occurrence of bare ground within a prairie dog colony is commonplace if not the norm. Prairie dogs, burrowing owls, mountain plovers and other faunal associates at prairie dog colonies require bare ground, very low structure grasslands, and good visibility.

INDIRECT EFFECTS

There are several indirect effects of the actions under the Alternatives (Table 11). Grazing and clipping by prairie dogs creates the low structure grassland typical of black-footed ferret habitat, and also shifts plant species composition. Permanently curtailing or removing prairie dog populations could result over time in a shift of the vegetative community from a buffalo grass/blue grama sod to a western wheatgrass/green needlegrass community (depending on the soil type at the prairie dog colony).

Black-footed ferret habitat is very dynamic. Soulé et al. (2005, 2007) labeled the prairie dog as a "strongly interacting species" in an ecosystem. Ecologically effective densities influence large areas of grassland, thereby creating black-footed ferret habitat. Miller et al. (2007) summarize the unique role played by prairie dogs in black-footed ferret habitat. Black-footed ferret habitat (prairie dog colonies) provides a ready source of prey to many predators such as the black-footed ferret and burrows for shelter to other animals and insects, including the black-footed ferret (Goodrich and Buskirk 1998, Kotliar et al. 1999, Shipley and Reading 2006). This combination of effects gives the prairie dog its role as a highly interactive (keystone) species in the ecosystem, creating a matrix of different habitats that increases diversity across the grassland and sustains black-footed ferrets (Kotliar et al. 1999, 2006; Miller et al. 2000). (see the section, *Prairie Dog as a Keystone Species in Creating Habitat for the Black-footed Ferret).*

Establishing minimum and maximum acreages of prairie dog colonies expands or curtails the role of black-footed ferret habitat in providing low grassland structure, and in providing for ecological processes typically found in grassland ecosystems (Table 11). Lastly, livestock play a major role in creating black-footed ferret habitat. Their grazing can stimulate prairie dogs to establish black-footed ferret habitat. Minimum and maximum acreages of prairie dog colonies will expand or curtail the role that livestock or other grazing ungulates play in the establishment of black-footed ferret habitat.

CUMULATIVE EFFECTS – Poisoning, Livestock Grazing, Plague, Climate Change, Shooting

Rodenticide use on other ownerships, livestock grazing, drought and climate change, plague, prairie dog shooting are reasonably foreseeable to occur in the project area.

Poisoning on Other Ownerships. The cumulative effect of former and current poisoning of prairie dog colonies in the Great Plains has been to eliminate almost all black-footed ferret habitat. The century-old poisoning of black-footed ferret habitat persists because prairie dogs consume the grasses and forbs consumed by domestic livestock. Therefore, private landowners and agencies (Figures 9 and 24) have directed extensive programs to eliminate prairie dogs. The general dislike of black-footed ferret habitat persists today (Chace 1973, O'Meilia et al. 1982, Fox-Parrish 2002, Reading et al. 1999, 2002, 2005, McCain et al. 2002, Lamb et al. 2006, Detling et al. 2006, Miller and Reading 2006, Hoogland 2006). Much of the rural public in the Great Plains views the prairie dog as a pest whether on private or federal land (Carr 1973, Lee

and Henderson 1989, Reading and Kellert 1993, Kayser 1998, Zinn and Andelt 1999, Lamb et al. 2001, Sexton et al. 2001, Wyoming Agricultural Statistics Service 2001, Fox-Parrish 2002).

Private landowners and agencies (Figures 9 and 24) have directed extensive programs to eliminate prairie dogs. The magnitude of today's poisoning is low relative to poisoning over the past century simply because there are fewer prairie dogs left to poison, however, poisoning on federal, state, and private lands has increased since 2004 following the removal of the prairie dog from the list of candidate species for addition to the federal list of endangered and threatened species (Forrest and Luchsinger 2006).

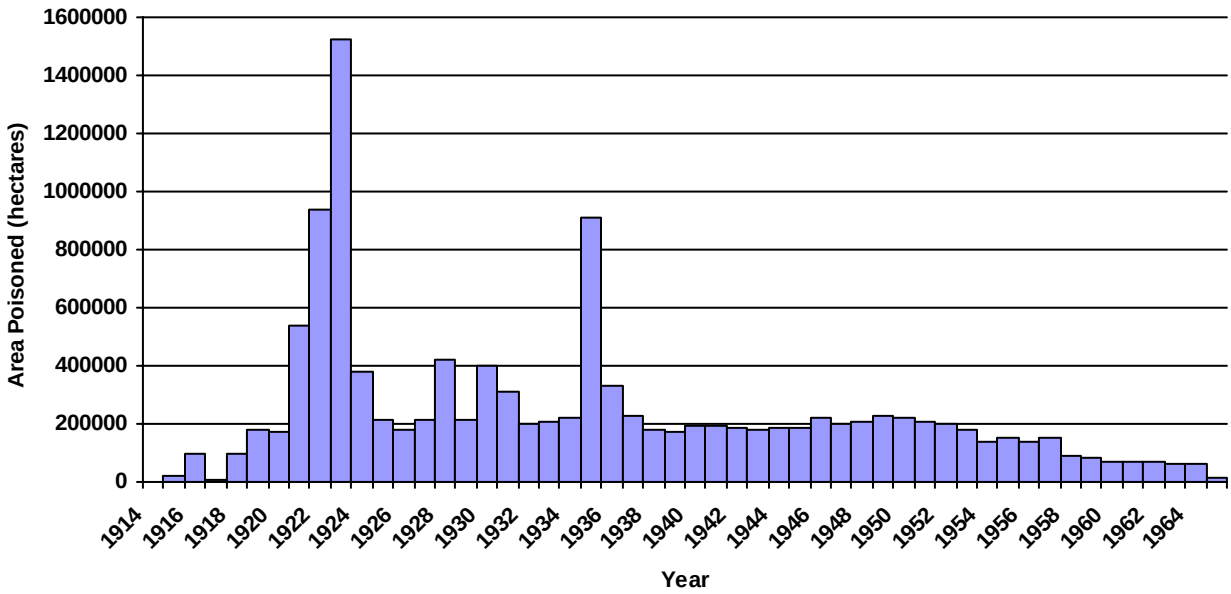


Figure 20. Area poisoned annually for elimination of black-tailed prairie dogs from 1915 to 1965 for all states except Wyoming, and including only the years 1918-1935 for New Mexico and 1921-1923 for Colorado (Forrest and Luchsinger 2006).

However, continued drought conditions in much of the Great Plains have led to prairie dog colony expansion and coincided with additional poisoning activities compared to pre-drought. Since July 1, 2006 the South Dakota bait plant sold 274,500 lbs of oats treated with zinc phosphide (South Dakota State Department of Agriculture 2007). About 6 ounces of treated oats are typically applied per acre of prairie dog colony (Andelt 2006). Enough bait was sold to control 732,000 acres of prairie dogs between July 1, 2006 and the issue date of the winter newsletter of the South Dakota State Department of Agriculture. The State of South Dakota and U.S. Forest Service used only bait from the Pierre, South Dakota bait plant. All of the bait produced at the bait plant is not sold in the study area or even in the State of South Dakota. The South Dakota bait plant is also not the only source of zinc phosphide treated oats in the area. Nevertheless, a large number of prairie dogs have been controlled in 2006 and there is no indication that this trend will cease.

Livestock Grazing. Livestock grazing is likely to continue on and in the vicinity of the national grasslands. In the absence of poisoning and other control of prairie dogs, such grazing can

promote black-footed ferret habitat. The FEIS and associated documents state that livestock and prairie dogs compete. Cattle and black-tailed prairie dogs exhibit a high dietary overlap—up to 60% in a mid-grass prairie and 64% in a short-grass prairie (Hansen and Gold 1977; Uresk 1984, 1986). However, diet overlap alone does not necessarily indicate that competition for resources is occurring or that either species is adversely affected (Miller et al. 2007). See Attachment 1 for a discussion on black-footed ferret habitat and grazing.

Livestock grazing can be used as a tool to establish and expand prairie dog colonies, creating prime black-footed ferret habitat in Conata Basin, for example (Figure 8; see *Prairie Dog Habitat of the Black-footed Ferret*, Section VI). Without extensive livestock grazing and the cooperation of livestock permittees, the Forest Service would not have been able to create the extensive prairie dog colony complexes at Conata Basin that supports a self-sustaining population of black-footed ferrets. Livestock grazing benefits black-footed ferret habitat. Little or no grazing impedes the establishment and expansion of black-footed ferret habitat (Figure 8).

Drought, Climate Change, and Black-footed Ferret Habitat. Drought is significant in the natural history of black-footed ferret habitat. Periods of low precipitation can occur annually intermixed with normal and above normal precipitation periods. However, an extended period of low precipitation (drought) has occurred during 2002-2007, resulting in reduced plant productivity and expansion of prairie dog colonies, albeit, with low densities of prairie dogs. Drought also reduces prairie dog productivity.

Climate history indicates that drought may persist into the future, however, periods of drought are normal. Records from lakes in the northern Great Plains show that droughts the severity of the Dust Bowl period are a recurring part of natural climate variability (Fritz 2008). At times, such as in the 16th century, major droughts occurred more frequently, whereas at other times, such as the early 1800s, major drought was rare. Moisture records from the Great Plains reveal that drought was prolonged and persisted for multiple decades during some time periods within the last few thousand years. The most recent of these periods occurred between ~800 and 1000 years ago – also referred to as the Medieval Period. Some people refer to the Medieval drought in the Great Plains as a “megadrought”, because it was unusually severe and persistent. Evidence for major prolonged drought in the Great Plains during the Medieval Period is also present in the dunes and wetlands of the Nebraska Sand Hills.

Alternatives that favor increasing prairie dog colony acreages during drought benefit the black-footed ferret because black-footed ferret home ranges must increase significantly during drought to compensate for reduced densities of prairie dogs. Alternatives that decrease prairie dog acreages during drought reduce food availability to black-footed ferrets.

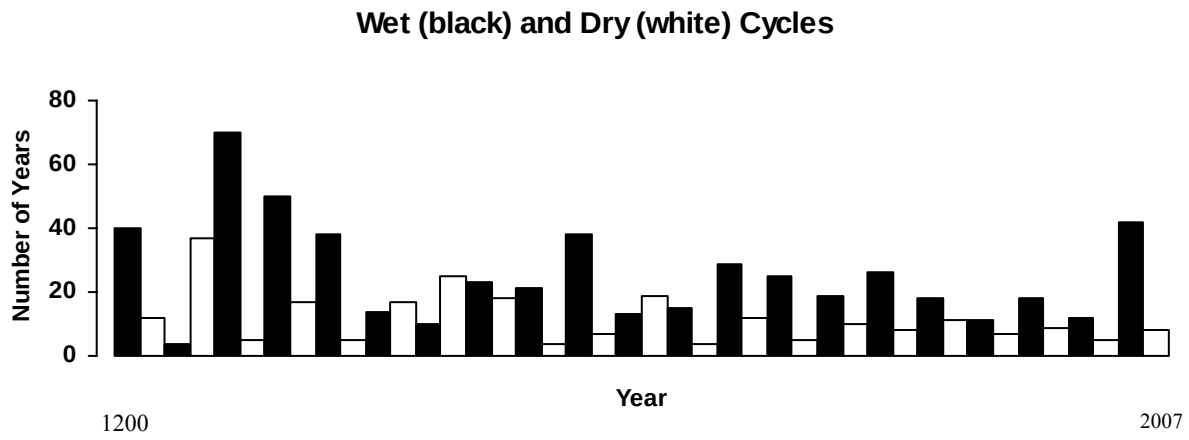


Figure 21. Tree ring data show repeated droughts of five years or longer in western Nebraska during 1200 - 2007 (Source: University of Nebraska).

Drought is one of the stimulants for this FEIS. However, drought must be put into ecological and historical context. Drought promotes short-statured vegetation and prairie dog colonies can expand rapidly establishing large colonies with low densities of prairie dogs as plant food sources decline under drought. Drought has played a major role in the expansion of black-tailed prairie dog colonies on the NNF, including in Conata Basin, and throughout the Great Plains. However, droughts occur regularly and prairie dog colonies and black-footed ferret populations persist even continuously for hundreds or thousands of years in the same location despite drought or wet periods (White 1986, Carlson and White 1987). The 42-year wet cycle (1957-1999) was unusually long and it has been the period during which most living Americans have lived. Extended drought is a new experience for most people. But again, the phenomenon is normal during the past 800 years (Figure 21). What we see today in Conata Basin black-footed ferret habitat and elsewhere in regards to bare ground has been seen before on prairie dog colonies during drought as noted by Smith (1958):

> As the drought continued in 1956, some areas of the dog town were bare and other areas were fifteen per cent covered by vegetation whereas outside the dog town the vegetation covered twenty-five per cent of the ground. The pond dried up in June and was completely dry for eight months. In the autumn the cattle were taken off the area. Severe dust storms occurred; wind eroded areas around the pond and windmill. In December of 1956, and in January, February, and March of 1957, the prairie dogs dug for roots until parts of the dog town looked as though they had been cultivated. April and May brought ten inches of rain, which came in slow drizzles, soaking in with little or no runoff. Annuals, especially peppergrass, began to green up the area and form a dense ground cover.

Climate change is occurring in the Great Plains and changes in wildlife management should reflect climate realities. According to the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2007) temperature and precipitation changes due to climate change are likely occurring

and will continue to occur (Figures 21 and 22). Recent climate model simulations indicate that during 2010-2039, year-round temperatures across North America will be outside the range of present-day natural variability. For most combinations of model, scenario, season and region, warming in the 2010 to 2039 time slice will be in the range of 1 to 3ºC. The projected warming is greatest in winter at high latitudes and greatest in the summer in the southwest U.S. Warm extremes across North America are projected to become both more frequent and longer. Some studies project widespread increases in extreme precipitation, with greater risks of not only flooding from intense precipitation, but also droughts from greater temporal variability in precipitation.

Climate change portends increased runoff in winter and spring and decreased soil moisture and runoff in summer. The Great Plains and prairie regions are particularly vulnerable. Projected increases in the frequency of heavy rainfall events and severe flooding also could be accompanied by an increase in the length of dry periods between rainfall events and in the frequency and/or severity of droughts in parts of North America. Over the next century, climate in South Dakota may change even more (EPA 1998, IPCC 2007). For example, based on projections made by the IPCC and results from the United Kingdom Hadley Centre's climate model (HadCM2), a model that accounts for both greenhouse gases and aerosols, by 2100 temperatures in South Dakota could increase by 3°F in spring and summer (with a range of 1-6°F) and 4°F in fall and winter (with a range of 2-7°F). Precipitation may increase by 10% in spring, summer, and fall, and 20% in winter. The amount of precipitation on extreme wet or snowy days in winter is likely to increase. Other climate models may show different results, especially regarding estimated changes in precipitation. The frequency of extreme hot days in summer would increase because of the general warming trend.

As conditions dry and drought becomes more frequent, prairie dog densities may decline but home ranges of black-footed ferrets could increase considerably. If a small population of black-footed ferrets could be established (uncertain at this time) on 1,500 to 3,000 acres under normal precipitation, such a population probably could not endure as prairie dog colonies became drier and prairie dog densities decreased. Black-footed ferrets would require larger home ranges to compensate for dispersed food sources and caps on prairie dog colony acreages would not allow for home range expansion.

Plague. Sylvatic plague is the principal disease threat to the black-footed ferret. It is an exotic disease foreign to the evolutionary history of North American species and did not exist on this continent prior to 1900 (Gage and Kosoy 2006). Plague is caused by the bacterium, *Yersinia pestis*, which fleas acquire from biting infected animals and can then transmit to other animals via a flea bite. The disease can also be transmitted pneumonically among infected animals or via the consumption of contaminated food items (e.g., black-footed ferrets eating plague-killed prairie dogs) (Godbey et al. 2006).

Since the arrival of plague into North America 100 years ago prairie dogs have not demonstrated evolved resistance to plague. The introduction of plague has subjected the black-footed ferret to a situation to which it is not evolutionarily adapted, thereby hastening extinction. The Siberian polecat, the black-footed ferret's closest relative, inhabits Asian steppe where plague is native. The polecat's reproductive strategy has to be more responsive to its varying environment and rodent prey. In contrast, the black-footed ferret appears relatively K-selected, that is, its litters are smaller than the polecat, an expected attribute for a specialist that evolved in the plague-free Great Plains inhabited by a stable prey species, the black-tailed prairie dog (Biggins 2000).

Prairie dogs are highly susceptible to sylvatic plague, a serious threat to the persistence of local prairie dog populations. A plague epizootic quickly kills close to 100 percent of prairie dogs in a colony. Plague is also highly prevalent in prairie dog colonies in an enzootic state without any obvious epizootic (Hanson et al. 2007).

Plague is uncommon in prairie dogs east of a line that approximates the 103rd meridian (Cully et al. 2006), near the Wyoming state line (Figure 26). Plague was confirmed in a prairie dog colony in western Custer County, South Dakota in September, 2004 near the Wyoming border, and less than 10 miles from the northern most boundary of the Fall River West Geographic Area. Plague positive prairie dogs were found on tribal lands in Shannon County in 2005, less than 10 miles from the eastern boundary of the Fall River Southeast Geographic Area. Prairie dog colonies may have almost certainly been affected on the Fall River Ranger District because few prairie dogs are observed at many colonies.

In 2004, plague occurred on the Wyoming state line in southwest South Dakota near the Fall River West GA. In 2005, plague struck prairie dogs approximately 25 miles south of Conata Basin. Recovery of prairie dog colonies is occurring. During the late summer and fall of 2005, approximately 3,500 pounds of the insecticide, deltamethrin, a synthetic pyrethroid, were applied to 7,000 acres of occupied prairie dog burrows in known black-footed ferret habitat in an effort to eliminate fleas, the most likely plague vector (Seery 2006). Dusting continued in 2006 and continues in Conata Basin in response to an outbreak of plague in the Basin.

On the Buffalo Gap National Grassland plague may be responsible for prairie dog die offs in all three of the Geographic Areas (GA) located on the Fall River Ranger District (Fall River Southeast GA, Fall River Northeast GA, and Fall River West GA), however, no prairie dog carcasses have been collected for analysis. Few prairie dogs can be seen on some colonies in the above areas. On the Fall River Northeast GA plague has probably occurred on two colonies (approximately 375 acres). On the Fall River Southeast GA plague has probably occurred on 20 colonies (approximately 1,940 acres). On the Fall River West GA plague has probably occurred on 5 colonies (approximately 500 acres). Plague may have occurred on additional colonies because only colonies that were not controlled in the past 3 years were examined. In 2008, plague struck prairie dogs in Conata Basin MA 3.63 and has already affected 25% of the colony acres in MA 3.63.

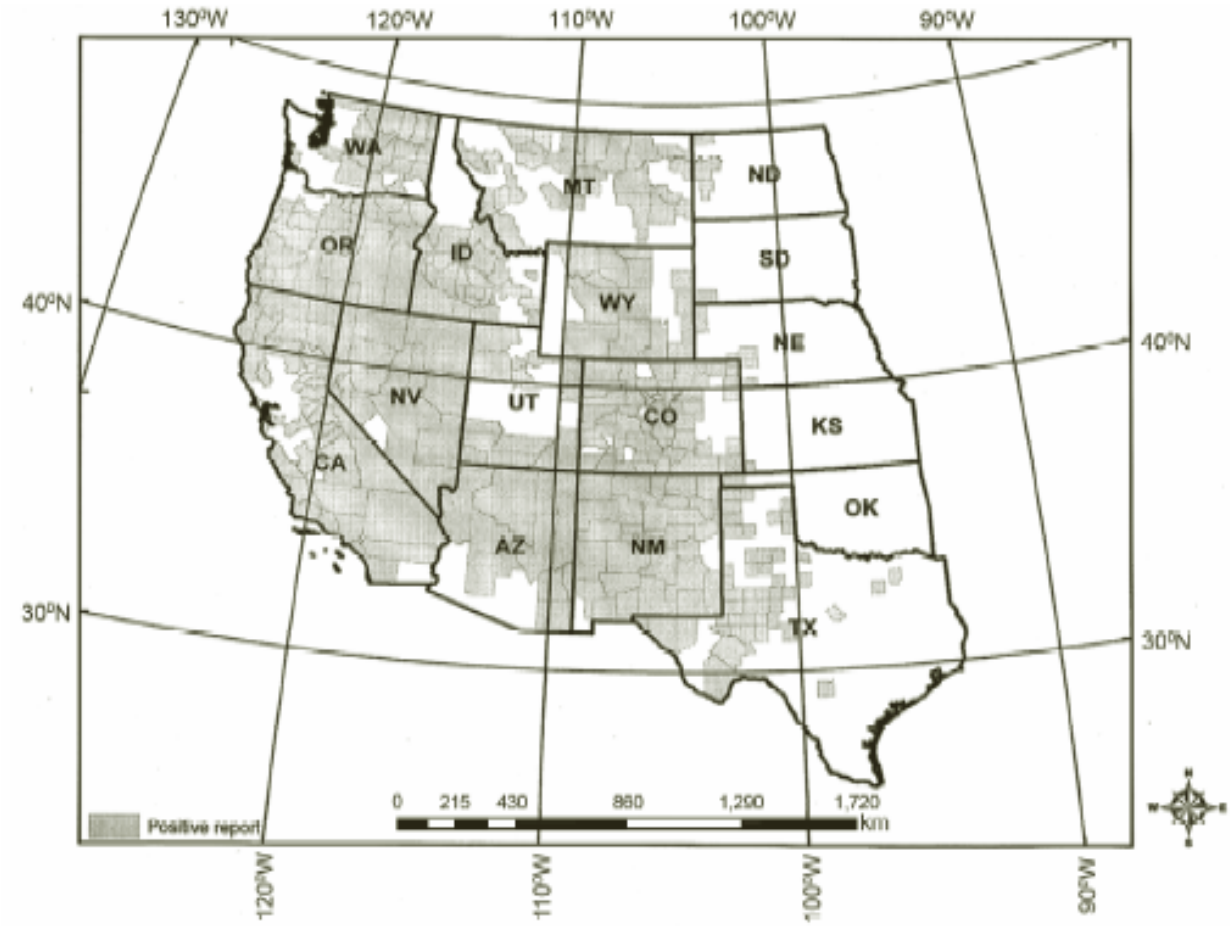


Figure 24. Counties with plague-positive mammals or fleas (1970-present) (Gage and Kosoy 2006). An imaginary plague line runs through the western Dakotas, Nebraska, Kansas, Oklahoma and Texas. The area east of that line is often referred to as plague-free and is the preferred area for black-footed ferret reintroductions.

In one instance, the black-footed ferret appears to have persisted despite the periodic presence of plague. In 1991, Shirley Basin, Wyoming was the first reintroduction site. Black-footed ferret releases were suspended there in 1994 due to plague and the small black-footed ferret population present was expected to be lost by the late 1990s. However, since 2002, the Shirley Basin black-footed ferret population has been growing rapidly (Lockhart et al. 2006, Grenier et al. 2007). This site is occupied by white-tailed prairie dogs. White-tailed prairie dog complexes are less densely populated than typical complexes of black-tailed or Gunnison's prairie dogs. Apparently, scattered populations of prairie dogs avoided contracting plague and were able to sustain a black-footed ferret population. Furthermore, outbreaks of plague appear to be associated with moisture and the Shirley Basin is one of the few areas in the white-tailed prairie dog range that has experienced prolonged dry conditions.

The potential for plague to persist in prairie dog populations on the national grasslands and forests in the project area is unknown, but it is acknowledged that plague can have dramatic impacts on prairie dog populations and black-footed ferrets. Plague can impact the black-footed

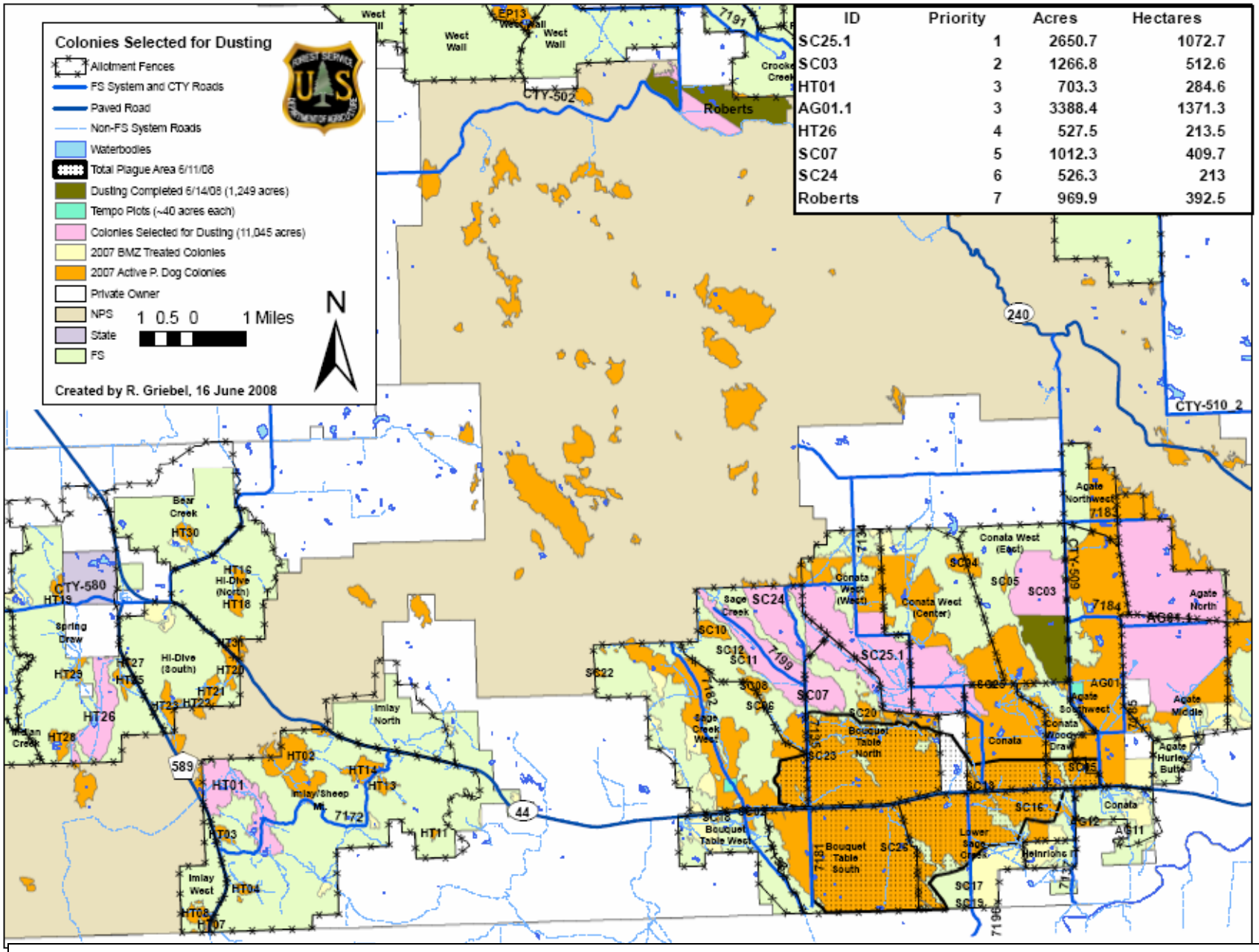
ferret directly via infection and subsequent mortality and by destroying the black-footed ferret's prey base of prairie dogs.

CBSG (2004) modeled the potential effect that introduction of this disease might have on the previously unaffected populations in Conata Basin. Two different scenarios in which the carrying capacity of the Conata Basin black-footed ferret population was reduced by either 50% or 75% of a baseline value of 250 breeding individuals. Such an event would occur, on average, every 20 years and after the plague event CBSG's simulation includes a linear increase in black-footed ferret carrying capacity over a period of six years to the original baseline value. Model results indicate a dramatic reduction in the size of prairie dog colonies (and, consequently, black-footed ferret carrying capacity) that can have a significant impact on the viability of black-footed ferret populations associated with them. When plague leads to a 50% reduction in black-footed ferret K, the risk of population extinction climbs to more than 80%. Extinction is virtually guaranteed within 30 years when K is reduced by 75% due to an outbreak.

In summary, recent studies of plague underscore the negative impact of this disease on black-footed ferret recovery. Although the readily recognized epizootics of plague are indeed a hazard to black-footed ferret recovery (so far, one reintroduced population has failed due to epizootic plague), the chronic presence of cryptic levels of enzootic plague are equally ominous. Over a 12-year period, a population of black-footed ferrets was nearly extirpated when augmentation and plague management ceased, but it was reestablished by additional releases and plague management; its future seems insecure without plague management. The South Dakota black-footed ferret reintroduction sites are some of the few sites thought to be plague-free. Recent black-footed ferret sites in Logan County, Kansas are presently thought to be plague-free. The Conata Basin site has become the centerpiece of black-footed ferret recovery, a site producing surplus ferret kits for translocation elsewhere. Conata Basin is now experiencing a plague epizootic. The extensive acres in Conata Basin may allow black-footed ferrets to survive the epizootic. Thus, while other black-footed ferret recovery sites, sites often with much smaller acreages of prairie dog colonies, have been lost due to plague, there is a highly disproportionate cumulative impact to the ferret recovery program of intentionally degrading the quality of the Conata Basin site by regulating the extent of prairie dog colonies.

Thus, while other black-footed ferret recovery sites have been lost due to plague, there is a highly disproportionate cumulative impact to the ferret recovery program of intentionally degrading the quality of this single site (Dean Biggins, USGS Research Scientist, Science Consistency Review Report on Nebraska National Forest DEIS, 2007).

The cumulative effect of plague outside of South Dakota and the absence of plague throughout most of South Dakota heighten the importance of federal lands such as national grasslands for black-footed ferret sites. Enhancing options for black-footed ferret sites in the non-MA 3.63 through nursery populations could potentially provide a relief valve for black-footed ferrets as plague continues to affect prairie dog colonies in either MA 3.63 or non-MA 3.63. As of 16 June 2008, plague had affected 25% of the prairie dog colonies in Conata Basin MA 3.63.



Extent of plague and dusting efforts in Conata Basin, June 16, 2008.

Shooting in Black-footed Ferret Habitat. The possibility of accidental black-footed ferret mortality exists with prairie dog shooting (Joslin and Youmans 1999) but it is small because the black-footed ferret is largely nocturnal. However, black-footed ferrets have been known to be aboveground during daylight hours, particularly early morning and late periods. Currently, prairie dog colonies in non-MA 3.63 are not closed to shooting.

Prairie dog shooting is extensive in South Dakota and affects prairie dog populations. In 2000, 12,219 residents and 3,081 non-residents of South Dakota shot prairie dogs during over 100,000 recreational shooting days (Gigliotti 2000). Shooters killed 1.23 million prairie dogs on non-tribal lands with about 84% shot on private land. Prairie dog shooting occurs throughout the year with peak shooting in the summer.

Although small mammals such as lagomorphs and squirrels recover quickly from hunting via density-dependent vital rates, such recovery is not observed in the black-tailed prairie dog (Pauli and Buskirk 2007a). Because of their coloniality, prairie dogs possess certain life-history traits that predisposed them to be particularly susceptible to hunting associated disturbances, which had cascading effects on population-level processes (Pauli and Buskirk 2007a). Shooting of prairie dogs may significantly reduce prairie dog densities (Vosburg and Irby 1998) and indefinitely maintain reduced densities in colonies (Knowles 1987).

Prairie dogs show no evidence of density dependence in overwinter survival or next-year natality. Rather, shooting induces not only additive effects on survival but also leads to reproductive near-collapse the summer following shooting (Pauli and Buskirk 2007a). Surviving prairie dogs increase alert behaviors eightfold and reduce both aboveground activity and time spent foraging by 66%. Changes in behavior lower the body condition of surviving adults by 35%. Survivors of shooting, especially juveniles, exhibited elevated stress levels; fecal corticosterone concentrations increased by 80% among juveniles. Pauli and Buskrik (2007a) discovered that overwinter survival rates did not increase in response to reduced prairie dog density. Pregnancy rates declined by 50% and reproductive output fell by 82%. Risk-disturbance overwhelmed any possible density-dependent effects of shooting in prairie dogs, which exhibited additive mortality in response to hunting, and reproductive failure 1 year after shooting. Risk-disturbance was the predominant mechanism whereby individuals and colonies were affected by hunting. The cumulative effect of shooting prairie dogs outside of Conata Basin/Badlands, where shooting is prohibited, is to lower the quality of already limited prairie dog colony habitat of black-footed ferrets.

Federal lands are used extensively for prairie dog shooting with expanding lead alloy bullets that leave lead fragments in prairie dog carcasses posing a risk to scavengers (Pauli and Buskirk 2007). Their "results suggest that recreational shooting of prairie dogs contributes to the problem of lead intoxication in wildlife food chains that include prairie dogs. Indeed, some features of recreational shooting, including the killing of large numbers of animals, not removing carcasses from the field, and using expanding bullets, is in contrast to traditional forms of hunting and may present potentially dangerous amounts and particle sizes of metallic lead to scavengers and predators of prairie dogs. Recreational shooting of black-tailed prairie dogs occurs with minimal regulation, yet appears to provide a readily available source of lead to scavenging vertebrates. Few agencies regulate recreational shooting intensity and duration, and none currently regulate the type of ammunition that can be used. Managers should consider measures, such as using non-expanding or lead-free ammunition, to reduce the likelihood of lead poisoning in scavenging raptors and carnivores."

In a study conducted on the Thunder Basin National Grassland, Wyoming, two types of bullets were tested to determine how much lead was present in the prairie dog carcasses after they had been shot: a soft point and a full metal jacket (both from .223 caliber rifles). Eighty-seven per cent of prairie dogs shot with soft point bullets contained bullet fragments compared to 7 percent of those shot with full metal jackets. Furthermore, the amount of lead found in prairie dog carcasses differed between the two bullet types; full metal jacket only averaged 19.8 mg of lead, while soft point averaged 225.2 mg of lead (Pauli and Buskirk 2007). Therefore, a scavenger, such as a black-footed ferret, that eats a prairie dog carcass could succumb to lead poisoning.

Cumulative Effects Summary. In the face of continued warming and more droughts in the Great Plains predicted by the IPCC, prairie dog colonies will likely expand and black-footed ferrets would need to expand their home range size accordingly. Alternatives 2 and 5 would best respond to climate change. Poisoning of prairie dog colonies in the vicinity of NFS lands is very likely to continue. Shooting is also likely to continue. Since the 2001 Forest Plan, plague has been detected on and near NNF lands. By June 16, 2008 plague had already affected 25% of the prairie dog colony acreage in Conata Basin MA 3.63.

The precarious state of the black-footed ferret throughout its range, the presence of plague, the reduction in size of the existing large prairie dog colony complex at Conata Basin, prairie dog control in the boundary area, extensive poisoning on adjacent private land, and the limited opportunity for black-footed ferrets to disperse into habitat outside of the MA 3.63 areas result in increased risk to the species.

Table 7. The percentage of suitable black-footed ferret habitat (acres of prairie dog colonies) allowed under each alternative per Geographic and Management Areas.

Geographic and Management Areas	***Total NFS Acres in Geographic or Management Area***	***Total Suitable Acres for black-footed ferret habitat (prairie dog colonies)***	***Current Prairie Dog Colony Acreage (% of suitable habitat)***	***ALT 1***	***ALT 2***	***ALT 3***	***ALT 4***	***ALT 5***
Oglala	94,484	62,347 (66%)	*1,125 (1.8%)*	*1,000 - 2,800 (1.6-4.5%)*	*1,125 - 13,097 (1.8-21%)*	*100 -900 (0.16-1.4%)*	*NA*	*9,500 - 18,700 (15-30%)*
Fall River Northeast	91,298	78,806 (86%)	*1,130 (1.2%)*	*1,000 - 2,800 (1.2-3.5%)*	*1,130 - 13,155 (1.2-16%)*	*0 -2,700 (0-3%)*	*NA*	*9,100 - 18,300 (11-23%)*
Fall River West	119,951	116,434 (97%)	*210 (0.18%)*	*1,000 - 3,600 (0.8-3%)*	*210 - 2,445 (0.18-2%)*	*0 -3,600 (0-3%)*	*NA*	*12,000 - 24,000 (10-20%)*
Fall River Southeast	86,666	84,142 (97%)	*42 (0.05%)*	*No acreage objective*	*42 -489 (0.05-0.5%)*	*0 -2,500 (0-3%)*	*NA*	*8,700 - 17,300 (10-20%)*
Smithwick MA 3.63	25,307	24,187 (95%)	*503 (2%)*	*2,100 - 5,000 (8-20%)*	*503 - 5,856 (2-24%)*	*0 -800 (0-3%)*	*NA*	*9,600 - 17,010 (39-70%)*
Wall North	69,437	63,894 (92%)	*454 (0.7%)*	*1,000 - 2,100 (1.5-3%)*	*454 - 5,285 (0.7-8%)*	*0 -2,100 (0-3%)*	*NA*	*6,900 - 13,900 (10-21%)*
Wall Southeast	90,840	79,017 (87%)	*1,414 (1.8%)*	*1,000 - 2,900 (1.2-3.6%)*	*1,414 - 16,461 (1.8-20%)*	*0 -2,800 (0-3.5%)*	*NA*	*9,100 - 18,200 (11-23%)*
Wall Southwest	28,580	15,125 (53%)	*214 (1.4%)*	*No acreage objective*	*214 - 2,491 (1.4-16%)*	*0 -830 (0-5%)*	*NA*	*2,600 - 5,100 (17-34%)*
Conata Basin MA 3.63	77,155	68,183 (88%)	*26,484 (39%)*	*12,500 - 19,000 (18-28%)*	*26,484 - 46,400 (39-68%)*	*0 -2,200 (0-3%)*	*8,000 - 12,000 (12-17%)*	*27,000 - 46,400 (39-68%)*
Fort Pierre	116,053	108,409 (93%)	*1,735 (1.6%)*	*1,000 - 3,500 (0.9-3%)*	*1,735 - 20,198 (1.6-18%)*	*0 -3,470 (0-3%)*	*NA*	*11,600 - 23,200 (11-21%)*
Total	799,771	700,544 (87%)	*33,311 (4.7%)*	*20,600-41,700 (3-6%)*	*33,311-125,877 (4.7-18%)*	*100-21,900 (0.01-3%)*	*NA*	*106,100-202,110 (15-29%)*

Table 8. The area requirements (acres of prairie dog colonies) for black-footed ferrets based upon findings in Conata Basin, Buffalo Gap National Grassland (Livieri 2007). Black-footed ferret home ranges are based upon spotlighting locations during 1998-1999 (wet years) and 2005 (dry year) (Livieri 2007a,c). One-hundred twenty breeding black-footed ferrets, the number estimated by CBSG (2004) for >90% population persistence, would require from 16,448 to 29,924 acres during wet and dry years, respectively (80.4 female black-footed ferrets X 193 acres + 6% = 16,448 acres; 80.4 female black-footed ferrets X 351.2 acres + 6% = 29,924 acres). A 95% probability of persistence would require 125-130 breeding adult ferrets.

Number of Breeding Adult Black-footed Ferrets	% Female	# Female	Home Range (dry conditions)	Prairie Dog Colony Acres	Home Range (wet conditions)	Prairie Dog Colony Acres
5	0.67	3.35	372.2	1246.87	204.58	685.34
7	0.67	4.69	372.2	1745.62	204.58	959.48
9	0.67	6.03	372.2	2244.37	204.58	1233.62
11	0.67	7.37	372.2	2743.11	204.58	1507.75
13	0.67	8.71	372.2	3241.86	204.58	1781.89
15	0.67	10.05	372.2	3740.61	204.58	2056.03
17	0.67	11.39	372.2	4239.36	204.58	2330.17
19	0.67	12.73	372.2	4738.11	204.58	2604.30
20	0.67	13.40	372.2	4987.48	204.58	2741.37
30	0.67	20.10	372.2	7481.22	204.58	4112.06
40	0.67	26.80	372.2	9974.96	204.58	5482.74
50	0.67	33.50	372.2	12468.70	204.58	6853.43
55	0.67	36.85	372.2	13715.57	204.58	7538.77
60	0.67	40.20	372.2	14962.44	204.58	8224.12
65	0.67	43.55	372.2	16209.31	204.58	8909.46
70	0.67	46.90	372.2	17456.18	204.58	9594.80
75	0.67	50.25	372.2	18703.05	204.58	10280.15
80	0.67	53.60	372.2	19949.92	204.58	10965.49
85	0.67	56.95	372.2	21196.79	204.58	11650.83
90	0.67	60.30	372.2	22443.66	204.58	12336.17
95	0.67	63.65	372.2	23690.53	204.58	13021.52
100	0.67	67.00	372.2	24937.40	204.58	13706.86
110	0.67	73.70	372.2	27431.14	204.58	15077.55
120	0.67	80.40	372.2	29924.88	204.58	16448.23
125	0.67	83.75	372.2	31171.75	204.58	17133.58
130	0.67	87.10	372.2	32418.62	204.58	17818.92
135	0.67	90.45	372.2	33665.49	204.58	18504.26
140	0.67	93.80	372.2	34912.36	204.58	19189.60
145	0.67	97.15	372.2	36159.23	204.58	19874.95
150	0.67	100.50	372.2	37406.10	204.58	20560.29
170	0.67	113.90	372.2	42393.58	204.58	23301.66
190	0.67	127.30	372.2	47381.06	204.58	26043.03
200	0.67	134.00	372.2	49874.80	204.58	27413.72
325	0.67	217.75	372.2	81046.55	204.58	44547.30
350	0.67	234.5	372.2	87280.90	204.58	47974.01

Table 9. The potential black-footed ferret population outcomes from establishing minimum and maximum acres of prairie dog colonies (black-footed ferret habitat) based upon black-footed ferret spatial use of Conata Basin (Table 8).

Geographic and Management Areas	Current Prairie Dog Colony Acres	Range of Prairie Dog Colonies by Alternative					Potential Breeding Adult Black-footed Ferret Population under Dry/ Wet Conditions				
		Alt 1[1]	Alt 2[1]	Alt 3[3]	Alt 4[4]	Alt 5	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Oglala	1,125	1,000-2,800	1,125 - 13,097	100 - 900	NA	9,500 - 18,700	0-11/7-21	0-53/7-95	0/0	-	37-75/70-136
Fall River Northeast	1,130	1,000 - 2,800	1,130 - 13,155	0 - 2,700	NA	9,100 - 18,300	0-11/7-21	0-53/7-95	0-11/0-20	-	36-74/65-135
Fall River West	210	1,000 - 3,600	210 - 2,445	0 - 3,600	NA	12,000 -24,000	0-14/7-26	0-9/0-17	0/0-25	-	49-96/89-175
Fall River Southeast	42	0	42-489	2,500	NA	8,700 - 17,300	0/0	0/0	10/17	-	35-69/64-125
Smithwick MA 3.63	503	2,100-5,000	503-5,856	800	NA	9,600 - 17,000	8-20/14-36	0-24/0-41	0/0	-	39-69/70-124
Wall North	454	1,000 - 2,100	454 - 5,285	0 - 2,100	NA	6,900 - 13,900	0-8/7-14	0-21/0-39	0-8/0-15	-	25-56/50-100
Wall Southeast	1,414	1,000 - 2,900	1,414 - 16,461	0 - 2,800	NA	9,100 - 18,200	0-11/7-20	5-65/11-120	0-10/0-20	-	36-73/65-134
Wall Southwest	214	0	214-2,491	830	NA	2,600-5,100	0/0	0-10/0-17	0/0	-	10-20/19-36
Conata Basin MA 3.63	26,484	12,500-19,000	26,484-46,400	2,200	8,000-12,000	27,000-46,400	50-76/90-139	119-186/191-345	8/16	31-49/59-89	109-345/199-345
Fort Pierre	1,735	1,000 - 3,500	1,735 - 20,198	0 - 3,470	NA	11,600 -23,200	0-14/7-25	7-81/12-146	0-13/0-25	-	46-94/85-170

Table 10. The FEIS Alternatives (1-5) apply rodenticide and establish extents of black-footed ferret habitat (prairie dog colonies). Such actions have direct effects on black-footed ferret habitat, black-footed ferret populations, the persistence of black-footed ferret populations, and successful dispersal of black-footed ferrets throughout the Geographic Areas.

Geographic and Management Areas	**Application of Rodenticide**					**Ranges of Black-footed Ferret Habitat**					**Black-footed Ferret Population**					**Black-footed Ferret Population Persistence[6]**					**Black-footed Ferret Dispersal[6]**				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Oglala	-	-	-	-	-	L[3]	H[5]	0[2]	-[1]	H	0	H[4]	0	-	H	0	H	0	-	H	L	H	-	-	H
Fall River Northeast	-	-	-	-	-	L	H	L	-	H	0	H	L	-	H	0	H	0	-	H	L	H	L	-	H
Fall River West	-	-	-	-	-	L	0	L	-	H	0	0	L	-	H	0	0	0	-	H	L	L	L	-	H
Fall River Southeast	-	-	-	-	-	0	0	L	-	H	0	0	L	-	H	0	0	0	-	H	0	0	L	-	H
Smithwick MA 3.63	-	-	-	-	-	M	H	0	-	H	M	M	0	-	H	0	M	0	-	H	M	M	L	-	H
Wall North	-	-	-	-	-	L	H	L	-	H	0	M	L	-	H	0	M	0	-	H	L	M	L	-	H
Wall Southeast	-	-	-	-	-	L	H	L	-	H	0	H	L	-	H	0	H	0	-	H	L	H	L	-	H
Wall Southwest	-	-	-	-	-	0	0	0	-	M	0	H	0	-	M	0	0	0	-	M	0	H	0	-	M
Conata Basin MA 3.63	-	-	-	-	-	M	H	L	M	H	M	H	L	M	H	M	H	0	M	H	H	H	L	M	H
Fort Pierre	-	-	-	-	-	L	H	L	-	H	0	H	L	-	H	0	H	0	-	H	H	H	L	-	H

[1] "-" signifies no effect. The application of rodenticide has no direct physiological effect on black-footed ferrets. Alternative 4 only provides prairie dog colony acreages for Conata Basin MA 3.63.

[2] "0" signifies that the direct effect contributes nothing to the viability of the black-footed ferret.

[3] "L" signifies a low, if any, viability contribution to the black-footed ferret.

[4] "M" signifies a moderate viability contribution to the black-footed ferret.

[5] "H" signifies a high viability contribution to the black-footed ferret.

[6]The minimum and maximum prairie dog colony acreage caps would limit or expand the capability of areas outside the two MA 3.63 reintroduction areas to support dispersing and self-sustaining black-footed ferret populations. An area of 1,000 acres, for example, is estimated to have the capability of supporting only about 5 to 10 ferrets (Table 8), a number too small to be self-sustaining. (*see Attachment 3 for further discussion of the basis, limitations and benefits of prairie dog colonies (black-footed ferret habitat) that are 1,000 acres or greater in size*).

Table 11. Establishing the extent of black-footed ferret habitat (prairie dog colonies) has indirect effects on the extent of low grassland structure and associated species, such as the black-footed ferret, and the amount of grassland ecosystem processes that black-footed ferret habitat provides in a grassland ecosystem. In addition, such extents curtail or expand the role that livestock grazing plays in creating black-footed ferret habitat. Each of the Alternatives (1-5) is scored for its contribution.

[1] "-" Alternative 4 only provides prairie dog colony acreages for Conata Basin MA 3.63.

Geographic and Management Areas	**Low Grassland Structure**					**Grassland Ecosystem Processes**					**Role of Livestock Grazing in Creating Black-footed Ferret Habitat**				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Oglala	L[3]	H	0[2]	-[1]	H[5]	L	H	0	-	H	L	H	0	-	H
Fall River Northeast	L	H	0	-	H	L	H	0	-	H	L	H	L	-	H
Fall River West	L	L	0	-	H	L	L	0	-	H	L	L	L	-	H
Fall River Southeast	0	L	L	-	H	0	L	L	-	H	0	0	L	-	H
Smithwick MA 3.63	M[4]	H	L	-	H	M	H	L	-	H	M	M	0	-	H
Wall North	L	H	0	-	H	L	H	0	-	H	L	M	L	-	H
Wall Southeast	L	H	0	-	H	L	H	0	-	H	L	H	L	-	H
Wall Southwest	0	H	L	-	H	0	H	L	-	H	L	L	0	-	H
Conata Basin MA 3.63	H	H	L	H	H	H	H	L	H	H	H	H	L	H	H
Fort Pierre	L	H	0	-	H	L	H	0	-	H	0	H	L	-	H

[2] "0" signifies that the alternatives' prairie dog colony acres contribute nothing to low grassland structure, ecosystem processes, and the role that livestock play in creating black-footed ferret habitat.

[3] "L" signifies that the alternatives' prairie dog colony acres contribute little to low grassland structure, ecosystem processes, and the role that livestock play in creating black-footed ferret habitat.

[4] "M" signifies a moderate contribution to low grassland structure, ecosystem processes, and the role that livestock play in creating black-footed ferret habitat.

[5] "H" signifies a high contribution to low grassland structure, ecosystem processes, and the role that livestock play in creating black-footed ferret habitat.

EFFECTS OF THE ALTERNATIVES ON THE BLACK-FOOTED FERRET

ALTERNATIVE 1

Buffalo Gap National Grassland

Conata Basin MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** A range of prairie dog acres from 12,500 to 19,000 acres would be established within Conata Basin. One of the bases for this range of acres was partly the "ferret family rating" model which was used to estimate the amount of habitat needed to support 100 breeding adult black-footed ferrets during wet and dry years (Table 6). However, actual home range data from Conata Basin indicate that this estimate of acres needed is too low, and that 100 breeding adult black-footed ferrets would require between 13,707 (wet years) to 24,937 (dry years) (Table 8). Furthermore, updated population viability modeling suggests that a population size of 100 is not likely to be sufficient; instead, at least 120 breeding adult black-footed ferrets are needed to sustain a black-footed ferret population with >90% probability of persistence over 100 years (CBSG 2004). In addition, species experts and USFWS et al. (1994) recommend a 95% probability of persistence which would equate to at least 125-130 breeding adult black-footed ferrets requiring 17,100 to 32,400 acres of prairie dog colonies. There are black-footed ferrets inhabiting prairie dog colonies on the national grassland that are adjacent to Badlands National Park. The species has dispersed from the reintroduction area up to 22 km from Conata Basin to colonies in Badlands. Loss of black-footed ferret carrying capacity in Conata Basin may affect the already small black-footed ferret population in Badlands. Alternative 1 does not specify the location of prairie dog colonies in Conata Basin that would be controlled: colonies distant from colonies in Badlands or colonies close to Badlands may be affected.
- **Prairie Dog Density.** Alternative 1 would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Prairie dog colonies typically may have low to very low similarity indices even in most wet years. Based on the maximum acreage cap, the current 26,000 acres of prairie dogs could be reduced to 19,000 acres at the outset under Alternative 1. Then, if the similarity index is less than 25% the 19,000 acres could be controlled, potentially down to the minimum of 12,500 acres, unless the black-footed ferret population falls below 100 breeding adults or there is a significant trend in that direction.

Smithwick MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** The original intent of the Smithwick MA 3.63 was to create a self-sustaining population of black-footed ferrets to meet the criteria of a recovery site. Over a period of years a large complex of prairie dog colonies would have been developed. Black-footed ferret home range data suggests that 4,400-7,500 acres of prairie dog colonies are required for 30 breeding adult black-footed ferrets (Table 8). At Smithwick, the effective extent of MA 3.63 in the IMZ is 17,649 acres. There are currently 500 acres of prairie dog colonies in Smithwick. Under Alternative 1, a range of 2,100 to 5,000 acres of prairie dog colonies would be allowed in Smithwick. The

minimum acre objective is based on a recent environmental assessment (EA) for a black-footed ferret reintroduction in Wind Cave National Park (National Park Service 2006a, 2006b). However, the Wind Cave project is a test of black-footed ferret viability. It is unknown if the experiment will be successful. This range of acres would at the least provide an experimental site for a nursery population of black-footed ferrets which as described by USFWS requires 1,500 – 3,000 acres. That is, USFWS will consider a site if it currently has at least 1,500 acres and intends to grow in prairie dog colony acreage. It is not expected that a self-sustaining population would be established; however nursery populations offer some value in allowing animals to be placed into the wild. Periodic supplementation of nursery populations would likely be needed.

- **Prairie Dog Density.** This alternative would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Therefore density could be substantially reduced within the specified acreage range, which would reduce habitat effectiveness for black-footed ferrets.

Geographic Areas – Direct and Indirect Effect

- **Range of Acres of Prairie Dog Colonies.** The indirect effect of establishing minimum and maximum acreages of prairie dog colonies in each GA greatly limits future natural expansion of black-footed ferrets from Conata Basin MA 3.63 to neighboring Wall North, Wall Southeast, Wall Southwest, and Fall River Northeast GAs. It's highly unlikely that black-footed ferrets could disperse to Fall River Southeast, Fall River West, Oglala, and Fort Pierre. Fundamentally, dispersal is an aspect of population dynamics that leads to settlement in an already occupied patch of habitat (re-enforcement) or leads to settlement in an unoccupied patch (colonization). Black-footed ferrets dispersing from Conata Basin would be searching for suitable habitat to colonize in Wall North, Wall Southeast, Wall Southwest, and Fall River Northeast. Successful dispersal by black-footed ferrets would require adequate prairie dog colony habitat. However, it is unlikely that either the 1,000-acre minimum or the 3% maximum would be sufficient for successful dispersal. An experimental nursery population of black-footed ferrets could be attempted in the above GAs but the unknowns associated with such populations warrant caution in assuming that such populations will be self-sustaining. The range of acres for Fort Pierre may help establish a black-footed ferret reintroduction site if the adjacent Lower Brule Indian Reservation pursues a black-footed ferret reintroduction project.
- **Prairie Dog Density.** This alternative would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Therefore density could be substantially reduced within the specified acreage range, which would reduce habitat effectiveness for black-footed ferrets.

Summary for Alternative 1: In summary, under Alternative 1, there is a lower likelihood of persistence of the black-footed ferret, as compared to the current Forest Plan, Alternative 2, and Alternative 5. This is due primarily to limits on future expansion of prairie dog colonies to comply with newly-established minimum and maximum ranges of acres (Table 7), and the authorization to reduce prairie dog density as determined by a Similarity Index or other measure of desired condition. Thus the overall quantity, quality, and distribution of black-footed ferret habitat (prairie dog colonies) on the planning unit will be less than under Alternatives 2 and 5,

which may decrease the survival and productivity of the reintroduced black-footed ferret population in MA 3.63 areas, and will constrain future opportunities for black-footed ferret reintroductions and natural expansion of black-footed ferrets from Conata Basin/Badlands.

The risk assessment for black-footed ferrets would be reduced from Outcome III under the current Forest Plan to Outcome IV in the absence of plague. The rationale for Outcome IV is that habitat remains fragmented with the population at Conata Basin/Badlands remaining largely isolated. Development of a larger acreage of prairie dog colonies at Smithwick would reduce the level of fragmentation but the reduced range of acres of prairie dogs as compared with Alternative 2 indicates that a self-sustaining population would not be established there. With plague now confirmed on Buffalo Gap, Outcome V is predicted. The 2008 presence of plague and the subsequent 25% reduction in black-footed ferret habitat in just a few weeks in Conata Basin MA 3.63 are relevant factors in assessing Alternatives such as Alternative1 that caps prairie dog colony acres at low levels in non-3.63 areas and also limits prairie dog colony acres in MA 3.63. Plague continues to spread in Conata Basin.

ALTERNATIVE 2

Buffalo Gap National Grassland

Conata Basin MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Under the 2001 Forest Plan (Alternative 2), it was projected that colony acreage in Conata Basin MA 3.63 would range between 26,484 to 46,400 acres over the life of the plan. A self-sustaining black-footed ferret population has been established.
- **Prairie Dog Density.** Under this alternative, there are no provisions to reduce prairie dog density based on a similarity index or other description of desired vegetation conditions. Density will be determined by prairie dog social organization and environmental conditions, particularly annual precipitation.

Smithwick MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** The 2001 Forest Plan envisioned the creation of another self-sustaining black-footed ferret population at Smithwick. The theme of the Smithwick MA 3.63 is: "Black-tailed prairie dog colony complexes are actively and intensively managed as reintroduction habitat for black-footed ferrets." The 2001 Forest Plan FEIS continues: "It's likely that sufficient habitat will be available for reintroductions and to support at least 30 adult ferrets in this area within the next 10 to 15 years. However, growth of the colony complex will need to continue beyond the next 10 to 15 years to increase the likelihood of long-term viability for a ferret population in this area." Thus, the current Forest Plan envisioned a self-sustaining population of black-footed ferrets at Smithwick. Boundary management and perhaps plague have resulted in 503 acres of prairie dogs currently in the Smithwick MA 3.63. The effective size (17,649 acres) of the MA 3.63 area in the IMZ suggests that a substantial population of black-footed ferrets could be established. Alternative 2 does not cap prairie dog colony acres at

Smithwick and allows prairie dog control only in the case of human health and damage to structures.

- **Prairie Dog Density.** This alternative does not include the provisions to reduce prairie dog density when a threshold value for similarity index or other definition of desired condition is exceeded.

Geographic Areas – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Under this alternative the current Forest Plan as amended in 2005 for boundary management would continue unchanged. With no caps on prairie dog colony acreage in the IMZ, prairie dog colony extent would likely grow over time and allow the establishment of a self-sustaining population of black-footed ferrets at Smithwick. In addition, uncapped prairie dog colony acreages would allow black-footed ferrets from Conata Basin and Smithwick to successfully disperse to adjoining GAs. Alternative 2 lists potential acres that could be occupied by prairie dogs based upon soils and slope under the current Forest Plan and based upon observed colony expansion rates. In the past five years, under low precipitation many colonies have grown as projected. For example, on Fort Pierre 1,735 acres are present. The 2001 Forest Plan used a prairie dog expansion model that predicted that the 720 acres on Fort Pierre in 2002 would expand to 1,200-1,900 acres in ten years (Sidle et al. 2006).
- **Prairie Dog Density.** This alternative does not include the provisions to reduce prairie dog density when a threshold value for similarity index or other definition of desired condition is exceeded. Density would vary naturally based on environmental conditions such as annual precipitation.

Summary for Alternative 2: This alternative confers the highest likelihood of persistence of the black-footed ferret, as supported by observed population trends in Conata Basin and population viability modeling. The 2001 Forest Plan as amended in 2005 predicted that by 2012 there would be between 29,600 and 41,400 acres of prairie dogs. There are currently 33,311 acres of prairie dog colonies on the Buffalo Gap, Fort Pierre, and Oglala national grasslands representing about 4.2% of the grasslands. The overall quantity, quality, and distribution of black-footed ferret habitat (prairie dog colonies) are expected to continue to increase over time depending on precipitation levels, which may improve the survival and productivity of the reintroduced black-footed ferret population, create another self-sustaining population of black-footed ferrets at Smithwick, allow successful dispersal of black-footed ferrets to other GAs, and expand future opportunities for reintroductions.

As stated in the 2001 Forest Plan (p. H-44), Outcomes III (in the absence of plague) and V (with presence of plague) were selected as the risk assessment for the black-footed ferret. The 2001 Forest Plan as amended in 2005 predicted that by 2012 there would be between 29,600 and 41,400 acres of prairie dogs. There are currently 33,311 acres of prairie dog colonies on the Buffalo Gap, Fort Pierre, and Oglala national grasslands representing about 4.2% of the grasslands. The 2008 presence of plague and the 25% reduction in black-footed ferret habitat in just a few weeks in Conata Basin MA 3.63 are relevant factors in assessing the value of Alternative 2 that does not cap prairie dog colony acres. The spread of plague continues in

Conata Basin. Alternative 2, by not capping prairie dog colony acres, would allow appropriate management of prairie dog colonies as the effects of plague are monitored and evaluated.

ALTERNATIVE 3

Buffalo Gap National Grassland

Conata Basin MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Alternative 3 would reduce the existing 26,000 acres of prairie dog colonies in Conata Basin to 2,200 acres, an 85% reduction. Under this alternative, the black-footed ferret population in Conata Basin/Badlands will not persist. CBSG (2004) simulations of 50% and 75% reduction in prairie dog colonies show a dramatic impact on the persistence probabilities of the black-footed ferret population in Conata Basin, indicating that an 85% reduction would mean there would no longer be a self-sustaining population. In addition, there would no longer be any dispersal of black-footed ferrets to support the small population within Badlands National Park.
- **Prairie Dog Density.** This alternative would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Therefore density could be substantially reduced within the specified acreage range, which would reduce habitat effectiveness for black-footed ferrets. Black-footed ferrets would not likely persist on treated areas where prairie dog densities were reduced by 90%.

Smithwick MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Alternative 3 provides only 800 acres of prairie dog colonies in Smithwick. This is not sufficient acreage to provide for even a small black-footed ferret nursery population at Smithwick.
- **Prairie Dog Density.** This alternative would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Therefore density could be substantially reduced within the specified acreage range, which would reduce habitat effectiveness for black-footed ferrets. Black-footed ferrets would not likely persist on treated areas where prairie dog densities were reduced by 90%.

Geographic Areas – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Alternative 3 provides various acreages of prairie dog colonies in the GAs some of which may be candidates for small experimental nursery populations as discussed previously. The 3,470 acres of colonies at Fort Pierre might figure into any future black-footed ferret reintroduction on adjacent tribal lands.
- **Prairie Dog Density.** This alternative would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Therefore density could be substantially reduced within the single acreage specified for each GA and MA. This would reduce habitat effectiveness for black-footed ferrets. Black-footed

ferrets would not likely persist on treated areas where prairie dog densities would be reduced by 90%.

Summary for Alternative 3: In summary, under Alternative 3, the black-footed ferret population at Conata Basin would not be expected to persist. In addition, this would increase the extinction risk for the black-footed ferrets in Badlands National Park. There would not be sufficient quantity, quality, and distribution of black-footed ferret habitat (prairie dog colonies) elsewhere on the planning unit to support a viable population of black-footed ferrets. The risk assessment would be Outcome VI. The 2008 presence of plague and the 25% reduction in black-footed ferret habitat in just a few weeks in Conata Basin MA 3.63 are relevant factors in assessing the value of Alternatives such as Alternative 3 that cap prairie dog colony acres at very low levels. The spread of plague continues in Conata Basin.

ALTERNATIVE 4

Buffalo Gap National Grassland

Conata Basin MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Alternative 4 allows for a minimum of 8,000 acres and a maximum of 12,000 acres of prairie dog colonies. Under this alternative the existing 26,000 acres of prairie dog colonies in Conata Basin would be reduced by at least 46% to the maximum of 12,000 acres, and allowed to go no lower than 8,000 acres. CBSG (2004) simulations of 50% and 75% reduction in prairie dog colonies show a dramatic impact on the persistence probabilities of the black-footed ferret population in Conata Basin. Eight thousand acres of prairie dog colonies could potentially support about 50 breeding adult black-footed ferrets. Twelve thousand acres could potentially support about 87 breeding adult black-footed ferrets. As discussed previously, a breeding adult black-footed ferret population greater than 100 has been recommended in the past and CBSG (2004) recommended that at least 120 breeding adult black-footed ferrets are needed to sustain a black-footed ferret population with >90% probability of persistence over 100 years. USFWS et al. (1994) recommended ≥95% probability which would require 125-130 breeding adult black-footed ferrets.
- **Prairie Dog Density.** This alternative would apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide. Prairie dog colonies would be managed to minimize situations exposing the land to bare soil by maintaining a similarity index of no less than 20 percent. Therefore density could be substantially reduced within the specified acreage range, which would reduce habitat effectiveness for black-footed ferrets to a greater extent than the other Alternatives.

Smithwick MA 3.63 – Direct and Indirect Effects

This alternative does not propose any changes to existing Forest Plan direction except in Conata Basin MA 3.63, and therefore the effects to the Smithwick area would be the same as under Alternative 2.

Geographic Areas – Direct and Indirect Effects

This alternative does not propose any changes to existing Forest Plan direction except in Conata Basin MA 3.63, and therefore the effects to areas outside MA 3.63 would be the same as under Alternative 2.

Summary for Alternative 4: In summary, under Alternative 4, the black-footed ferret population at Conata Basin would have a lower likelihood of persistence than under Alternatives 1, 2, and 5. Under Alternative 3 there is no likelihood of persistence. Alternative 4's lower likelihood of persistence would be due primarily to the Alternative's reduced prairie dog colony extent and reductions in density of prairie dogs to meet Similarity Index of 20%. This would also reduce the likelihood of persistence of the associated population in Badlands National Park. There would not be sufficient quantity, quality, and distribution of black-footed ferret habitat (prairie dog colonies) elsewhere on the planning unit to support a viable population of black-footed ferrets. The Outcome is IV or V depending on whether or not Alternative 2 acreages are selected. The 2008 presence of plague and the 25% reduction in black-footed ferret habitat in just a few weeks in Conata Basin MA 3.63 are relevant factors in assessing the value of Alternative 2 that does not cap prairie dog colony acres. The spread of plague continues in Conata Basin.

ALTERNATIVE 5

Buffalo Gap National Grassland

Conata Basin MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** Alternative 5 provides for the breeding adult black-footed ferrets estimated by CBSG (2004) for >95% population persistence probability and the alternative provides for additional breeding black-footed ferrets. Unlike the current Forest Plan (Alternative 2), this alternative establishes minimum and maximum acreage limits that would reduce the amount of potential habitat over time.
- **Prairie Dog Density.** This alternative would not apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide.

Smithwick MA 3.63 – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** This alternative provides substantial acreages of prairie dog colonies for a dispersing and colonizing population of black-footed ferrets.
- **Prairie Dog Density.** This alternative would not apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide.

Geographic Areas – Direct and Indirect Effects

- **Range of Acres of Prairie Dog Colonies.** This alternative provides substantial acreages of prairie dog colonies for dispersing and colonizing populations of black-footed ferrets.
- **Prairie Dog Density.** This alternative would not apply a similarity index threshold to determine whether prairie dog density should be reduced using rodenticide.

Summary for Alternative 5: In summary, the black-footed ferret population at Conata Basin would have a similar likelihood of persistence under Alternative 5 as Alternative 2 and a greater likelihood of persistence than under Alternatives 1, 3, and 4. Alternative 5 would also continue to support dispersal and genetic interaction with the black-footed ferrets in Badlands National Park. Over time, sufficient quantity, quality, and distribution of black-footed ferret habitat (prairie dog colonies) may develop elsewhere on the planning unit to allow establishment of additional populations of black-footed ferrets. Outcome II is selected which is more favorable to the black-footed ferret than Alternative 2 because Alternative 5 is aggressive in increasing black-footed ferret habitat.

9. Whooping Crane

Distribution and Status. Whooping cranes (*Grus americana*) were nearly extinct (15 or 16 wintering birds) in 1941, but by 1995 there were 257 birds in captivity and in the wild (Lewis 1995). These large white cranes are rare migrants across Buffalo Gap and Fort Pierre National Grasslands (Peterson et al. 1991, Graupman et al. 1991, Austin and Richert 2001) (Figures 30 and 31). Whooping cranes that migrate across the Great Plains nest in Canada and winter on the Texas Gulf Coast. The U.S. Geological Survey (Austin and Richert 2001) undertook a comprehensive review of observational and site evaluation data of migrant whooping cranes in the United States for the period, 1943-1999. The following discussion is based upon the USGS evaluation.

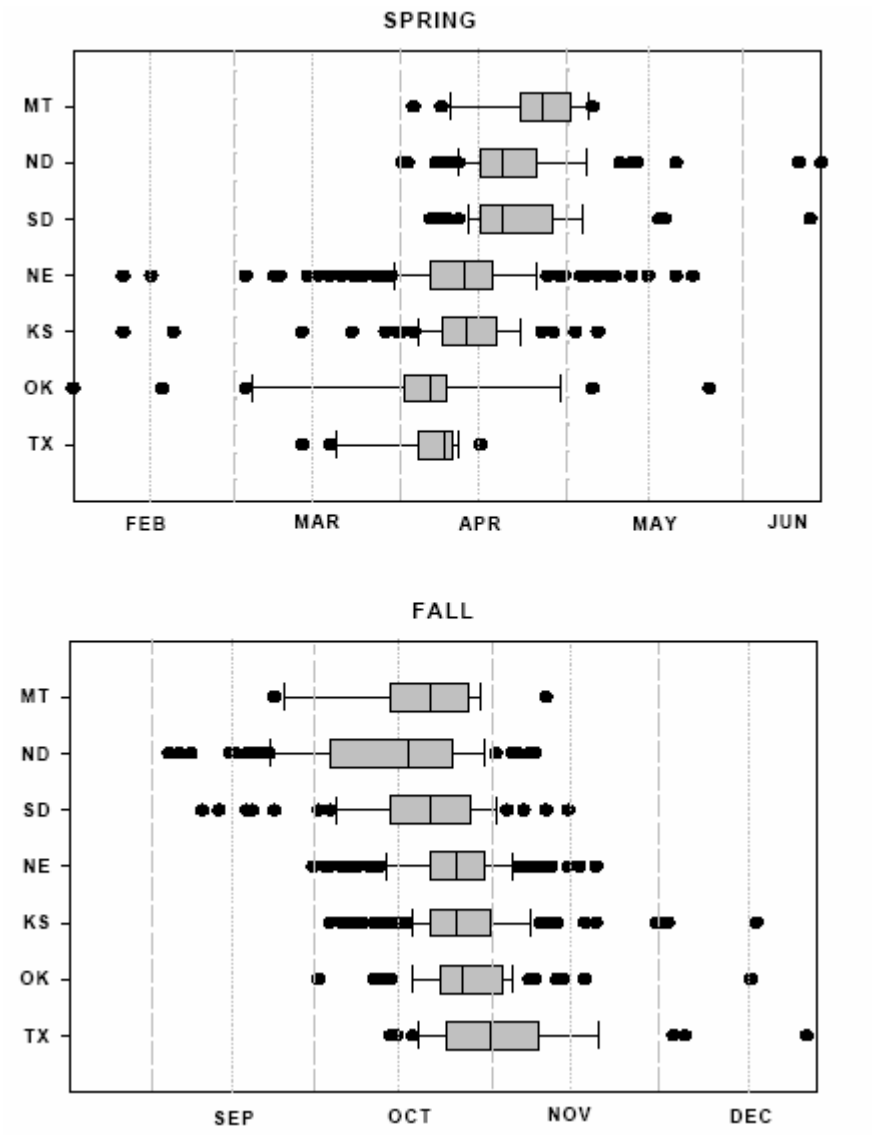


Figure 25. Dates of occurrence of whooping cranes in spring and fall, by state, 1943-1999. Box plots show median (vertical line box), 25th and 75th percentiles (box), 10th and 90th percentiles (bars) and outliers (dots) (Austin and Richert 2001).

Migration. Based on incidental observations, spring migration commences in mid- to late March and continues through mid-late May (Figure 29). Extreme dates include few observations in Oklahoma, Nebraska, and Kansas in February and early March, and in South and North Dakota in June. Some of these outliers were cranes that wintered in Oklahoma or summered in North Dakota. The peak of migration, as indicated by median dates of occurrence, was 8 April in Texas, 6 April in Oklahoma, 12 April in Kansas and Nebraska, 19 April in South and North Dakota, and 26 April in Montana. Few whooping cranes were observed in the United States after early May. The main periods of occurrence in each state over all years seem to be relatively short: the core 50% of the observations ranged from 6 days in Texas to 13 days in South Dakota. Fall migrants were first observed in North and South Dakota in early September; in Nebraska, Kansas, and Oklahoma in early October; and in

Texas by mid-October. The peak of migration, as indicated by median dates, were 22 October in Montana, 18 October in North Dakota, 22 October in South Dakota, 27 October in Nebraska, 27 October in Kansas, 28 October in Oklahoma, and 1 November in Texas.

Migration Habitat. Migrant whooping cranes use shallow water, including stock dams, as overnight roost sites (Ashton and Dowd 1991). Most wetlands used for roosting during migration were less than 10 acres in size and within 1 km of suitable feeding sites, croplands or wetlands (Lewis 1995). The birds are omnivorous and feed on plants, grain, and animals, including amphibians and invertebrates (Ashton and Dowd 1991).

Palustrine and riverine habitats in the central Great Plains provide roosting and foraging habitat to whooping cranes during spring and fall migration (Austin and Richert 2001). Characteristics of roost habitat have been examined in detail for the Platte River in Nebraska (Johnson 1982, Lingle et al. 1984, Faanes 1992, Faanes and Bowman 1992, Faanes et al. 1992), an area long recognized as a critical habitat for whooping cranes during migration. Although the Platte River is the best known spring stopover area for migrating whooping cranes, whooping cranes also use many other areas during spring and fall migration. Whooping cranes have been observed on various roosting and feeding areas throughout the migration path, which extends through North and South Dakota, Nebraska, Kansas, Oklahoma, and Texas. These areas play a key role in crane migration.

Austin and Richert (2001) evaluated the record of whooping crane sightings during migration. Palustrine wetlands accounted for >75% of records in all states except Nebraska; in that state, the proportions of observations occurring on palustrine and riverine systems were both high (56.0 and 39.6% of state records, respectively). Roost sites were most common on riverine systems only in Nebraska, primarily the Platte, Niobrara, and North and Middle Loup rivers. Most of the whooping cranes found on riverine roosts were single cranes or non-family groups, particularly on the Platte. Whooping cranes were most commonly observed on wetlands having seasonal and semi-permanent water regimes. Cranes were observed on a wide range of wetland sizes in both spring and fall, with no apparent pattern relative to social groups. Cranes used portions of rivers that ranged in width from 27 to 457 m and averaged 267 + 87 (SD) m. Maximum depths of wetlands on which cranes were observed averaged 50.8 + 41.4 cm (20.0 + 16.3 inches), while specific sites within wetlands where cranes were observed feeding or roosting averaged 18.0 + 10.7 cm (7.1 + 4.2 inches). Most wetland shorelines were classified as having a slight slope (1 to <5% slope). In riverine systems, roosting cranes were more often observed on unvegetated sites than on vegetated sites, but palustrine roost sites had a broad range of emergent vegetation types.

Most feeding sites were upland crops, whereas dual-use sites were more often wetlands. On upland crop sites, 83% of grain stubble was wheat stubble, 75% of row-crop stubble was corn, and 80% of green crops was winter wheat. Habitats adjacent (<1.6 km [1 mi]) to roost sites were most frequently described as cropland (73.8%) and upland perennial cover (69.5%). Woodland habitat occurred adjacent to >70% of riverine roost sites but <8% of palustrine roost sites. More than two-thirds of sites where cranes were observed were <0.5 mi of human developments. Nearly half of the roost sites and two-thirds of feeding sites had unobstructed visibility of <0.25 mi). Private ownership accounted for >60% of all sites used by whooping cranes and >80% of feeding sites, which reflected the high use of crop fields.

Most sites where cranes were observed feeding were in upland crops whereas cranes observed at dual-use sites were more often in wetlands. Seasonally-flooded habitat was largely comprised of flooded pasture (47% of records) and seasonal wetlands (42% of records). Permanent wetlands were largely marshes (30–40%) and reservoirs (30–40%). Sixty percent of upland cover was described as pasture. For upland crops, wheat comprised 83% of small grain stubble, corn comprised about 75% of row-crop stubble, and winter wheat comprised 80% of green crops.

Most sites where cranes were observed feeding were upland crops, with lower occurrence of cranes seen in seasonally flooded habitats, permanent water, or upland perennial cover. No cranes were recorded feeding in woodland. Proportions of habitat types varied little between seasons. Although upland crops occurred in similar high proportions in descriptions of both feeding sites and adjacent habitat, cranes were less frequently observed in upland cover or on wetlands than occurred in adjacent habitat. In spring, cranes most frequently were observed feeding on row-crop stubble, with lesser use of small grain stubble and green crops; <10% of records were for standing small grain, standing row-crops and other. In fall, cranes were most frequently observed on green crops, small-grain stubble, and row-crop stubble. Cranes were infrequently observed in standing small grain, small-grain or row-crop stubble, or in other habitats such as CRP.

Habitats adjacent to roost sites (<1.6 km) most frequently were described as cropland (73.8%) and upland perennial cover (69.5%); permanent wetlands (36.2%) and upland cover (30.5%) were also common. Woodland habitat occurred adjacent to >70% of riverine roost sites but adjacent to <8% of palustrine roost sites. All riverine roosts also had adjacent upland cover, whereas only about half of palustrine roost sites had such adjacent cover; however, upland cropland was common. For both wetland systems, seasonal wetlands occurred more frequently in adjacent habitat for spring roost sites, probably reflecting their seasonal occurrence in the landscape, and permanent wetlands occurred more frequently adjacent to roost sites in fall. Upland cropland was more common in spring than in fall, but the large number of fall records from Cheyenne Bottoms, Quivira, and Salt Plains, where habitat adjacent to roosts is more likely to be non-cropland habitat than on private lands, may be a factor in these seasonal differences.

The most common habitats adjacent to feeding sites were cropland and upland perennial cover; permanent and seasonal wetlands and woodland were less common nearby. Occurrences of seasonal wetlands and upland cover in adjacent habitat were higher in spring than in fall. The higher occurrence of woodland in spring likely relates to greater occurrence of feeding observations in spring on river systems, all of which occurred in Nebraska. Adjacent croplands were most likely to be green crops (winter wheat, alfalfa, winter rye, barley) or row-crop stubble.

Whooping cranes appear similar to sandhill cranes in their frequent use of cropland for feeding, particularly corn and wheat stubble (Howe 1987, Johns et al. 1997). However, data from dual use sites indicated that wetlands may provide important feeding areas for some whooping cranes. Howe (1987) did not distinguish between feeding-only and dual-use sites for radio-marked whooping cranes. He noted that the importance of cropland for feeding-only sites was likely higher than the 42% he reported because many feeding sites were actually categorized as roost sites. That is consistent with the frequent use of permanent or seasonally-flooded wetlands for dual-use sites in the USGS evaluation (Austin and Richert 2001).

ESA and Other Status:

ESA Status	Conservation Status[1]
ESA—Endangered	G1, N1N; Nebraska - S1; South Dakota - SNA

[1] Definitions - http://www.natureserve.org/explorer/nsranks.htm

In spring and fall, whooping cranes migrate through South Dakota and conservation agencies monitor the migration. A contingency plan protects whooping cranes should they appear locally during fall migration.

Direct, Indirect and Cumulative Effects. Zinc phosphide is highly toxic to wild birds. It is also toxic to non-target mammals. Nearly sixty studies have been conducted on the toxicity of this rodenticide to wild animals. The most sensitive bird species which have been evaluated are geese (LD50 of 7.5 mg/kg for the white- fronted goose). Pheasants, morning doves, quail, mallard ducks and the horned lark are also very susceptible to zinc phosphide. Blackbirds are less sensitive (Extension Toxicology Network 1993). Seed-eating animals on national grasslands will be at risk from zinc phosphide treated oats. The whooping crane is granivorous.

The LRMP prohibits the use of rodenticides (above-ground baits) outside October 1 to January 31 to reduce risks to migratory birds. Fall migration by whooping cranes may overlap with the period of application of rodenticide (in October). There is a remote possibility that whooping cranes could be exposed to rodenticide bait (oats) if they stopped on a project area during migration. Feeding patterns of the cranes, the low concentration of zinc phosphide in the bait, the small amount of bait applied per unit area, widely scattered bait, and the short exposure of bait contribute to low primary and secondary hazards to the birds (Tietjen 1976).

The actual process of applying rodenticide might also deter or scare cranes from the immediate area. Changes in the structure and composition of vegetation after prairie dog poisoning occurs would not affect cranes because they are only present on the ground briefly during migration.

Cumulative effects could include mortality and injuries from prairie dog shooters, but this would be unusual. The whooping crane is a well known protected species and there are very stiff penalties for killing or injuring an endangered species. Gunfire and other hunter activities might scare birds locally, but these potential effects are considered insignificant and discountable. Other cumulative effects to whooping cranes include collisions with fences and power lines.

Whooping cranes could ingest rodenticide bait in treated colonies. However, the likelihood of whooping cranes landing where rodenticide was recently applied is so remote that it is considered a “discountable effect.” The contingency plan (USFWS 2000a) and consultation with the USFWS would reduce risks to cranes. If whooping cranes are sighted in an area where rodenticide is being applied, poisoning will stop until the cranes leave the area or are hazed out of the area. In addition, if rodenticide has been applied to an area where cranes have been seen, the area will be watched and any cranes appearing will be hazed to eliminate exposure to treated grain. The application of prairie dog rodenticide or sport shooting would not influence food availability for these migrants. Whooping cranes rarely use prairie dog colonies as habitat. Therefore, the range of prairie dog colony acres is not critical to the whooping crane.

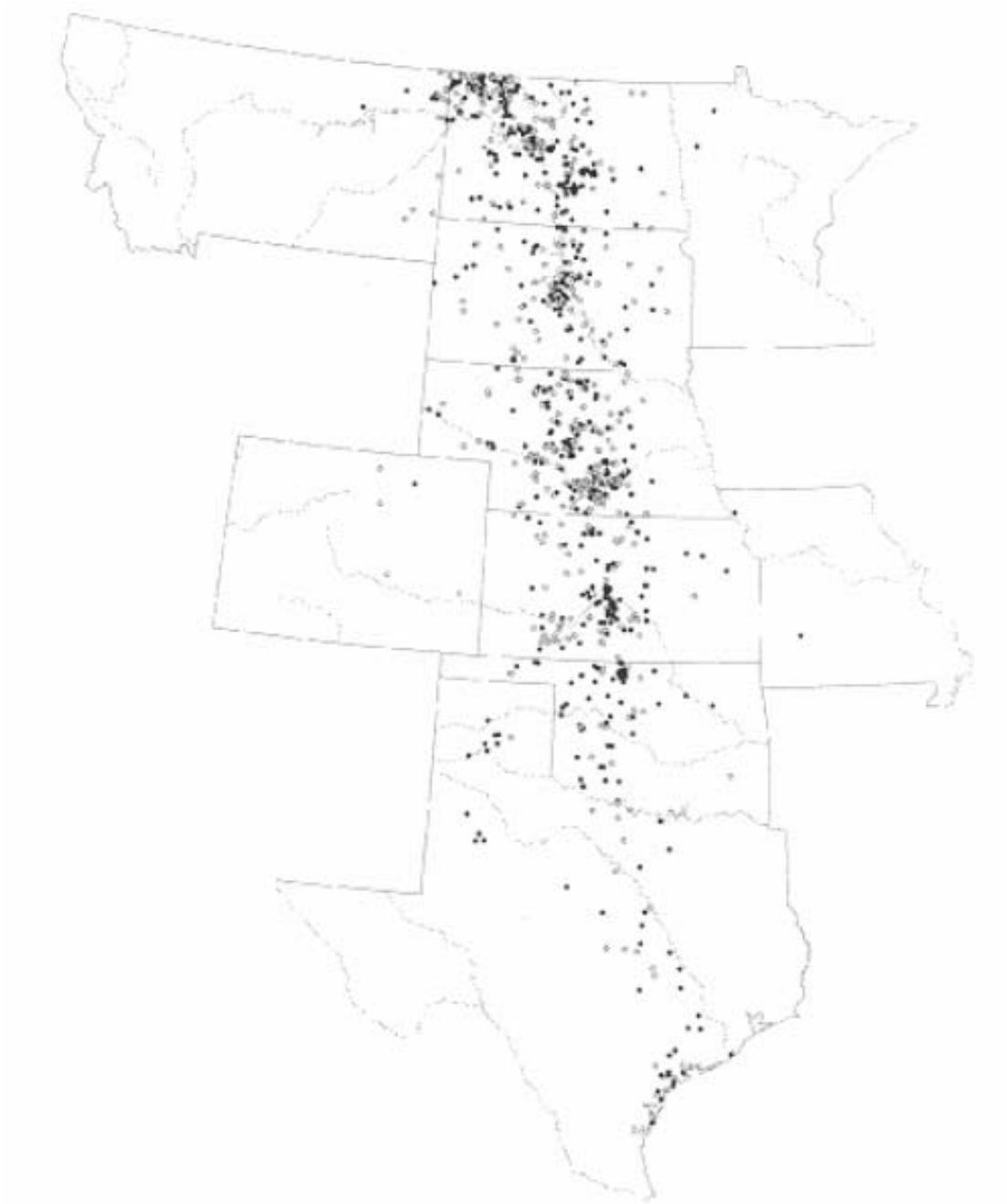


Figure 26. Whooping crane fall (●) and spring (°) sightings, 1943-1999 (Austin and Richert 2001)

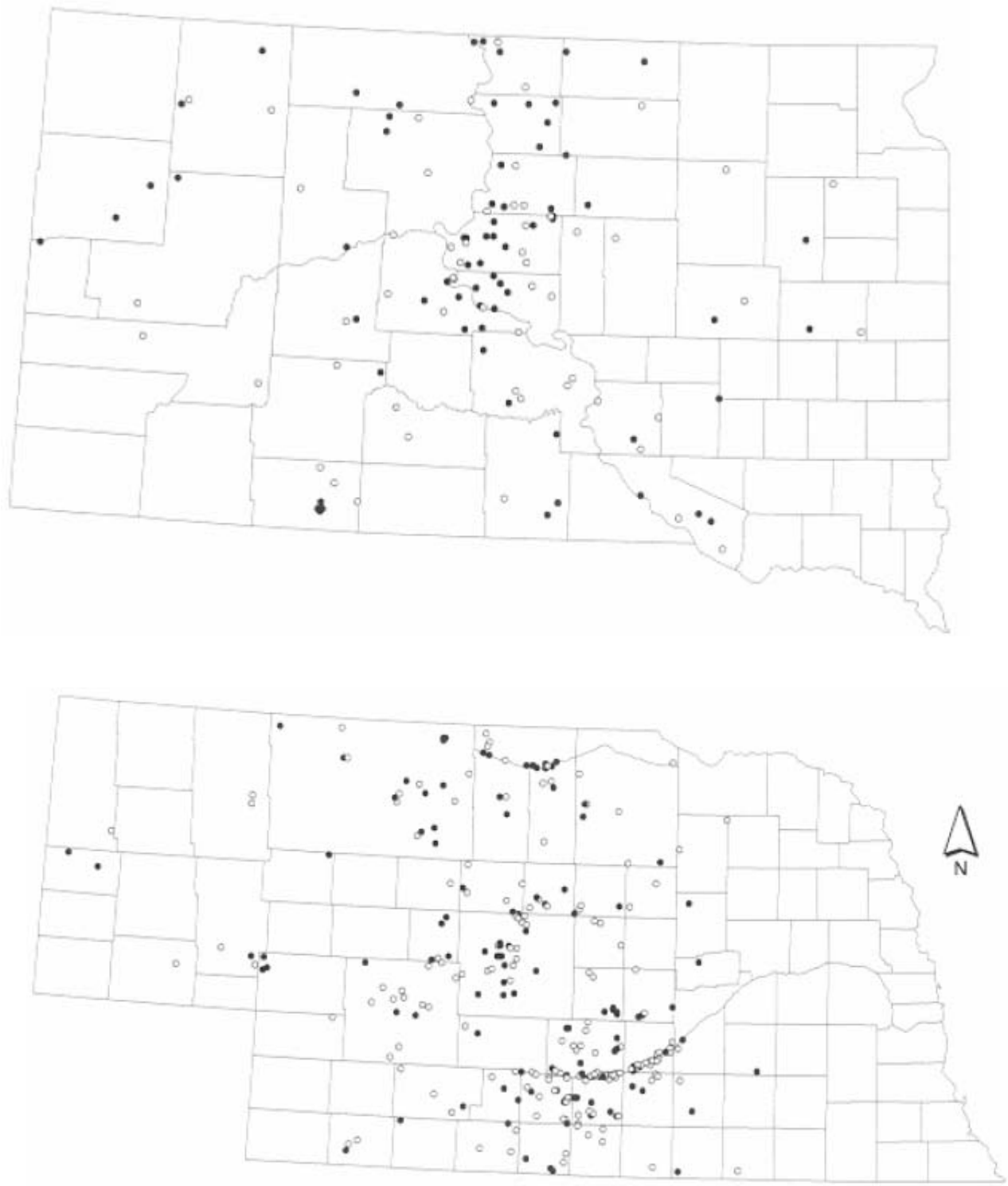


Figure 27. Whooping crane fall (●) and spring (°) sightings in Nebraska and South Dakota, 1943-1999 (Austin and Richert 2001).

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11. ATTACHMENTS

Attachment 1 - Black-footed Ferret Habitat: Prairie Dog and Ungulate Grazing

Some of the Alternatives severely limit black-footed ferret habitat in most GAs (Table 2) in part because black-footed ferret habitat (prairie dog colonies) reduces forage for livestock. However, as indicated in the "Purpose of and Need for Action" in Chapter 1 of the FEIS" whether black-footed ferret habitat (prairie dog colonies) competes with livestock or other ungulates depends upon the extent of colonies. Also relevant is the scale of management. For example, one thousand acres of prairie dog colonies on a 1,200-acre fenced livestock grazing allotment on a 100,000-acre Geographic Area may lead to competition on the 1,200 acres. However, competition is unlikely if 1,000 acres of prairie dog colonies are scattered throughout a 100,000-acre Geographic Area.

Black-footed ferret habitat consists of prairie dog colonies that are areas with reduced vegetation density created by grazing pressure from prairie dogs and ungulates, including livestock. The extent of colonies is likely a major factor in any evaluation of competition between ungulates and prairie dogs. Some Alternatives limit black-footed ferret habitat in GAs in part because black-footed ferret habitat reduces forage for livestock.

However, it is important to understand the ecological definition of competition between two species. The mere fact that two species consume the same vegetation does not convey competition. Molles (2005) defines interspecific competition as competition between individuals of two species that reduces the fitness of both species. He adds: "The effects of competition on the two competitors may not be equal, however. The individuals of one species may suffer greatly reduced fitness while those of the second are affected very little." For example, competition in the environment may be severe as exemplified by broom snakeweed (*Gutierrezia sarothrae*) (Holechek et al. 2004) which severely restricts production of associated grasses, and the alleopathic smooth brome (*Bromus inermis*) affecting native plant communities on the Fort Pierre National Grassland.

The *Oxford Dictionary of Ecology* (Allaby 2005) defines competition:

> the interaction between individuals of the same species (intraspecific competition), or between different species (interspecific competition) at the same trophic level, in which the growth and survival of one or all species or individuals is affected adversely. The competitive mechanism may be direct (active), as in alleopathy and mutual inhibition, or indirect, when a common resource is scarce.

Does the prairie dog component of black-footed ferret habitat adversely affect prairie dogs or livestock? Derner et al. (2006) observed weight gains in livestock on pastures next to the Pawnee National Grassland, Colorado during six years. Annual precipitation was below average during 4 of the 6 years. When prairie dogs occupied 20% of the pasture, cattle weight gain declined by 5.5%; when prairie dogs occupied 60% of the pasture, cattle weight gain declined by 13.9% (Figure 1). Over the entire study, mean seasonal weight gain of cattle on pastures without prairie dogs was 6% higher than on pastures with prairie dogs; mean area occupied by prairie dogs was 24%, with a range from 4% to 63%.

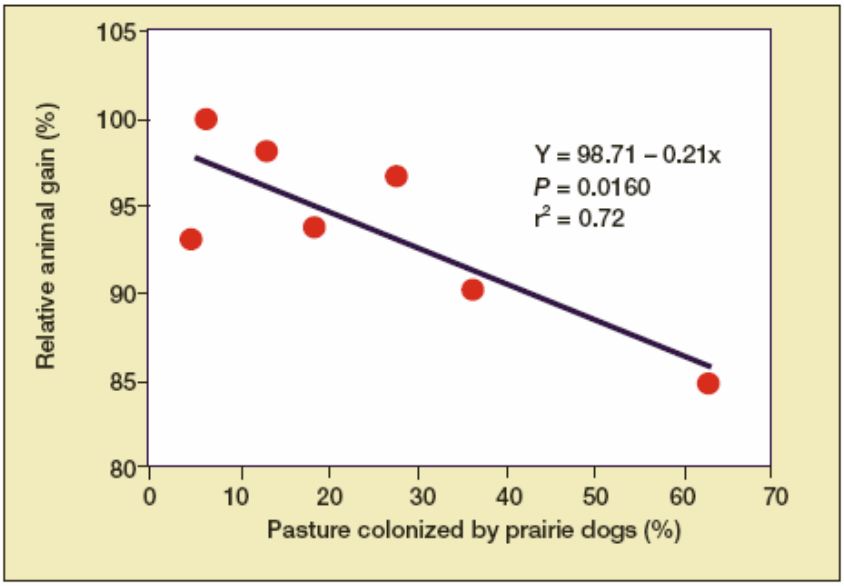

Figure A-1. Response of relative livestock weight gain (percentage, weight gain in pastures with prairie dogs/weight gain in pastures without) to increasing area colonized by prairie dogs at the USDA's Central Plains Experimental Range located near Pawnee National Grassland (Derner et al. 2006).

Using the results of Derner et al. (2006), it is possible to p whether competition between livestock and prairie dogs will occur under the FEIS alternatives. Overall, the current 33,311 acres of prairie dog colonies in the project area represents only 4.7% of the 700,544 acres suggesting that competition is not occurring, that there is no adverse effect to livestock or black-footed ferret habitat (prairie dog colonies) (Table 1). However, 39% of Conata Basin MA 3.63 is occupied by prairie dog colonies but weight gain decline would be well below 13.9% and the area is fundamentally devoted to black-footed ferret habitat (Table 7). Overall, Alternative 1 allows 3-6% of suitable habitat for prairie dog colonies and competition is unlikely. Alternative 2 allows 4.7-18% of suitable habitat for prairie dog colonies, less than the 20% occupancy for a 5.5% decline in weight gain (Derner et al. 2006). Alternative 3 allows 0.01-3% of suitable habitat for prairie dog colonies and competition is unlikely. Alternative 4 does not present a range of prairie dog colony acres for any area except Conata Basin MA 3.63. Alternative 4 allows 12-17% of suitable habitat for prairie dog colonies in Conata Basin. Weight gain decline would be well below 5.5% or 13.9% and the area is fundamentally devoted to black-footed ferret habitat. Alternative 5 allows 15-29% of suitable habitat for prairie dog colonies, slightly more than 20% occupancy at its maximum for a decline in livestock weight gain of slightly more than 5.5%.

Excerpts from the latest review of the livestock/prairie dog relationship are relevant to understanding the effects of black-footed ferret habitat, negative or positive, on livestock (*Miller, B.J., R.P. Reading, D.E. Biggins, J.K. Detling, S.C. Forrest, J.L. Hoogland, J. Javersak, S.D. Miller, J. Proctor, J. Truett, and D.W. Uresk. 2007. Prairie dogs: an ecological review and current biopolitics. Journal of Wildlife Management 71:2801-2810*):

Ecological Effects of Competition

We follow Ricklefs and Miller (2000:384) in defining competition as resulting ''when many species seek the same resources, and the depressing effect that each one has on the availability of the shared resources adversely affects the others.'' Cattle and black-tailed prairie dogs exhibit a high dietary overlap—up to 60% in a mid-grass prairie and 64% in a short-grass prairie (Hansen and Gold 1977; Uresk 1984, 1986). Competition, however, does not necessarily occur simply because 2 species use the same resource. Competition exists when species A is worse off because

of the activities by species B, and vice versa. Thus, cattle and prairie dogs may seek the same resources, but diet overlap alone does not prove that either species is adversely affected.

Demonstrating competition is difficult in natural systems. First, there is an issue of scale. High competition may occur in localized cases (e.g., a single ranch), but when considering larger landscapes the actual level of competition may become insignificant. Second, although prairie dogs clearly reduce plant biomass, debate remains about the impact to other grazers because of increases in forage quality as a result of prairie dog activities. It appears that the degree of compensation is highly situational (see Curtin 2006, Derner et al. 2006, Detling 2006). Third, presence and level of competition among species can vary across geographical area (e.g., differences in productivity), across vegetation types (mid-grass, short-grass, or desert grasslands), among seasons, and among years (by variation in rainfall). Because we often lack data over the full range of these conditions, a useful guideline may be that in areas of low biomass productivity, competition is more likely than in areas of high biomass productivity (Detling 2006). Competition is also more likely at higher stocking levels than at light levels (see review by Holechek et al. 2004). The larger public policy question is whether competition justifies poisoning prairie dogs on publicly owned lands to benefit cattle grazing by private leasees.

Proponents of holding prairie dogs at low numbers claim such management is necessary to maintain wild ungulates and economically viable numbers of domestic livestock (Stoltenberg et al. 2004, Vermeire et al. 2004). They frame competition around a negative effect on large ungulates by prairie dogs, and typically define competition as overlapping resource use. Even if prairie dogs compete with large ungulates, the fact remains that coexistence is possible as millions of bison (*Bison bison*), pronghorn (*Antilocapra americana*), and elk (*Cervus elaphus*) lived for millennia with prairie dogs before European settlers introduced domestic livestock to the Great Plains.

In North America, individual bison cows and yearlings appear to benefit from grazing on prairie dog colonies, as opposed to grazing only away from those colonies (Vanderhye 1985, Detling 2006). Seasonal weight gain of bison varies directly with the time they spend grazing on prairie dog colonies (Detling 2006). For wild ungulates, competition with high densities of livestock may present a larger problem than competition with prairie dogs. When researchers calculated livestock competition based on diets, cattle grazing reduced bison numbers by 72% and elk numbers by 40% (Wydeven and Dahlgren 1985, Uresk 1986, Holechek et al. 1989).

At the beginning of the 20th century, Merriam (1902) estimated the effects of prairie dogs on grazing lands. Some people cite his work as justification for poisoning prairie dogs to benefit cattle grazing (see Vermeire et al. 2004). Furthermore, Merriam used an unstated formula to claim that 256 prairie dogs consume as much grass as one cow, and failed to correct for dietary overlap or to account for prairie dog food that is not livestock forage (Koford 1958). Merriam (1902:258) concluded ‘‘Hence, it is no wonder that the annual loss from prairie dogs is said to range from 50 to 75 per cent of the producing capacity of the land.’’ Modern standards of evidence cannot support this assertion, which recent studies contradict.

O’Meilia et al. (1982) estimated competition between cattle and prairie dogs in Oklahoma, USA, and found no statistical difference in weight gain between steers raised on and off of prairie dog colonies. A reanalysis by Vermeire et al. (2004) of O’Meilia’s data agreed with the original conclusion that no statistical difference in weight gain of steers occurred over the entire year, but they found a difference during winter. However, reduced winter weight gains are irrelevant for most western ranchers, because cattle typically do not free-range during winter (particularly on

public lands) and ranchers supplement cattle in winter with stored foods. The O'Meilia et al. (1982) study comprised small sample sizes, so we should cautiously interpret both the original conclusion and the reanalysis (Detling 2006).

After reintroducing black-tailed prairie dogs to the Gray Ranch in southwestern New Mexico, vegetation was shorter on the prairie dog colony (Brown 2003; Curtin 2003, 2006). Vegetation diversity was lower on the colonies, but biomass was slightly higher than on random control plots, perhaps because grasses became more bunched (Curtin 2006). Soils probably played some role in the biomass results because prairie dogs colonized the richer areas (C. Curtin, Massachusetts Institute of Technology–United States Geological Survey Science Impact Collaborative, personal communication). Most importantly, large grazers do not find the tabosa grass (*Hilaria mutica*) of the region palatable, so livestock did not use the grass away from prairie dog colonies; livestock only ate tabosa grass after prairie dogs clipped it (C. Curtin, personal communication).

A study in New Mexico also reported that cattle walked miles from water across open terrain to graze on prairie dog colonies (Brown 2003, Curtin 2003). Curtin (2003:91) observed, ''In short, prairie dogs have a positive interaction with native and non-native grazers.'' We should not extrapolate this example from southwestern grasslands across the prairie dog's range. In short-grass steppe habitat in northeastern Colorado, USA, cows showed no preference for grazing on or off colonies (Guenther and Detling 2003, Detling 2006). In a northern mixed-prairie, bison showed a decided preference for grazing on prairie dog colonies (Coppock et al. 1983b, Detling 2006).

Using actual data and linear programming Uresk and Paulson (1988) estimated competition between cattle and prairie dogs at 4% to 7% in South Dakota, USA. Data included diets, consumption rates, plant production, stocking rates (20% to 80% forage utilization), densities of black-tailed prairie dogs (up to 40 ha of prairie dogs at 44 prairie dogs/ha in a 2,100-ha pasture), and plant seral stages. They analyzed vegetation from 4 treatments: 1) neither cattle nor prairie dogs, 2) prairie dogs only, 3) both cattle and prairie dogs, and 4) cattle only (Uresk and Bjugstad 1983; Collins et al. 1984; Uresk 1985, 1987).

Many ranchers follow the adage ''take half and leave half'' of the vegetation (Lacey and Van Poolen 1981). When reviewing studies of stocking rates, Holechek et al. (2004) reported that heavy grazing used an average of 57% of primary forage species, moderate grazing used 43%, and light grazing used 32%; over long time frames, moderate grazing levels maintained vegetation productivity for arid and semi-arid grasslands. Using Uresk and Paulson's (1988) model, Detling (2006) suggested that when cattle consume 60% of the vegetation in a pasture and prairie dogs occupy 2% of that pasture, cow-calf capacity declines by 3.3%. Looking at different scales, individual pastures may include more than 2% of their area occupied by prairie dogs, but prairie dogs still occupy about 2% of their former range (Proctor et al. 2006). Holechek et al. (2004) promoted a moderate stocking rate (about 45% utilization) for range health, and stocking at that rate should also reduce competition between livestock and prairie dogs.

More recently, Derner et al. (2006) looked at interactions between cattle and prairie dogs on the short-grass steppe of the Pawnee National Grasslands, Colorado. Over 6 years, the weight of cattle declined with increasing area occupied by prairie dogs, but at a rate proportionately lower than the increasing percentage of pasture occupied by prairie dogs ($Y = 98.71-0.21X$). When prairie dogs occupied 20% of the pasture, cattle weight gain declined by 5.5%; when prairie dogs occupied 60% of the pasture, cattle weight gain declined by 13.9% (Derner et al. 2006). Annual precipitation was below average in 4 of the 6 years, and mean weight gain of cattle on and off of

colonies was significantly different (which the authors defined as $P > 0.10$) in 3 of 5 years (2 of which experienced below average precipitation) for which the authors analyzed weight gain (Derner et al. 2006). One of those years demonstrated highly significant differences ($P < 0.001$) and that year involved the pasture with a prairie dog colonization level of 63% and below average precipitation. During the wet year, only one site with prairie dogs (4.3%) was lower in cattle weights than other sites with and without prairie dogs (Tukey's Multiple Comparison Procedure, $\alpha = 0.01$). Over the entire study, mean seasonal weight gain of cattle on pastures without prairie dogs was 6% higher than on pastures with prairie dogs; mean area occupied by prairie dogs was 24%, with a range from 4% to 63% (Derner et al. 2006).

Contrary to statements by Vermeire et al. (2004:692), Uresk and Paulson (1988) did not ''limit'' prairie dogs to an early seral stage. Prairie dogs simply did not occur on the 58% of the 2,100-ha pasture that occurred at or near climax; the authors did not assume this (Uresk and Paulson 1988). Prairie dogs inhabited areas of the pasture that fell within the remaining 3 seral categories: early, early-intermediate, and a few in late-intermediate seral condition. Due to many years of heavy livestock grazing, areas of the grasslands existed in early seral stages of plant succession with buffalo grass (Buchloe dactyloides) being the dominant plant (Johnson et al. 1951, Lewis et al. 1956). However, with livestock reductions and poisoning of black-tailed prairie dogs, plant succession progressed to later seral stages (Uresk 1987, 1990). We recognize that plant succession does not always proceed in an orderly fashion; when disturbance is severe enough to push a system across a threshold, nonlinear responses can dominate.

All prairie dog towns sampled in the Badlands National Park, Buffalo Gap Grasslands, Thunder Basin Grasslands, and Ft. Pierre Grasslands contained prairie dog colonies in early or intermediate seral stages of plant succession (Koford 1958, Uresk 1985, Cincotta et al. 1989, Severson and Plumb 1998). In mixed-grass and tall-grass prairie, managing for a long-term, climax stage by reducing livestock-grazing increases vegetation height, and thus reduces the number of prairie dogs, which do not colonize in climax vegetation (Koford 1958, Snell and Hlavachick 1980, Snell 1985, Uresk 1987). Disturbance is indeed equated with seral status, and prairie dogs seek areas of disturbance or early seral condition (Koford 1958; Uresk 1987, 1990; Uresk and Paulson 1988; Cincotta et al. 1989). Prairie dogs do alter the vegetation for structure and composition, generally in association with another large herbivore, but the short grasses and the mid grasses are well adapted to herbivory (Uresk 1987, Winter et al. 2002).

Researchers estimate dietary overlap at 60% and 64% for cattle and prairie dogs in a mid-grass and short-grass prairie, respectively (Hansen and Gold 1977; Uresk 1984, 1986). Both livestock and prairie dogs independently and synergistically induced changes in plant species composition. Koford (1958) and Knowles (1982) found that prairie dogs began clipping mid grasses at approximately 15 cm or higher. Without grazing by livestock, or with light livestock grazing, clipping by prairie dogs generally occurs to maintain the colony in short vegetation (Koford 1958, Snell and Hlavachick 1980, Snell 1985, Uresk 1987). However, Heady and Child (1994) reported that plant biomass can decline by 1% to 5% from the hoof action of cows and soil compaction, and this decreases plant biomass available for livestock. The negative effects of soil compaction increase as stocking rates increase (Holechek et al. 2004).

Vermeire et al. (2004) concluded that the presence of prairie dog burrow-mounds reduced vegetation, which reduced livestock carrying capacity. Mounds account for 2.5% to 6% of the ground area on a prairie dog colony (Farrar 2002, Detling 2006). However, as moisture runs off these mounds, the adjacent areas harvest the water and nutrients for plant growth. As a result, the aboveground biomass of plants associated with mounds increases in native vegetation (Gold

1976, Severe 1977). This increase in aboveground biomass can variably offset the loss of vegetation on the prairie dog burrow-mounds.

Attachment 2 – Adaptive Management for Black-footed Ferrets and Prairie Dogs

Strategy for a Science-based Approach to Management of Prairie Dogs, Black-footed Ferrets, Vegetation, and Soils on the Nebraska National Forest

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Objectives

Identify a science-based program to gain reliable knowledge that reduces uncertainty, improves understanding of risk, and facilitates informed management of black-tailed prairie dog and black-footed ferret populations, vegetation and soil conditions on the Nebraska National Forest (NNF). The information gained would be used to refine assumptions and hypotheses about the outcomes of our management of the prairie dog ecosystem. The intent is to ensure that a science-based component of prairie dog management is an integral part of new decisions and their implementation.

Integrating a science-based approach to the NNF decision would ensure that key assumptions are properly evaluated through a systematic process. This provides a level of protection to the Conata Basin black-footed ferret population commensurate with its high value. It also helps ensure that the appropriate information is being collected to allow us to properly manage prairie dogs well into the future to achieve resource objectives on the NNF.

Contemporary prairie dog management in the Forest Service demands a new, more informed approach to developing, evaluating, and adapting management strategies over time. Recent circumstances on the NNF involving two Forest Plan amendments since Plan revision in 2002, have served as a catalyst for in-depth assessment of the complexities and information needs associated with successfully managing the prairie dog ecosystem on the NNF *and likely on all national grasslands*. Our goal on the NNF is to develop a model, hands-on approach to assemble a foundation of information to evaluate important assumptions, adjust management over time, and reliably inform our progress toward achieving desired outcomes for multiple resource values and uses on the NNF.

Background

The NNF has a long history of conflict over prairie dogs and prairie dog management on the national grasslands. The widely-held perception of prairie dogs and their management historically was one of a pest devastating to soils, vegetation, and livestock forage production and that must be suppressed to the maximum extent possible by the most effective means possible: poisoning by rodenticide. This was the case across all land ownerships, and rodenticide remains the primary management tool on non-federal lands in South Dakota and many other western states.

The NNF was both effective and efficient at reducing prairie dog colony acreages. Historically, decisions to control acres were primarily driven by conflicts with landowners/permittees and available funding. For example, from 1978 – 1980 the NNF responding to litigation reduced prairie dog acres on the Buffalo Gap National Grassland (including Conata Basin) from 21,000 acres to approximately 3,000 acres.

The 1980s were the start of a turning point in the philosophy and practice of prairie dog management on the NNF. Prairie dog proponents began taking more active interest in management decisions. A 1989 prairie dog management plan developed by the NNF represented the first attempt to establish objectives for acres of prairie dogs and special areas where they and associated species would be emphasized over other values and uses. The plan also established 'non-lethal' strategies, in addition to continued rodenticide use. A key component was an ambitious and highly successful agency land exchange program to consolidate national grassland parcels and reduce conflicts with adjacent landowners.

During that time, discussions and habitat evaluations were conducted by multi-agencies to assess the potential of Conata Basin/Badlands National Park habitat for supporting a black-footed ferret reintroduction. This effort established the Conata Basin/Badlands as a high priority reintroduction site nationally. The first of several ferret releases began in 1994 on the National Park and 1996 on the National Grassland following completion of an extended NEPA process and interagency EIS.

The Conata Basin site has since become the most successful recovery site to-date in the national recovery program. It currently supports the only recognized self-sustaining population (~200 animals) and supplies highly-prized, wild-born animals to other recovery sites in North America.

In 2002, the Forest issued a revised Land and Resource Management Plan (LRMP). The LRMP further established direction for prairie dog, black-footed ferret, and vegetation objectives while maintaining livestock grazing. In 2005 the NNF issued a decision to mange prairie dogs along boundaries of the Forest under an adaptive management approach. A key adaptive management assumption affected the decision. The assumption was livestock exclusion from boundary areas and rodenticide use would provide a vegetative buffer limiting prairie dog movement. Presently, the NNF is evaluating alternatives in an EIS to amend direction in their LRMP for interior colony prairie dog management. This decision is a "second part" to prairie dog management.

Foundation for a Science-Based Approach to New Prairie Dog Management Decisions

Despite the successes to-date of the black-footed ferret recovery program at Conata Basin, the long-term persistence of the population is not assured. The reintroductions on most other locations have been unsuccessful to-date. Ferrets are currently concentrated in a smaller portion of the Conata Basin/Badlands recovery area than originally envisioned and potentially exposing them to unknown and higher risk.

Public concerns over prairie dog impacts to soil stability and vegetation have been resurrected and amplified during the most recent drought cycle. The NNF is considering reducing prairie dog acres and densities on a periodic basis when certain thresholds are met.

The Forest recognizes that some of the "best available science" has limits and should be used conservatively to evaluate management alternatives. Despite enormous investments in the Conata Basin recovery program there have been no systematic scientific studies on the ecology, habitat use patterns, or demographics of the ferret population. Monitoring data were also used by the IUCN Captive Breeding Specialist Group (CBSG) in an initial exploratory attempt at a Population Viability Analysis modeling exercise. However, there has been no concerted effort to validate the model.

The major areas of uncertainty and assumptions are the focus of the science proposal: 1) The CBSG population viability analysis modeling effort (2003) produced a reliable estimate of the

number of black-footed ferrets needed to maintain population persistence for 100 years, 2) Annual monitoring data provide reliable knowledge of ferret home range sizes over time that can be directly correlated with total acres of prairie dog habitat needed to maintain 125 to 130 ferrets and population persistence, 3) Total acres of prairie dog habitat is the key variable influencing habitat quality and productivity of the black-footed ferret population in Conata Basin, 4) The NNF can monitor and assess both total acres of active prairie dog colonies *and* colony densities over time to make site-specific decisions about location and timing of rodenticide treatments to remain within the desired range of prairie dog acres, 5) "Non-traditional' applications of rodenticide to manage prairie dog *densities* can be effective in reducing prairie dog movements and colony expansion, restoring vegetation toward desired conditions, and maintaining ferret habitat quality and use, 6) The NRCS similarity index and desired vegetation condition of buffalograss-blue grama plant community is consistent with site vegetation potentials across all NNF areas or with other desired conditions and objectives for soils, prairie dogs, and black-footed ferrets, 7) Soil conditions and stability during the recent drought cycle have deteriorated in the presence of prairie dogs to an extent that compromises rangeland ecosystem function and current and future potentials for vegetation.

The attached Table A2-1 provides a proposed package that includes adaptive management studies and research opportunities for the NNF decision. The items in the table should be considered as a package and are listed in no particular order of importance. They are all inter-connected and in reality some will overlap at some point, meaning 2 or more may potentially be merged in study designs. Preliminary funding needs are identified and different options for conducting the studies will be explored.

Estimated Funding Needs.

Total estimated cost of the complete applied science package is $1.75MM. Table A2-1 that follows provides the breakdown of proposed investigations and costs by main research area.

Table A2-1. Applied science package for prairie dog management, Nebraska National Forest, relevant under all alternatives.

1) Measures of Vegetation and Soil Response to Prairie Dogs and Management
Applied Management Questions: What is the applicability of the NRCS's Vegetation Similarity Index to managing rangelands occupied by prairie dogs, and is it the most appropriate method for establishing, evaluating and adapting the NNF's vegetation and prairie dog management objectives over time? Areas of Applied Study: → Use available data/published papers supplemented with new field data, to identify vegetation conditions and similarity indices associated with black-tailed prairie dog colonies on the NNF. *Outcome and Applications.* i) Verifies vegetation conditions and similarity index values the NNF can expect on prairie dog colonies, compared to that proposed and incorporated into the current prairie dog management alternatives and may be part of the final decision; ii) Results can be shared with the state of South Dakota and Fall River Co.; iii) Better understanding if a reliable relationship exists between prairie dog density and vegetation condition that would inform feasibility of managing prairie dog densities to meet long-term desired vegetation and habitat conditions.
→ Field test the NRCS index approach with other methods of measuring vegetation condition and do sampling on colonies and at multiple geographic scales Factor into the design other site variables unrelated to management that also influence vegetation condition and potential (i.e. colony age, prairie dog density, soils, recent precipitation history). *Outcome and Applications.* i) Tests whether the NRCS method provides a reliable method to monitor and trigger prairie dog management; ii) Potentially conducted as component of the previous investigation, establishes the most useful method and scale/s for monitoring vegetation conditions relative to desired conditions and management objectives for vegetation, prairie dogs, and ferrets; iii) Tests assumption that a Forest-wide desired condition of buffalo grass-blue grama association is realistic and attainable, or whether multiple desired conditions and management objectives are most appropriate.
→ Design and implement scientifically-based, long-term *vegetation* monitoring program to quantify response of vegetation to NNF lethal and non-lethal management of prairie dogs. "Response" should include measures of composition, cover, diversity and nutritional qualities. *Outcome and Applications.* i) Builds on the research described above to apply the most appropriate sampling and data analysis procedures to quantify results of prairie dog management relative to desired conditions for vegetation, prairie dogs, and ferrets; ii) Establishes vegetation and forage response to specific management practices across a range of sites at a range of spatial and temporal scales.
→ Design and implement scientifically-based, long-term *soil* monitoring program to quantify relationship of prairie dog colonies to soil movement. Factor in site variables identified for the above investigations and include appropriate control sites in the surrounding Badlands environment around Conata Basin. Techniques developed at the University of Kansas and successfully used in the Mojave Desert to monitor soil movement in relation to DoD training disturbance and natural resource objectives may be useful. *Outcome and Applications.* i) Establishes contribution of prairie dog colonies and complexes to soil movement (at range of scales) relative to soil movement in areas without -prairie dogs to assess and adapt desired conditions for vegetation; ii) Results can be used in place-based refinement of soil and vegetation management objectives for areas of the NNF occupied by prairie dogs. ***Est. Funding Needs: $350 M total over 7-10 years***

Table A2-1, cont.

2) Managing Prairie Dog Densities

Applied Management Questions: Is management of prairie dog *density* using rodenticide a viable alternative to total colony elimination, and can prairie dog densities be effectively managed at target densities with an acceptable level of precision?

Areas of Applied Study:

→ Experimentally compare the effectiveness of different rodenticide application approaches (i.e. strip treatments vs. reduced application rates vs. partial-colony treatments) for attaining target prairie dog densities. Establish which approach, if any, can be used to reduce prairie dog density to desired target levels and with acceptable confidence.

With support from vegetation studies described above, understand connection between prairie dog densities and vegetation response. This type of investigation could be conducted anywhere prairie dogs exist on the NNF and should be prioritized away from the ferret population in Conata Basin, given the experimental nature of these 'non-traditional' approaches.

Outcome and Applications. i) Information to design prairie dog management employing rodenticide in a more informed way; ii) Understanding of economic cost/benefits of alternative approaches to applying rodenticide; ii) Provides understanding of the effect of different rodenticide management approaches to vegetation; iii) If management to maintain targeted prairie dog densities appears feasible, better knowledge of how to regulate densities to meet vegetation objectives while maintaining densities at levels expected to continue to support ferrets.

Est Funding Needs: $200 M total over 5 years

3) Black-footed Ferret Response to Prairie Dogs and Management

Applied Management Questions: How do individual ferrets and ultimately the Conata Basin population react to changes in their habitat from NNF management, and how can the results of the CBSG PVA modeling being used in the NNF planning and other population modeling be used to examine important assumptions and inform future adaptive management protocols?

Areas of Applied Study:

→ Develop a reliable protocol to accurately estimate ferret population abundance and demographics in Conata Basin to an acceptable level of precision and confidence.

Outcome and Applications. i) Provides reliable ferret population estimate that can be evaluated as the management plan is implemented.; ii) Provides information necessary to understanding whether population size is stable, increasing, and overall conformance with LRMP objectives for sustaining the ferret population.

→ Investigate seasonal habitat use patterns and population demographics, in relation to characteristics of the habitat over time. Compare ferret behavioral and population response to both fine-scale (colony size, prairie dog density) and broad-scale habitat characteristics (inter-colony distance, number of colonies, total habitat area) across the Conata Basin.

Outcome and Applications. i) Better understanding if ferrets change their behavior in response to management in ways that put them at higher risk, i.e. habitat change forces ferrets into smaller habitat base and higher BFF densities. These population responses influence vulnerability to other stressors including disease, competition, and predation.; ii) Provides information on poorly understood aspects of ferret ecology and population dynamics from Conata Basin needed to determine progress toward meeting overall desired objectives for ferret sustainability, prairie dog conservation, and vegetation conditions. Provides knowledge necessary to adapt future site-specific management to changing environmental conditions; iii) Informs future management of the Conata Basin and understanding of favorable attributes of prairie dog colonies and complexes including configuration and size; iv) Tests assumptions regarding acres and distribution of prairie dog habitat and sustaining the Conata Basin ferret population.

→ Validate and refine the CBSG ferret population modeling and explore other population modeling approaches to understand dynamics of ferrets under different conditions. Use the models to identify hypotheses and data needs from the field and identify hypotheses to test.

Outcome and Applications. i) Better understanding of post-management effects in relation to ferret population changes; ii) Higher confidence and less risk in effects analyses, annual site-specific management, and future management decisions; iii) Better understanding of potential thresholds in ferret population characteristics and clearer understanding of uncertainty regarding the dynamics around those thresholds; iv) Response of ferrets to variable prairie dog abundance and distribution; v) Relationship of management objectives for prairie dog acres to ferret response.

Est. Funding Needs: $1.2 MM total over 7-10 years

Attachment 3 – Black-footed Ferrets and Prairie Dog Colony Acres

A major aspect of the action alternatives would be a minimum and maximum range of prairie dog colony acres to be allowed in each GA (Tables 2 and 7). A consideration in the analysis of potential effects on the black-footed ferret is how setting a minimum of 1,000 acres of colonies and a maximum acreage of 3% of gross GA acreage, and setting a maximum inter-colony distance of 6 miles, will affect the sustainability of a viable population at Conata Basin, the ability to support a future reintroduction into the Smithwick MA 3.63, the effects on black-footed ferrets that disperse outside of MA 3.63, and to what extent future options are maintained for future black-footed ferret reintroductions or natural establishment on the six GAs in habitat outside of MA 3.63.

One of the reasons for the near extinction of the black-footed ferret is the scant acreage of prairie dog colonies throughout the prairie dog's range in the Great Plains. If black-footed ferrets could survive in an area of low prairie dog colony acreage, the species would still occur in the Great Plains because such colony extents can still be found on private land (Figure 1). In the Great Plains, prairie dog colonies typically are small and constitute a small extent of private rangeland. Examples of the low percentage of private land base in prairie dog colonies are displayed on the non-federal land within the GAs (Table 1; Figures 1 and 2). The percentage in prairie dog colony ranges from 0.17% on Fort Pierre GA non-federal land (much of that non-federal land is in cropland) to 4% on Fall River Northeast GA. The percentage of non-federal land in prairie dog colonies remained stable during 2002-2006 despite the drought (Table 1). Total acres fell from 8,977 to 8,005 acres (2.0 - 1.9%). On federal land in the GAs, the percentage of land base in prairie dog colony ranged from 0.5 - 4.2% in 2002, depending on the GA, and from 0.17 - 1.5% in 2006 after BMZ poisoning (Table 1). Total prairie dog acreage on federal land fell from 8,264 to 6,068 acres (1.7 - 1.2%). Almost all of the current acreage is in the IMZ. As of June 16, 2008 over 8,000 acres in Conata Basin MA 3.63 have been affected by plague.

The USFWS and others have long viewed large acreages of prairie dog colonies as essential for recovery of the black-footed ferret (Roelle et al. 2006). Prairie dog colony extent for black-footed ferrets has been a minimum of 10,000 acres, perhaps 5,000 acres, and now the USFWS will consider a reintroduction site if the site contains at least 1,500 – 3,000 acres of prairie dog colonies. This consideration by USFWS does not convey that 1,500 – 3,000 acres are the total acres a site needs for black-footed ferret reintroduction, nor does it convey that 1,500 – 3,000 acres are all that is needed in Conata Basin. Indeed, these small reintroduction sites are experiments to test whether a population of black-footed ferrets can be established at such acreages. The experiment may fail or the small sites such as Wind Cave National Park and Smokey Valley Ranch, Kansas may require periodic supplementation with captive-reared or wild born black-footed ferrets. The USFWS and others believe that it is crucial to attempt to establish and maintain as many black-footed ferret populations as possible in native habitats in order to achieve recovery of this species. The experiments at low prairie dog colony acreage will provide useful information but they are in another sense a sign of desperation because it is very difficult to find large extents of prairie dog colonies for large self-sustaining populations of black-footed ferrets.

The introduction of black-footed ferrets at Wind Cave is a test of the viability of using a reintroduction site with less than 5,000 acres of prairie dog colonies (National Park Service 2006). The Black-tail Prairie Dog Management Plan for Wind Cave sets the limits of prairie dog

colonies within the park between 1,000 and 3,000 acres (3.6 - 11% of the park's land base or 12 – 35% of its 8,566 acres of suitable prairie dog habitat). The limits at Wind Cave were established before a black-footed reintroduction was proposed and approved:

> The primary goal of the project is to test and evaluate the viability of ferret populations in a small prairie dog complex (i.e., approximately 2,500 acres). The information obtained from this project will have significant implications to the ferret recovery program. The five-year goal of the proposed reintroduction is to establish a self-sustaining population of black-footed ferrets in the park. Specifically, the population would consist of at least 30 breeding females after five years. In the long-term (*i.e.*, continuing five years and longer after release), the goal would be to have a ferret population with size and distribution in a proportional relationship to the extent of prairie dog complexes in the park.

Again, it is unknown at this time if a complex of 1,000 – 3,000 acres will be able to support a self sustaining population of black-footed ferrets, therefore the Park will be testing the viability of a site <5,000 acres (National Park Service 2006). Black-footed ferrets were reintroduced into Wind Cave in 2007 when the prairie dog colony acreage was 2,800 acres. A similar reintroduction has recently occurred at The Nature Conservancy's 16,800-acre Smokey Valley ranch in Kansas where there are about 2,600 acres of prairie dog colonies.

In light of the above, an understanding of prairie dog colony acreages, including the origin of minimum and maximum acre values, and black-footed ferret habitat requirements is therefore important. It is important to bring into this report everything that is relevant to the persistence of black-footed ferret habitat, prairie dog colonies.

The origin of a minimum of 1,000 acres of prairie dog colonies per GA is the 2001 Forest Plan and the Multi-State Conservation Plan for the Black-tailed Prairie Dog (Luce 1999, 2002). The 2001 Forest Plan does not establish minimum and maximum acreages of prairie dog colonies but states that for two GAs that were very low in prairie dog colony acreage the Forest Service desired to establish at least one 1,000-acre complex right away.

The Forest Plan and Mutli-State Plan rely upon several reports and papers, including Knowles (2000) who discusses five levels of prairie dog population viability, including the 1,000-acre level (Table 7). These levels address random demographic events, loss of genetic diversity, extinction due to normal environmental variables, catastrophic events such as plague, and associated species viability. Table 7 displays a summary of Knowles' (2000) probable minimum population levels required to reduce the likelihood of extinction from these factors. Knowles (2000) examined the history of prairie dog colonies on the 46,000-acre South Unit of Theodore Roosevelt National Park, North Dakota, "the best long-term data on prairie dog populations in an area not known to have experienced a plague epizootic." During 1947-1997, prairie dog colonies occupied from 184-782 acres (0.4-1.7%) of the South Unit and 19 prairie dog generations occurred. During the 51-year monitoring period, 27 prairie dog colonies were observed and 11 went extinct for at least one year. Twenty-one colonies were active in 1997.

Knowles viewed 51 years (1947-1997) as an adequate time for genetic and demographic problems to emerge and for environmental variables to affect the prairie dog population. Knowles concluded that in the absence of plague, a "50,000-acre block of land with 1-2% prairie dog occupancy distributed among approximately 20 population centers (500 to 1,000 acres, or an estimated 5,000 to 10,000 individual prairie dogs)" would be suitable for long-term prairie dog

population viability. A metapopulation such as the South Unit population can persist as long as rate of recolonization exceeds rate of extinction, even though no local population may survive continuously over time (McCullough 1996). Ability of prairie dogs to disperse among colonies is critical because recolonization after local extinction is essential for regional persistence of metapopulations (Fahrig and Merriam 1994, Hanski 1999, Hanski and Simberloff 1997, Harrison and Taylor 1997, Roach et al. 2001).

In areas with plague, Knowles (2000) reached a different conclusion on the extent of prairie dog colonies, recommending that at least 10,000 acres of prairie dog colonies be maintained for long-term population viability, a value consistent with later work (Proctor et al 2006, Miller and Reading 2006). Plague has the potential to influence prairie dog populations more than any other single factor (Knowles (2000):

> Plague is a serious catastrophic event and has the capability to reduce a large viable prairie dog colony complex to the point where genetic viability and even random demographic events become important factors. A plague epizootic event can depopulate large prairie dog complexes in a matter of a few years. Typically, when a plague epizootic occurs in a prairie dog colony, at best only a few individuals survive the event and in some cases none survive. For example, on the Northern Cheyenne Indian Reservation in south-central Montana, a plague epizootic reduced an 11,000 acre prairie dog colony complex to about 650 acres in approximately three years…This colony complex was situated within a corridor of approximately 75,000 acres of prairie and breaks habitats along the Tongue River….Prairie dog numbers dropped below the long-term viability level (10,000 individuals) but did not reach a point that genetic or demographic viability would be an issue. Subsequently, prairie dog numbers have increased well above the point that long-term viability would be a concern. Plague, however, will probably always be a factor with this complex and only over the long-term will it be known if prairie dogs will be able to maintain a viable population.
>
> Prairie dog population viability with plague is a completely different situation than in areas without plague….Prairie dogs have no immunity to plague and their dense colonial life style makes them highly vulnerable to epizootics. Population reductions of greater than 99% have been reported in individual prairie dog colonies and prairie dog complex acreage reductions of 57 to 96% have been documented in Montana….Plague has the potential to decimate prairie dog complexes and at present there is no cost effective method of controlling plague epizootics.
>
> Data collected in Montana would suggest the prairie dog complexes of 10,000 acres or larger can survive a plague epizootic…In Montana, the population consequences of plague have been monitored at two major prairie dog complexes that originally exceeded 10,000 acres….The Phillips and Blaine Counties prairie dog complex in north-central Montana was and still is Montana's largest prairie dog complex. This complex reached its peak acreage around 1990 when mapping data indicated approximately 51,000 acres of prairie dogs and 450 colonies. Plague was first suspected in 1992 and occupied prairie dog acreage began a downward trend. It should be noted that in the 20 year period where prairie dogs increased from 5,000 acres in 1972 to 51,000 acres in 1990, there was no official prairie dog control program.

This above prairie dog colony acreage in Phillips and Blaine counties was a similar prairie dog acreage suggested by Gilpin (1999, 2001) as a minimum for a prairie dog preserve. However, this prairie dog population existed on a landscape 12 times larger than proposed by Gilpin (1999). Gilpin (1999, 2001) estimated that long-term survival of prairie dogs will require at least 20 sanctuaries, each with at least 257,000 acres of suitable habitat, of which 10-50% is inhabited by prairie dogs. Phillips County exclusive of the Charles M. Russell National Wildlife refuge has a prairie land base of about 2.2 million acres and over 21,000 acres of prairie dog colonies.

Large areas of prairie dog colonies are the theme of many prairie dog publications including the book, *Conservation of the Black-tailed Prairie Dog* (Hoogland 2006), with federal lands playing a significant role. Miller et al. (2006) proposed a "more effective conservation of prairie dogs that includes the adoption of the "precautionary principle" (Shipworth and Kenley 1996, Johnston et al 1999, Foster et al. 2000) in the design of prairie dog sanctuaries, that is, more and larger sanctuaries than might otherwise seem necessary. The principle urges caution and this is especially relevant with the presence of expanding plague. Cully et al. (2006), authorities on plague, indicated that because of so many unanswered questions regarding plague "the best conservation strategy versus plague for now is to maintain numerous colonies of prairie dogs distributed throughout their geographic range…"

The distinction that Knowles (2000) makes between 1,000 and ≥10,000 acres is important. Prairie dog colony acreage goals are dependent upon the presence of plague. A management objective for prairie dog viability in an area without plague requires significantly less acreage of prairie dog colonies than an area where plague is present. Plague was not known to occur in the Nebraska National Forest planning area at the time of the 2001 Forest Plan. However, plague has been reported in Fall River Southwest and Fall River Southeast GAs, and on Pine Ridge Indian Reservation which adjoins Wall Southwest, Fall River Northeast, and Fall River Southeast GAs. Elsewhere in South Dakota, plague is present in prairie dog colonies on Cheyenne River Indian Reservation. By June 16, 2008 plague had affected over 8,000 acres of prairie dog colonies in Conata Basin MA 3.63 and the epizootic continues. Although plague has not been recorded in each NNF GA, plague is now present in South Dakota and could appear on any prairie dog colony. A manifestation of this concern has been the application of delta dust to kill fleas in prairie dog colonies in Conata Basin MA 3.63 since the outbreak of plague on adjacent Pine Ridge Indian Reservation in 2005 and its continued application today with the arrival of plague into Conata Basin MA 3.63.

The extent, size, and distribution of prairie dog colonies may be relevant in prairie dog management decisions. Today's prairie dog colonies are smaller, rarer, and more isolated than they were before the arrival of plague in the 1940s (Cully et al. 2006, Manes 2006, Proctor et al. 2006). These characteristics probably render today's prairie dogs less susceptible to plague (Cully and Williams 2001). Today's population structure is not an evolved response to combat plague but is the consequence of poisoning, loss of habitat, and plague itself. A strategy for prairie dog population persistence may be widely scattered colonies, a pattern typically observed on most public and private land where prairie dog colonies occur.

The Multi-State Plan for the Black-tailed Prairie attempts to plan for prairie dog conservation across the entire Great Plains. The Plan does not suggest viable prairie dog colony acreages in areas with and without plague. The Plan states:

> A reserve design model with which to predict the occupied acreage and distribution necessary for long-term viability of the species is not currently available for the black-tailed prairie dog. This is due at least partially to the lack of predictability of plague events and impacts west of roughly the 103rd Meridian. Therefore absolute values for the acreage and distribution necessary to maintain the species for the long-term are also not available. In the absence of precise information, the Conservation Team has chosen to use an adaptive management strategy based on the relative importance of different habitats to black-tailed prairie dogs. The Service's Candidate Conservation Agreement with Assurances (CCAA) policy supports such an adaptive management approach regarding species with population characteristics like the black-tailed prairie dog. Several adaptive management approaches were proposed

> and evaluated as a means to conserve black-tailed prairie dogs as an 11-state population. The Bailey Eco-region habitat model was determined to be a viable approach for establishing a baseline occupied acreage target for each state, an equitable distribution of target acreages between the eleven states based on the relative value of eco-regions from both a biological and a socio-political standpoint, and a reasonable 11-state occupied acreage objective for the next ten years.

The Multi-State Conservation Plan lists Categories for Conservation Focus Areas:

A. An area of public land containing suitable habitat, preferably with an existing complex of greater than 1,000 occupied black-tailed prairie dog acres in one or more colonies,
B. An area of mixed public and private or tribal land containing suitable habitat, preferably with an existing complex of greater than 1,000 occupied black-tailed prairie dog acres in one or more colonies,
C. An area of tribal lands or a combination of tribal and private lands within or adjacent to the exterior boundaries of Tribal reservations containing suitable habitat, preferably with an existing complex of greater than 1,000 occupied black-tailed prairie dog acres in one or more colonies,
D. An area on private lands owned or managed by a private conservation organization (The Nature Conservancy, Turner Endangered Species Fund, or others) containing suitable habitat, preferably with an existing complex of greater than 1,000 occupied black-tailed prairie dog acres in one or more colonies,
E. An area on other private lands containing suitable habitat, preferably with an existing complex of greater than 1,000 occupied black-tailed prairie dog acres in one or more colonies

However, the Plan "believes that scientific justification exists for using 5,000 acres as a minimum complex size for black-tailed prairie dogs and associated species." For just prairie dogs, the Multi-State Conservation Plan Dog (Luce 2002) calls for Conservation Focus Areas that are greater than 1,000 acres of prairie dog habitat, encompassing either an existing complex of occupied prairie dog colonies or an area where a complex of colonies can be created to sustain a viable population of prairie dogs for long-term management. A complex is defined as:

> A group of prairie dog colonies distributed such that individual prairie dogs can physically disperse from one colony to another. For the purposes of this document, this is defined as 7 km (4.3 mi) which is the longest nightly movement recorded for the black-footed ferret, an obligate predator on prairie dogs. Inter-colony movements of black-tailed prairie dogs are typically confined to approximately 8 km (5 mi).
>
> Summary of justification for definition of a complex from the scientific literature: Black-tailed prairie dog movement between colonies is most often confined to about 8 km (5 mi) (Smith 1967). Ten km (6 mi) movement has been documented but is considered rare (Knowles 1985). Garrett and Franklin (1988) documented movement of up to 5.2 km (3 mi). The longest nightly moves by black-footed ferrets at Meeteetse, Wyoming was 7 km (4.3 mi) (Biggins and Fagerstone 1984, Richardson et al. 1987, Biggins et al. 1993).

Hooglnad (2006) defines a complex as a group of two or more colonies in which each colony is less than 4 miles from another colony. The current Nebraska Forest Plan defines a prairie dog colony complex as "a group of at least 10 prairie dog colonies with nearest-neighbor inter-colony distances not exceeding 6 miles with a total colony complex acreage of at least 1,000 acres." The ten colonies was taken from a general discussion on meta-populations by Hanski (1997) who

suggested that for species in general an adequate successful network of small habitat fragments should have a minimum of 10-15 well-connected fragments. Hanski indicated that even this number may be insufficient if regional stochasticity is strong and local dynamics are strongly correlated. The six-mile maximum for inter-colony distance is taken from Knowles (1985) who published the farthest known dispersal distance for the black-tailed prairie dog. Because the probability of survival declines with dispersal distance, an inter-colony distance value should be less than the maximum recorded dispersal distance.

In their discussion of the Multi-State Conservation Plan, Luce et al. (2006) remind readers to review Proctor et al. (2006) and Miller and Reading (2006) for further discussion of prairie dog colony acreages and associated species, including the black-footed ferret. Proctor et al. (2006 recommend close to 10,000 acres while Miller et al. (2006) recommend at least 7,400 acres. Luce (2006) searched for sites throughout the Plains that contained at least 4,500 acres of prairie dog colonies to support the minimum adult population of 30 black-footed ferrets identified in the recovery plan (USFWS 1988).

Table A3-1. The acres of active prairie dog colonies needed to ensure population viability of prairie dogs and associated species (Knowles 2000).

VIABILITY		NECESSARY ACRES OF PRAIRIE DOG COLONIES
Prairie Dog: Short-term viability		10
Prairie Dog: Genetic viability		100
Prairie Dog: Long-term viability – no plague		1,000
Prairie Dog: Long-term viability – plague		10,000
Prairie Dog Associated Species:	Burrowing Owl	1,000-4,000
	Mountain Plover	3,000-9,000
	Ferruginous Hawk	10,000-15,000
	Black-footed Ferret	10,000-15,000