COLONY ACREAGE AND DISTRIBUTION OF THE BLACK-TAILED PRAIRIE DOG IN SOUTH DAKOTA, 2008

August 2009

Silka L. F. Kempema, Chris Marsh, and Kory Marsh

South Dakota Department of Game, Fish and Parks
Wildlife Division Report 2009-02

Table of Contents

List of Tables

List of Figures

Appendix

Recommended Citation

Kempema, S. L. F., C. Marsh, and K. Marsh. 2009. Colony acreage and distribution of the black-tailed prairie dog in South Dakota, 2008. South Dakota Department of Game, Fish and Parks Wildlife Division Report Number 2009-02, Pierre, South Dakota. 30 pages.

Executive Summary

In 2008, we documented 630,849 acres of black-tailed prairie dog colonies in thirty counties in South Dakota by visually interpreting aerial photographs with a Geographic Information System (GIS). Colony acreage accounted for 2.1% of the 29,542,298 acre study area. This was an increase of 5,439 colony acres (1%) from the 625,410 (SE = 6,009) colony acres estimated in 2006. Note that the study area examined in 2006 differed slightly from those in 2008. Colony acreage in 2008 was divided by landownership as follows: 339,114 acres on non-tribal lands and 291,735 acres on tribal lands. In 2006, we estimated 303,237 (SE = 6,009) colony acres on non-tribal lands and 322,173 acres on tribal lands. Black-tailed prairie dog colony acreage goals set forth in the state management plan were achieved in 2008 and require no change in current management action.

Introduction

In response to a petition to list the black-tailed prairie dog (*Cynomys ludovicianus*) in 1998, several states began a cooperative process to retain management of this species. *The Black-tailed Prairie Dog Conservation Assessment and Strategy* (Van Pelt 1999) and *A Multi-state Conservation Plan for the Black-tailed Prairie Dog*, Cynomys ludovicianus, *in the United States* (Luce 2003) were produced. Van Pelt (1999) identified the need for multi-state management of the black-tailed prairie dog and Luce (2003) proposed long-term conservation actions for a multi-state management approach. The goal of both the conservation assessment and strategy and the multi-state conservation plan is to assure long-term conservation of the species, precluding the need for Endangered Species Act protection.

Two of the proposed conservation actions include the identification of specific colony acreage objectives at both the national and state levels and implementation of state-level management plans. Acreage goals were based on maintaining 1% and 0.1% of suitable habitat within core and secondary management areas, respectively. These management areas are located within the historic range of the species as defined by Bailey's ecoregions (Bailey et al. 1994). Three of the six specific target acreage objectives outlined include maintaining:

1) a complex >5,000 acres in each state,
2) at least 10% of the total occupied acreage in colonies or complexes > 1,000 acres
3) a species distribution within 75% or more of the counties in the historic range or historic geographic distribution.

The South Dakota Departments of Game, Fish and Parks (SDGFP) and Agriculture (SDDA) worked cooperatively to develop the South Dakota Black-tailed Prairie Dog Conservation and Management Plan (Cooper and Gabriel 2005). The plan was finalized and approved by the South Dakota legislature in 2005. One of the objectives in the state plan is to identify a state-specific acreage goal. The statewide black-tailed prairie dog colony acreage goal of 199,472 acres was set using those standards outlined by Luce (2003). To accommodate tribal management of black-tailed prairie dogs in South Dakota, the total state-wide colony acreage goal is

divided by landownership with the goal of 166,958 acres on non-tribal land (state, federal, and private) lands. Apportionment of the total state-wide acreage goal was done to recognize separate management of black-tailed prairie dogs acreage on tribal lands.

The strategy used to ensure the state meets minimum acreage levels is the implementation of administrative and management actions in response to colony acreage triggers (Cooper and Gabriel 2005). Actions are undertaken when the following non-tribal black-tailed prairie dog colony acreage triggers are met: 1) >160,000 acres, 2) between 125,000 and 160,000 acres, and 3) <125,000 acres. Sales of prairie dog toxicant will be limited if the state-wide colony acreage trigger of < 145,000 acres is met. Refer to Cooper and Gabriel (2005) for details on specific administrative and management actions.

As per Cooper and Gabriel (2005), SDGFP has committed to monitoring colony acreage and distribution of black-tailed prairie dogs to determine what actions are needed. An additional objective within the state plan is to identify the most effective monitoring tool, implement this tool at three-year intervals, and evaluate the effectiveness of this tool by comparison with existing data.

Methods

SDGFP used aerial photograph interpretation during the previous two monitoring efforts in 2003 and 2006 (Dowd Stukel et al. 2004, Kempema 2007). In July of 2008, SDGFP staff was made aware that the Farm Service Agency's (FSA) National Agricultural Imagery Program (NAIP) would be taking aerial photographs of South Dakota on a three year schedule beginning in the summer of 2008. At that time, SDGFP was scheduled to monitor black-tailed prairie dog colony acreage and distribution in 2009. For the third monitoring effort, the SDGFP planned to use the NAIP photographs because of their availability, resolution, and coverage. Thus, the SDGFP began monitoring efforts a year earlier to mesh the black-tailed prairie dog monitoring schedule with the NAIP photography schedule for the state. The SDGFP will continue to monitor black-tailed prairie dog colony acreage and distribution using a three year schedule; the next monitoring effort will be done in 2011.

Census

During 2008-2009, we determined the acreage and distribution of black-tailed prairie dog colonies in all counties in South Dakota west of the Missouri River and those adjacent to and east of this river (study area; Figure 1). Counties or portions of counties within the Black Hills ecoregion were excluded. Our intent was to conduct a complete census of the study area. Using ArcGIS 9.2, one observer visually interpreted one-meter resolution aerial photographs obtained from the FSA's NAIP. Photographs were taken during late June through July of 2008. A two-mile by two-mile grid was superimposed over the photographs to provide a systematic approach to image analysis. Image analysis consisted of the observer visually inspecting each cell in the grid and digitizing the portions deemed to be prairie dog colonies (Figures 2 and 3). Several characteristics of black-tailed prairie dog colonies are detectable

on aerial photographs. Black-tailed prairie dog herbivory causes changes in vegetation composition and height between a colony and surrounding grassland (Dalsted et al. 1981). Mounds of excavated bare soil are created at black-tailed prairie dog burrow entrances. These mounds are typically one to three meters in diameter and are often void of vegetation (Hoogland 2006). These characteristics make colonies conspicuous on aerial photographs. Well-traveled roads running through a colony boundary were not included as part of the colony. Thus, a colony intersected by a road would be interpreted and digitized as two polygons or colonies. Typical signs indicating activity status of a colony (observation of prairie dogs, fresh diggings, and fresh feces) could not be interpreted from the aerial photographs.

Ground-truthing

Ground-truthing was conducted to determine the accuracy of detecting black-tailed prairie dog colonies (presence or absence) and associated activity status (active or inactive) using aerial photograph interpretation. Ground-truthing consisted of one driver/spotter and one spotter/scribe with a tablet PC running ArcGIS 9.2. The same observer that visually interpreted the photographs was always present during ground-truthing. Routes were chosen based upon ability to view colonies, ground conditions, and those that provided a representative coverage of the study area.

Presence or absence and activity status were determined by visual inspection and recorded on the tablet using the “tablet tools” feature of ArcGIS. If any portion of the colony was active, the entire colony was classified as active. A 1-mile buffer (based on estimated in-field line-of-sight) was applied to all roads traveled. Accuracy of interpretation was determined by comparing the colony acreage digitized from photo interpretation with that observed in the field within the 1-mile buffer. If an interpreted colony was later determined by ground-truthing to be inactive or something other than a black-tailed prairie dog colony, it was removed from the final GIS layer (misinterpretation). Colonies not detected during photograph interpretation but spotted from the road were marked as well (omission). These colonies were then digitized and added to the final GIS layer.

Ancillary Data

GIS layers from previous monitoring efforts conducted by SDGFP were referenced to aid the interpretation process. In addition, contact was made with individuals from several other wildlife agencies and organizations that were known to have previously collected spatial information on the size and location of black-tailed prairie dog colonies on property they manage. Agencies and organizations were asked to provide the most recent spatial information and associated metadata on black-tailed prairie dog colonies to assist SDGFP in this monitoring effort. These layers were compared to the final layer produced by SDGFP to determine the presence or absence of a colony and the activity status of a colony (if a particular dataset contained this information).

Land Ownership

Location and ownership (county, tribal, state, federal, and private) of colonies were determined by using the “intersect tool” in ArcGIS on layers containing county and state and federal land boundaries. A GIS layer of tribal trust land parcels was provided by the Bureau of Indian Affairs (BIA) on April 14, 2009 to assist in calculating the colony acreage and distribution on tribal trust lands. Overlaying tribal trust data provided by the BIA with reservation boundaries provided specific tribal trust ownership. Statistics were calculated using the “statistics” function found in the layer’s attribute table.

Results

Study area

Aerial photograph interpretation resulted in the digitization of 10,949 polygons representing black-tailed prairie dog colonies (Figure 4). These polygons ranged in size from less than one to 6,425 acres and averaged 57.7 acres (SD = 171.9) and were found in thirty counties. The census of the study area resulted in 630,849 acres of black-tailed prairie dog colonies accounting for approximately 2% of the 29,542,298 acre study area. Shannon, Dewey, Pennington, and Mellette counties accounted for just over half (51%) of the total colony acreage in the study area (Table 1).

The total black-tailed prairie dog colony acreage was divided by landownership as follows: 339,114 acres on non-tribal lands and 291,735 acres on tribal lands (Table 1). Pennington and Shannon counties have the highest black-tailed prairie dog colony acreage on non-tribal (63,489 acres) and tribal lands (103,665 acres), respectively (Table 1).

Non-tribal

Black-tailed prairie dog colonies on non-tribal lands (339,114 acres; private, state, and federal) accounted for 54% of the total colony acreage in 2008 (Figure 5). Colony acreage on non-tribal lands was broken down further: 75,665 acres on public lands and 263,449 acres on private lands (Table 2), accounting for 12% and 42% of the total colony acreage, respectively (Figure 5). Over half (52%) of the black-tailed prairie dog colony acres found on public land were in Pennington County (Table 2). Two state departments and four federal agencies had lands with black-tailed prairie dog colonies that accounted for 8,293 and 75,665 colony acres, respectively (Table 3). Dewey County had the highest colony acreage on private lands (Table 2).

Tribal

Colony acreage on tribal lands (291,735 acres) accounted for 46% of the total colony acreage in 2008 (Figure 5). Pine Ridge Reservation has the highest percentage of colony acres (19%) in the study area (Figure 5). Shannon and Dewey counties contribute over half (54%) of the colony acreage found on tribal lands.

Ground-truthing

We conducted ground-truthing along 2,342 miles on five separate occasions. This resulted in eight days of ground-truthing between October 9, 2008 and March 19, 2009 (Tables 4-5 and Figure 6). This resulted in 25% (154,258 acres) of the total colony acreage being ground-truthed. We misinterpreted 7% (11,326 acres) of the colony acres ground-truthed. This included the colony acres in the Conata Basin impacted by plague (10,832; Griebel 2008). When removing the acreage impacted by plague, 494 of the colony acres ground-truthed (0.3%) were misinterpreted. Ground-truthing revealed that 457 colony acres (0.3%) were omitted or missed during aerial photograph interpretation.

Discussion

Multi-state management plan

South Dakota has two colonies (digitized polygons) greater than 5,000 acres in Pennington County (Table 6). Forty colonies located in eight counties are greater than 1,000 acres (Table 6). The total acreage of black-tailed prairie dog colonies greater than 1,000 acres accounts for 14% of the 630,849 colony acres as estimated in this report.

We used both the core and secondary management areas as defined by the Bailey's ecoregion model to define the historical range of the black-tailed prairie dog (Luce 2003, Cooper and Gabriel 2005). There are 38 whole or partial counties in South Dakota located within the historical range of this species. Twenty-nine of these counties were included in the study area. At least one black-tailed prairie dog colony is present in 30 of the 38 (79%) counties within the historical range of this species.

State management plan

The state-wide (199,472) and non-tribal (166,958) colony acreage goals set forth in Cooper and Gabriel (2005) were achieved in 2008. Tribal colony acreage in 2008 exceeds that apportionment of the state-wide acreage goal set to accommodate tribal management of black-tailed prairie dogs. Thus, there is no change in current management action (Cooper and Gabriel 2005).

Trends in colony acreage and distribution

This report summarizes the third of three monitoring efforts conducted by the SDGFP during the past eight years. Study area and methods were similar among these efforts, excluding minor discrepancies, in particular the use of a sample estimate for counties stratified as low density in 2006. Please refer to Dowd Stukel et al. (2004), Kempema (2007) and the methods section of this report for further details. Study area extent was similar and aerial photograph interpretation was used to some extent in all three of these monitoring efforts to determine colony acreage and distribution.

Total black-tailed prairie dog colony acreage increased 52% from the census conducted in 2002-2003 to 2006 (Figure 7). This increase corresponded with a severe ongoing drought during this period. Total estimated colony acreages

increased approximately 5,400 acres from 2006 to 2008 (Figure 7). The study area in this report encompassed eight additional counties than the 2006 study area. Black-tailed prairie dog colony acreage in these counties alone (8,870 acres) could account for the increase in total colony acres in South Dakota.

During 2002-2003 and 2006, tribal colony acreages accounted for 53% and 52% of the total colony acres, respectively. Similarly, in 2008, non-tribal lands accounted for just over half of all black-tailed prairie dog colony acres (54%). Refer to Table 7 for a more detailed comparison of county colony acreage over time. Again, the study areas examined and methods used in all three years were not exactly the same; refer to Dowd Stukel et al. (2004) and Kempema (2007) for further details.

In 2006, counties or portions of counties were classified as high or low density based on existing knowledge of black-tailed prairie dog colony distribution (Figure 8; Kempema 2007). A complete census of the high-density counties was conducted during all three monitoring efforts. A comparison of total black-tailed prairie dog colony acreages among years for this area most accurately illustrates the temporal change in colony acreage in South Dakota based on available data. Colony acreage in the area designated high-density in 2006 increased 55% from 2003 (350,719 acres) to 2006 (544,425 acres; Figure 10). Colony acreage decreased slightly (3%) in this area from 2006 to 2008 (530, 221 acres; Figure 9).

Historical precipitation values from the U.S. Historical Climatology Network website (http://cdiac.ornl.gov/epubs/ndp/ushcn/usa_monthly.html) were obtained from an automated weather station close to the majority of black-tailed prairie dog colony acres within the study area (Station # 391972, COTTONWOOD 2 E, SD). The major (55%) increase in colony acreage was detected during an extended period of below-normal average annual precipitation (Figure 9).

In 2008, annual precipitation increased and a plague outbreak occurred in the Conata Basin in southwestern South Dakota, both of which may have tempered any expansion of colonies in the high density areas. The recent increase in precipitation also enhanced the contrast between clipped vegetation on colonies and the surrounding vegetation which, along with higher resolution, aided in photograph interpretation.

Maximum colony (polygon) size decreased over time in the high density area from 29,836 acres in 2003 to 18,765 acres in 2006 to 6,425 acres in 2008. Maximum colony size in a survey of documented black-tailed prairie dog colonies in a study of eastern Colorado (EDAW 2000) was 4,129 acres. Johnson et al (2003) reported the largest colony covered 2,360 acres in New Mexico. The largest colony in Oklahoma was 616 acres (Shackford et al. 1990). Although data illustrate a decrease in colony size, South Dakota may still have some of the larger colonies found within the range of this species.

Average polygon size in the high density area remained similar among years (2003 = 60 acres, 2006 = 71 acres, 2008 = 61 acres). During a survey conducted in 1997-1998 of the Great Plains (including South Dakota), most black-tailed prairie dog colonies were less than 99 acres (40 hectares) and isolated (Sidle et al. 2001). In 1996-97, average colony size in New Mexico was 96 acres (Johnson et al. 2003). EDAW (2000) reported an average active colony size of 75 acres in Colorado using information from 1995-2000. Oklahoma colonies averaged 46 acres in size (Shackford et al.1990). Despite potentially having some of the larger colonies within the species range, average colony size in South Dakota is smaller.

Distribution of colonies in the study area was clumped around counties located within tribal lands and was very similar in location to the counties that were stratified as high density in 2006 (Figure 8, Kempema 2007). The extreme northwest and the part of the state in and around Haakon County hosted few colonies. Counties east of the river had comparatively fewer colonies than those to the west. Sidle et al. (2001) reported most of the black-tailed prairie dog colonies in the Great Plains occurred on or near public and tribal lands and those remaining colonies were often isolated. Similar to this report, Sidle et al. (2001) also found that northwestern South Dakota held few colonies. Colony distribution appears to remain unchanged.

Limitations to photograph interpretation

Plague

Aerial photograph interpretation is especially limited on colonies that experience an abrupt change in activity status (Biggins et al. 2006). Plague and poisoning are two factors that can alter the activity status of a colony.

Plague is a flea-born disease assumed to be introduced to the North American continent in the early 1900's. Fatality rates of sylvatic plague, as it is known when found in wildlife species, are often high and can be 100% in prairie dog species (Barnes 1993). This can cause an abrupt change in colony activity status. In 2004, plague was confirmed in a black-tailed prairie dog collected from Custer County in southwestern South Dakota. In the years to follow, plague moved eastward. Confirmed impacts to black-tailed prairie dog colonies from plague occurred in Shannon, Dewey, and Pennington counties. We attempted to account for undetectable changes in colony activity status due to plague during our photograph interpretation by coordinating with and obtaining information from agencies and tribes that were tracking the localized movement and impact of this disease on black-tailed prairie dogs.

The Oglala Sioux Parks and Recreation Authority (OSPRA) has monitored plague movement on the Pine Ridge Indian Reservation since the 2005 plague outbreak in Shannon County. Spatial information indicating colony activity status was provided by OSPRA to assist in our photograph interpretation. In addition, on November 24, 2008, SDGFP and OSPRA staff met to visit areas previously or currently being impacted by plague.

In January of 2008, the test results of fleas collected in November of 2007 from a colony in Dewey County revealed plague was present on Cheyenne River Indian Reservation. In response, the Bureau of Indian Affairs informed and coordinated with other tribes, and state and federal agencies to help monitor movement of the disease and to detect additional impacts. This was the only known colony to be impacted by plague in the area. By the end of 2008, black-tailed prairie dogs were observed recolonizing the area.

Plague was detected in the Conata Basin of Pennington County on May 13, 2008. As of November 4, 2008, 10,823 black-tailed prairie dog colony acres were known to be impacted by plague in the Conata Basin area of Buffalo Gap National Grassland (Griebel 2008). Intensive monitoring of plague movement and disease prevention measures are being taken in the Conata Basin. Dead prairie dogs were collected in May and June of 2009 from the Conata Basin and confirmed to be plague mortalities, thus indicating the disease is continuing to impact prairie dog acreage in that area. Spatial information on the location and acreage impacted by plague was provided by the U.S. Forest Service to assist in photograph interpretation.

The Conata Basin was photographed by the FSA on July 4, 2008 during a known outbreak of sylvatic plague in this area (Griebel 2008). Data provided by the U.S. Forest Service shows that the shaded areas in Figure 11 were completely plagued-out as of November 4, 2008 (Griebel 2008). More specifically, eighty percent of the known acreage impacted by plague in this area occurred by mid-June. Based on interpretation of the FSA photograph, colonies in the area were active. Detailed information on the movement of plague (dates and acreages) in the Conata Basin (Griebel 2008) proved to be very useful in this monitoring effort. Areas interpreted to be active, but known to be impacted by plague (10,832 acres) were not included in the total acres of black-tailed prairie dog colonies in this report.

Poisoning

Poisoning is one of several ways to address any damage caused by black-tailed prairie dogs. Grain bait treated with zinc phosphide is one of the most commonly used and available poisons in South Dakota. One prairie dog colony acre requires 1/3 to one pound of zinc phosphide poison, depending on prairie dog density (Andelt 2006). Success rates of zinc phosphide vary depending on application and colony poisoning history (Hygnstrom and Virchow 1994, Tietjen 1976). Thus, variability in poisoning effectiveness may irregularly affect the colony signature interpreted from an aerial photograph. Uresk and Schenbeck (1987) determined, however, that the change in colony size after poisoning could be determined via aerial photographs due to vegetative growth on burrow-entrance mounds. This vegetative growth, however, may take years (Uresk and Schenbeck (1987), resulting in an overestimation of active colonies by this method.

An attempt was made to collect information on the total acreage of black-tailed prairie dog colonies poisoned from July 1, 2008 through February 28, 2009. Information on colonies poisoned as a result of an unwanted encroachment from

public land onto private land was available from the SDGFP Wildlife Damage Management Program (WDMP). Less than 30,000 colony acres were poisoned in each of the last two years (Appendix A). Eighty to ninety percent of the acres poisoned by the WDMP were on private lands. It is important to note that a percentage of the poisoned acres are often retreated in subsequent years (A. Smith, unpublished report).

We attempted to obtain additional information on private lands control by contacting county weed and pest supervisors. This contact information was provided by SDDA. Four of the 25 people contacted via e-mail responded. At least 4,310 estimated acres were poisoned on private lands in Charles Mix, Corson, Campbell, Walworth, and Dewey counties by programs other than the SDGFP WDMP. This was the first year in which SDGFP tried to further address the additional amount of acres poisoned on private lands.

A total of 105,750 lbs of zinc phosphide bait were sold from the SD Bait Station between July 1, 2008 through April 15, 2009. Of this volume, 73,100 lbs (69%) were sold to purchasers within the state. Although this information provides an indication of the demand for this toxicant, interpretation must be done with caution. These data do not reflect the actual amount or location of application or the effectiveness of these applications.

Currently, information on colony acres poisoned on private lands in South Dakota is limited in scope, accuracy, and lacks spatial information.

This or any photography has an important limitation; it is only a moment in time. Prairie dog colonies are dynamic systems that undergo natural changes in animal density, size, and distribution. Plague and poisoning only add to these fluctuations. To our knowledge, the best information available on colony acres impacted by plague and poisoned in the study area was collected. It is important to acknowledge that we may not be aware of all the colony acres impacted by plague nor do we know the total colony acres poisoned in South Dakota.

Resolution of photographs used in 2008 (1-meter) was double that of photographs used in 2006 (2-meter). In an evaluation of high-resolution (1-m) satellite imagery, Sidle et al. (2002) were easily able to detect black-tailed prairie dog colonies. This may have allowed for a more precise estimate of black-tailed prairie dog colony acres.

Black-tailed prairie dog density

This report does not provide information on either the number or density of black-tailed prairie dogs or their burrow-entrances. That was not the intent of this survey. Density of black-tailed prairie dogs in a particular area depends on locality and varies annually, seasonally, and with management (Biggins et al. 2006).

Recommendations

Monitoring should continue to provide the basis for conservation and management of the black-tailed prairie dog in South Dakota. The method used should be accurate, logistically feasible and cost effective (Sidle et al. 2002). Aerial photograph interpretation has been recommended as a suitable method to find and map colonies of black-tailed prairie dogs (Biggins et al. 2006). Limitations previously identified such as scale and coverage (Sidle 1999) no longer exist. The scale of the photography (1:3,780) available for South Dakota is much larger than that recommended by Dalsted et al. (1981). We feel that the 1-m resolution provides enough precision to detect a colony, a conclusion also reached by Sidle et al. (2002) regarding similar resolution satellite imagery.

In particular the FSA NAIP photographs were useful for the SDGFP for the following reasons: 1) the resolution was of sufficient detail to detect colonies and continues to improve, 2) photographs are readily available and at no additional cost to the department, and 3) available coverage. In addition, interpretation of NAIP photographs may be a workable option for estimating acreage and distribution across the range of the species.

- We consider aerial photograph interpretation of the NAIP photographs a suitable method to estimate the acreage and distribution of black-tailed prairie dog colonies within the state and would recommend continuing to use this method.

Ground-truthing may be limited by road availability, coverage, and accessibility. Determining a route to maximize the number of colonies visited can be difficult. Ancillary problems may arise from the geography of a region limiting visibility of the colony. Despite these limitations, we found that ground-truthing in concert with interpretation assisted in improving the accuracy of the interpretation by allowing the observer to correct and learn from mistakes. The ability to match features seen from the ground with the photographs is useful in determining whether a given feature is a colony. Less than 1% of colony acres ground-truthed in this study was missed. Similarly, Sidle et al. (2002) detected no additional colony acres during ground-truthing. As part of their proposed sampling scheme, these authors recommended the use of ground-truthing, either by flight or ground-visits to verify colony activity status.

- We recommend continuing to verify activity status and presence/absence of colonies by ground-truthing along roads.
- We also recommend improve field verification by incorporating the use of aircraft in areas that have limited road access.

As illustrated by the photographs of the area impacted by plague in the Conata Basin (Figure 10), sharing spatial data on both the movement and impact of plague and colony acreage collected from the ground is important; interagency cooperation and data sharing were helpful in the completion of this survey.

- We recommend continuing to partner and share spatial data on both the movement and impact of plague and colony acreage collected from the ground.

Much effort has been put towards monitoring the colony acreage and distribution of the black-tailed prairie dog in South Dakota.

- We recommend that staff code time and travel to more accurately measure this effort.

In addition,

- More information on the amount and location of acres poisoned in South Dakota is needed to address the changing colony status of colonies that are poisoned.

Acknowledgements

We'd like to recognize the following for their part in this monitoring effort: Eileen Dowd Stukel, Tom Kirschenmann, Aimee Nickolas, and Art Smith with SDGFP; Diane Mann-Klager with Bureau of Indian Affairs; Mike Claymore with Cheyenne River Sioux Tribe; Shaun Grassel with Lower Brule Sioux Tribe; Barb Muenchau and Greg Schroeder with the National Park Service; Trudy Ecoffey and Rob Goodman with Oglala Sioux Parks and Recreation Authority; Scott Larson with the U.S. Fish and Wildlife Service; Randy Griebel, Robert Hodorff, Ruben Mares, John Sidle, and Dan Svingen with the U.S. Forest Service; and Kristy Bly of World Wildlife Fund, Northern Great Plains Program, formerly with Bad River Ranches and Turner Endangered Species Fund. Funding for this project was provided by the SDGFP.

References Cited

Andelt, W. F. 2006. Methods and economics of managing prairie dogs. Pages 129-138 *in* J. L. Hoogland, editor. Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands. Island Press, Washington, D. C.

Bailey, R. G., P. E. Avers, T. King, and W. H. McNab, editors. 1994. Ecoregions and subecoregions of the United States. U. S. Forest Service, Washington, D. C.

Barnes, A. M. 1993. A review of plague and its relevance to prairie dog population and the black-footed ferret. Pages 28-37 *in* J. Oldemeyer, D. E. Biggins, B. J. Miller, and R. Crete, editors. Management of prairie dog complexes for the reintroduction of the black-footed ferret. U.S. FWS Biological Report 13, Washington, D. C.

Biggins, D. E., J. G. Sidle, D. B. Seery, and A. E. Ernst. 2006. Estimating the abundance of prairie dogs. Pages 94-107 *in* J. L. Hoogland, editor. Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands. Island Press, Washington, D. C.

Cooper, J. and L. Gabriel. 2005. South Dakota black-tailed prairie dog conservation and management plan. South Dakota Department of Game, Fish and Parks and South Dakota Department of Agriculture. Pierre, South Dakota. 68 pages.

Dalsted, K. J., J. S. Sather-Blair, H. K. Worcester, and R. Klukas. 1981. Application of remote sensing to prairie dog management. Journal of Range Management 34:218-223.

Dowd Stukel, E., J. Sidle, and A. Nickolas. 2004. Results of South Dakota black-tailed prairie dog acreage survey, 2002-2003. South Dakota Department of Game, Fish and Parks Wildlife Division Report Number 2004-12, Pierre, South Dakota. 12 pages.

EDAW. 2000. Black-tailed prairie dog study of eastern Colorado. EDAW, Inc., Fort Collins, Colorado. 44 pages. Accessed at http://wildlife.state.co.us/NR/rdonlyres/CA21609D-7E7C-4A33-A52C-F080393174BD/0/Entire_Report.pdf.

Griebel, R. L. 2008. Wall Ranger District Conata Basin 2008 Plague Control Report. U. S. Forest Service, Nebraska National Forest, Wall Ranger District, Wall, South Dakota. 11 pages.

Hoogland, J. L. 2006. Social behavior of prairie dogs. pages 7-26 *in* J. L. Hoogland, editor. Conservation of the black-tailed prairie dog: saving North America's Western grasslands. Island Press, Washington, D.C.

Hygnstrom, S. E and D. R. Virchow. 1994. Prairie Dogs. Pages B85-B96 *in* S. E. Hygnstrom, R. M. Timm, and G. E. Larson, e*ditors.* The Handbook: Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska.

Johnson, K., T. Neville, L. Pierce. 2003. Remote sensing survey of black-tailed prairie dog towns in the historical New Mexico range. New Mexico Natural Heritage Program, University of New Mexio NMNHP Publication No.03-GTR-248. 28 pages.

Kempema, S. L. F. 2007. South Dakota black-tailed prairie dog colony acreage and distribution, 2006. South Dakota Department of Game, Fish and Parks Wildlife Division Report Number 2007-07, Pierre, South Dakota. 21 pages.

Luce, R. J. 2003. A Multi-state conservation plan for the black-tailed prairie dog, *Cynomys ludovicianus*, in the United States – an addendum to the black-tailed prairie dog conservation assessment and strategy, November 3, 1999. 79 pages.

Shackford, J.S., J. D. Tyler, and L. L. Choate. 1990. A Survey of the black-tailed prairie dog in Oklahoma, Final Report, Nongame Program, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma. 18 pp.

Sidle, J. G. 1999. PPS Prairie dog patrol: GPS aerial surveys of dog towns. GPS World 10:30-35.

Sidle, J. G., D. H. Johnson, and B. R. Euliss. 2001. Estimated areal extent of colonies of black-tailed prairie dogs in the Northern Great Plains. Journal of Mammalogy 82:928-936.

Sidle, J. G., D. H. Johnson, B. R. Euliss, and M. Tooze. 2002. Monitoring black-tailed prairie dog colonies with high resolution satellite imagery. Wildlife Society Bulletin 30:405-411.

Smith, A. 2009. South Dakota private/public lands prairie dog control, March 2, 2009. South Dakota Department of Game, Fish and Parks, Wildlife Division, Pierre, South Dakota. 7 pages.

Tietjen, H. P. 1976. Zinc phosphide: A control agent for black-tailed prairie dogs. U.S. Department of the Interior. U.S Fish and Wildlife Service Wildlife Leaflet 509. Washington D. C.

Uresk, D. W. and G. L. Schenbeck. 1987. Effect of zinc phosphide rodenticide on prairie dog colony expansion as determined from aerial photography. Prairie Naturalist 19: 57-61.

Van Pelt, W. E. 1999. The black-tailed prairie dog conservation assessment and strategy-final draft. Nongame and Endangered Wildlife Program. Arizona Game and Fish Department, Phoenix, Arizona. 55 pages.

Table 1. Black-tailed prairie dog colony acreage and distribution on non-tribal and tribal lands in South Dakota, 2008.

County		Colony Acres			
Name	**Area[b]**	**Tribal**	**Non-Tribal**	**Total**	**%[c]**
Bennett	762,249	4,029	6,427	10,456	1.7
Brule	541,318	0	1,158	1,158	0.2
Buffalo	311,706	861	2,027	2,888	0.5
Butte	1,431,054	0	5,052	5,052	0.8
Campbell	493,334	0	136	136	0.0
Charles Mix	735,548	40	494	535	0.1
Corson	1,618,709	21,261	19,821	41,081	6.5
Custer	614,364	0	26,518	26,518	4.2
Dewey	1,564,822	53,379	27,275	80,655	12.8
Fall River	1,122,286	0	22,367	22,367	3.5
Gregory	673,666	45	1,670	1,715	0.3
Haakon	1,169,652	0	2,582	2,582	0.4
Hand[a]	920,987	0	3	3	0.0
Harding	1,717,456	0	4,110	4,110	0.7
Hughes	511,857	330	1,953	2,283	0.4
Hyde[a]	554,185	1	1	2	0.0
Jackson	1,197,962	9,819	13,046	22,864	3.6
Jones	621,636	0	5,682	5,682	0.9
Lyman	1,091,761	5,301	5,449	10,749	1.7
Meade	2,163,858	1	27,090	27,091	4.3
Mellette	837,985	30,964	25,297	56,261	8.9
Pennington	1,273,769	0	63,489	63,489	10.1
Perkins	1,851,915	7	18,727	18,735	3.0
Potter	574,606	0	598	598	0.1
Shannon	1,343,507	103,665	15,818	119,483	18.9
Stanley	970,540	617	8,822	9,439	1.5
Sully	684,610	0	1,272	1,272	0.2
Todd	889,890	37,271	12,737	50,009	7.9
Tripp	1,034,429	384	4,429	4,813	0.8
Walworth	475,988	0	0	0	0.0
Ziebach	1,261,819	23,758	15,062	38,820	6.2
Totals	**29,542,298**	**291,735**	**339,114**	**630,849**	**100%**

[a] This county was not included in the study area; black-tailed prairie dog colony acreage resulted from a colony that extended across the Buffalo County line.
[b] County area includes both land and water.
[c] Percent of total black-tailed prairie dog colony acres in study area.

Table 2. Black-tailed prairie dog colony acreage and distribution on non-tribal (state, federal and private) lands in South Dakota, 2008.

	Public				Total
County	State	Federal	Total	Private	Non-tribal
Bennett	192	794	986	5,439	6,425
Brule	37	0	37	1,121	1,158
Buffalo	0	0	0	2,027	2,027
Butte	104	1,054	1,158	3,894	5,052
Campbell	0	0	0	136	136
Charles Mix	10	0	10	485	494
Corson	373	1,028	1,400	18,420	19,821
Custer	687	8,625	9,312	17,206	26,518
Dewey	323	0	323	26,953	27,275
Fall River	489	5,012	489	21,878	22,367
Gregory	0	0	0	1,670	1,670
Haakon	47	0	47	2,535	2,582
Hand[a]	0	0	0	3	3
Harding	1,144	201	1,344	2,766	4,110
Hughes	29	0	29	1,925	1,953
Hyde[a]	0	0	0	1	1
Jackson	48	2,086	2,134	10,912	13,046
Jones	124	281	406	5,276	5,682
Lyman	431	316	747	4,701	5,449
Meade	972	498	1,470	25,620	27,090
Mellette	517	0	517	24,780	25,297
Pennington	845	38,641	39,486	24,004	63,489
Perkins	1,056	2,397	3,452	15,275	18,727
Potter	8	0	8	590	598
Shannon	0	4,517	4,517	11,301	15,818
Stanley	347	1,922	2,269	6,553	8,822
Sully	87	0	87	1,186	1,272
Todd	0	0	0	12,737	12,737
Tripp	24	0	24	4,405	4,429
Ziebach	402	0	402	14,660	15,062
Total	**8,293**	**67,372**	**75,665**	**263,449**	**339,114**

[a] This county was not included in the study area; black-tailed prairie dog colony acreage resulted from a colony that extended across the Buffalo County line.

Table 3. Black-tailed prairie dog colony acreage and distribution on public lands in South Dakota, 2008.

State	Total
School and Public Lands	6,902
Game, Fish and Parks	
Game Production Areas[a]	767
Parks and Recreation Areas[b]	625
total	8,293
Federal	
National Parks	17,204
National Forest and Grasslands	47,320
Fish and Wildlife Service	794
Bureau of Land Management	2,054
total	67,372
Total	75,665

[a] This includes colony acreage lands formerly owned by the Corp of Engineers land along the Missouri River.
[b] This includes colony acreage on Bureau of Reclamation lands managed by the Parks Division of the Department of Game, Fish and Parks.

Table 4. Date and location of ground-truthing aerial photograph interpretation of black-tailed prairie dog colony acres in South Dakota, 2008-2009.

Year	Date	County
2008	October 9	Dewey
	November 24	Shannon
2009	January 20-21	Gregory, Jackson, Mellette, and Tripp
	February 5-6	Bennett, Butte, Corson, Custer, Dewey, Fall River, Harding, Mellette, Perkins, Shannon, and Ziebach
	March 18-19	Haakon, Hughes, Meade, Stanley, Sully, Perkins, and Potter

Table 5. Miles driven to ground-truth aerial photograph interpretation of black-tailed prairie dog colony acres in South Dakota

County	Miles
Bennett	46
Brule	91
Butte	51
Charles Mix	2
Corson	77
Custer	41
Dewey	160
Fall River	36
Gregory	105
Haakon	78
Harding	54
Hughes	99
Jackson	149
Jones	46
Lawrence	21
Lyman	128
Meade	243
Mellette	133
Pennington	97
Perkins	70
Potter	25
Shannon	189
Stanley	85
Sully	86
Todd	36
Tripp	58
Ziebach	136
Total	2,342

Table 6. Location, number, and total county acreage of black-tailed prairie dog colonies (digitized polygons) greater than 1,000 acres in South Dakota, 2008.

County	# Colonies	Colony acres
Corson	1	1,157
Dewey	8	15,378
Lyman	1	1,332
Meade	3	3,544
Mellette	4	6,097
Pennington [a]	6	17,764
Shannon	17	37,993
Todd	2	2,355
Total	**42**	**85,620**

[a] Two colonies are greater than 5,000 acres and are located in the Conata Basin of Pennington County.

Table 7. Temporal comparison of black-tailed prairie dog colony acreage and distribution in South Dakota.

County	2003[a]	2006[b]	2008[c]
Bennett	6,511	10,742	10,456
Brule	1,277	na	1,158
Buffalo	1,983	na	2,888
Butte	2,009	4,400	5,052
Campbell	0	na	136
Charles Mix	245	na	535
Corson	26,213	40,646	41,081
Custer	13,213	18,936	26,518
Dewey	48,342	58,720	80,655
Fall River	9,291	16,855	22,367
Gregory	1,131	1,457	1,715
Haakon	1,483	2,965	2,582
Hand	252	na	3
Harding	2,976	4,235	4,110
Hughes	1,449	na	2,283
Hyde	729	na	2
Jackson	11,586	25,550	22,864
Jones	2,536	2,967	5,682
Lyman	5,781	10,853	10,749
Meade	18,116	23,115	27,091
Mellette	37,960	65,578	56,261
Pennington	36,804	57,909	63,489
Perkins	8,093	12,690	18,735
Potter	162	na	598
Shannon	90,736	144,336	119,483
Stanley	5,813	8,140	9,439
Sully	815	na	1,272
Todd	49,884	76,250	50,009
Tripp	3,360	8,708	4,813
Walworth	538	na	0
Ziebach	22,834	30,357	38,820
Total	**412,122**	**625,410**	**630,849**

a = see Dowd Stukel et al. (2004) for a description of the study area and methods used
b = see Kempema (2007) for a description of the study area and methods used; Not applicable (na) indicates these counties were not included in the study area in 2006
c = see methods section of this report. Note that in 2008 a complete census of Hand and Hyde was not conducted.

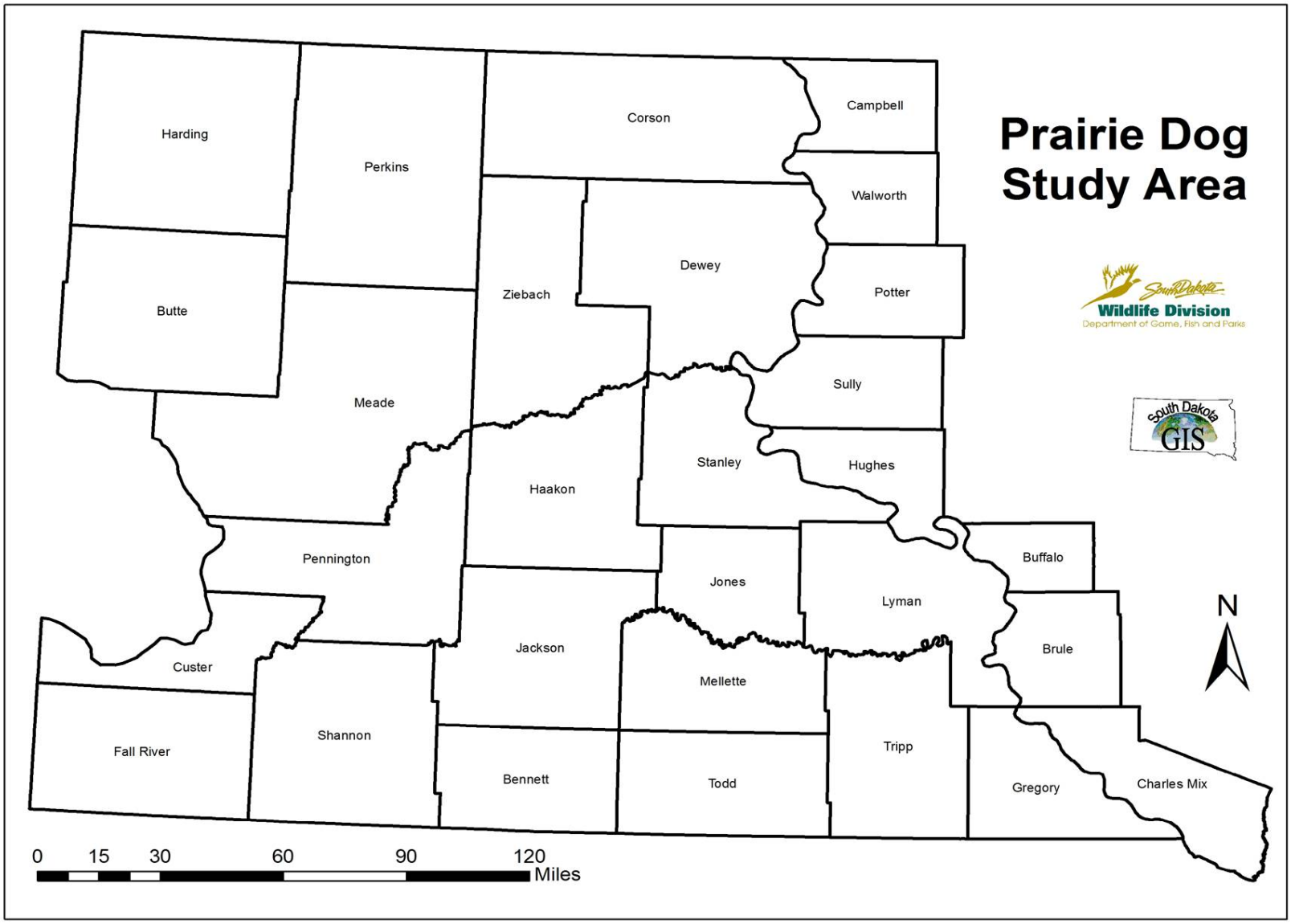


Figure 1. Counties and portions of counties censused for acreage and distribution of black-tailed prairie dog colonies in South Dakota, 2008.

Figure 2. Example of aerial photograph interpretation using contrasting land cover coloration and presence of burrow-entrance mounds to indicate a black-tailed prairie dog colony (outlined in yellow) in Corson County, South Dakota, 2008.

Figure 3. Example of aerial photographs interpretation using presence of burrow-entrance mounds to indicate a black-tailed prairie dog colony (outlined in yellow) in Corson County, South Dakota, 2008.

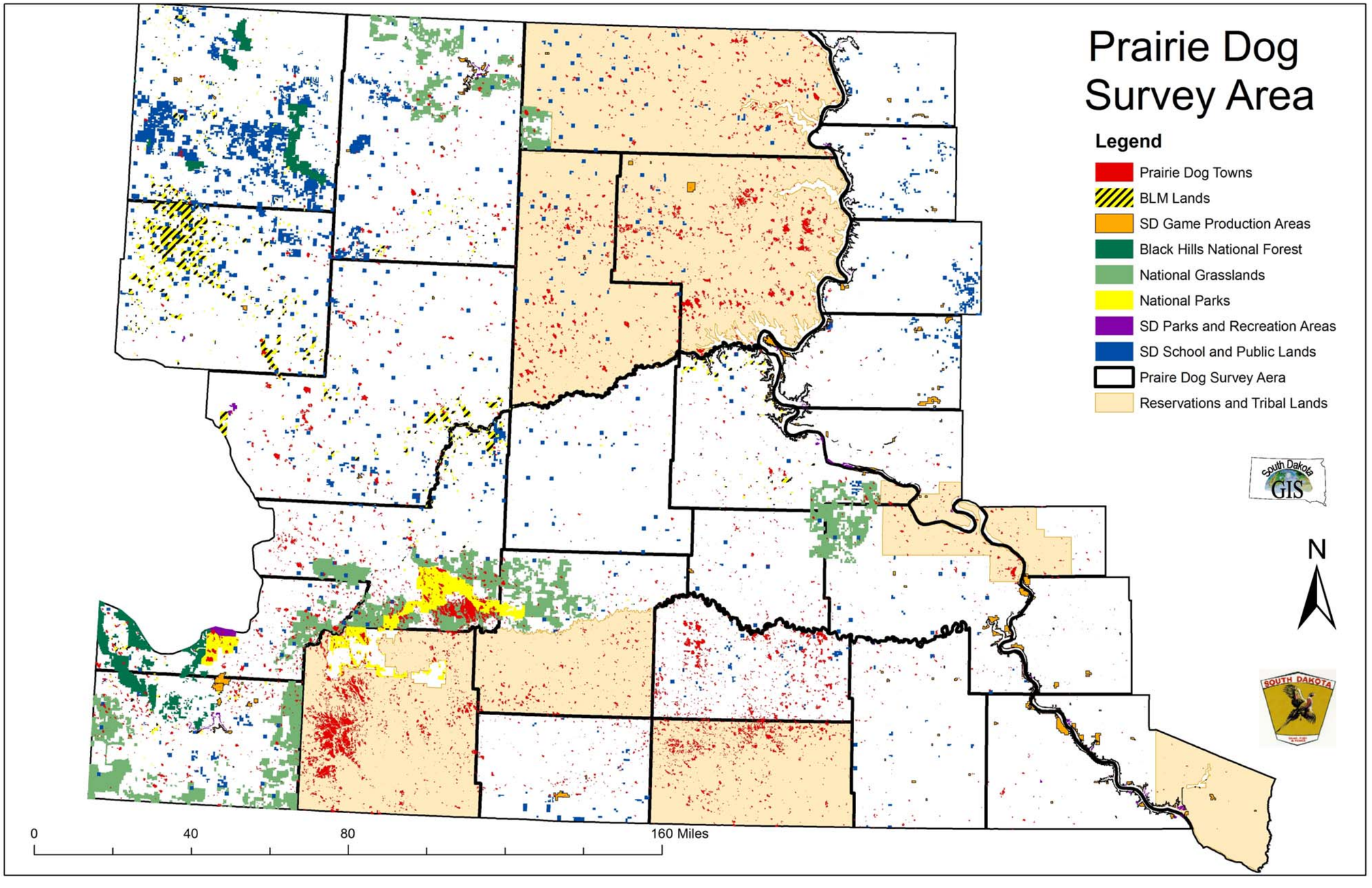
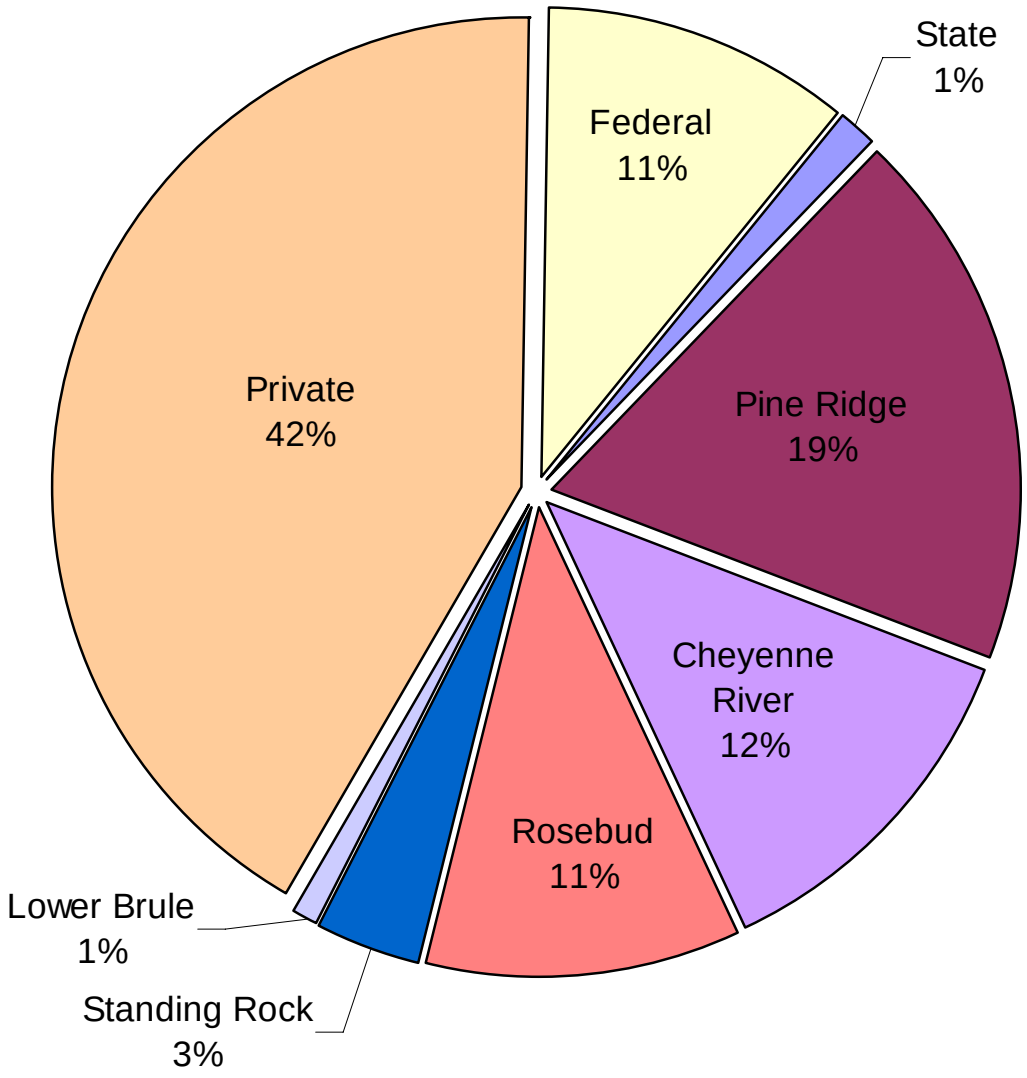


Figure 4. Black-tailed prairie dog colony acreage and distribution in South Dakota, 2008.

Figure 5. Percent composition of black-tailed prairie dog colony acres by ownership in South Dakota, 2008. Private, federal and state lands are classified as non-tribal; Pine Ridge, Cheyenne River, Rosebud, Standing Rock, and Lower Brule reservations are classified as tribal. Crow Creek and Yankton Reservations (not shown) contained less that 0.05% of the total colony acres.



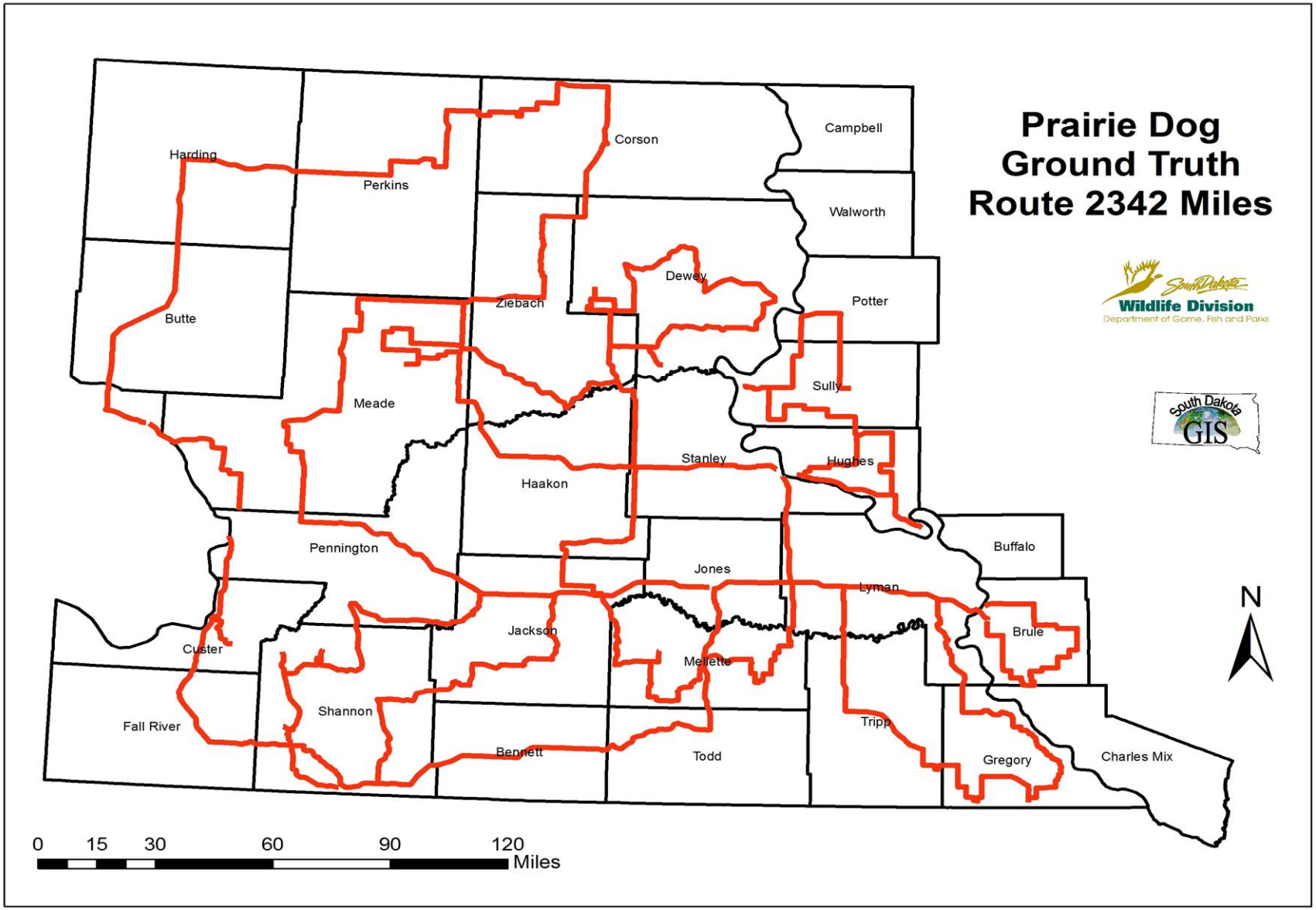


Figure 6. Location of routes used to ground-truth aerial photograph interpretation of black-tailed prairie dog colony acreage and distribution in South Dakota, 2008-2009.

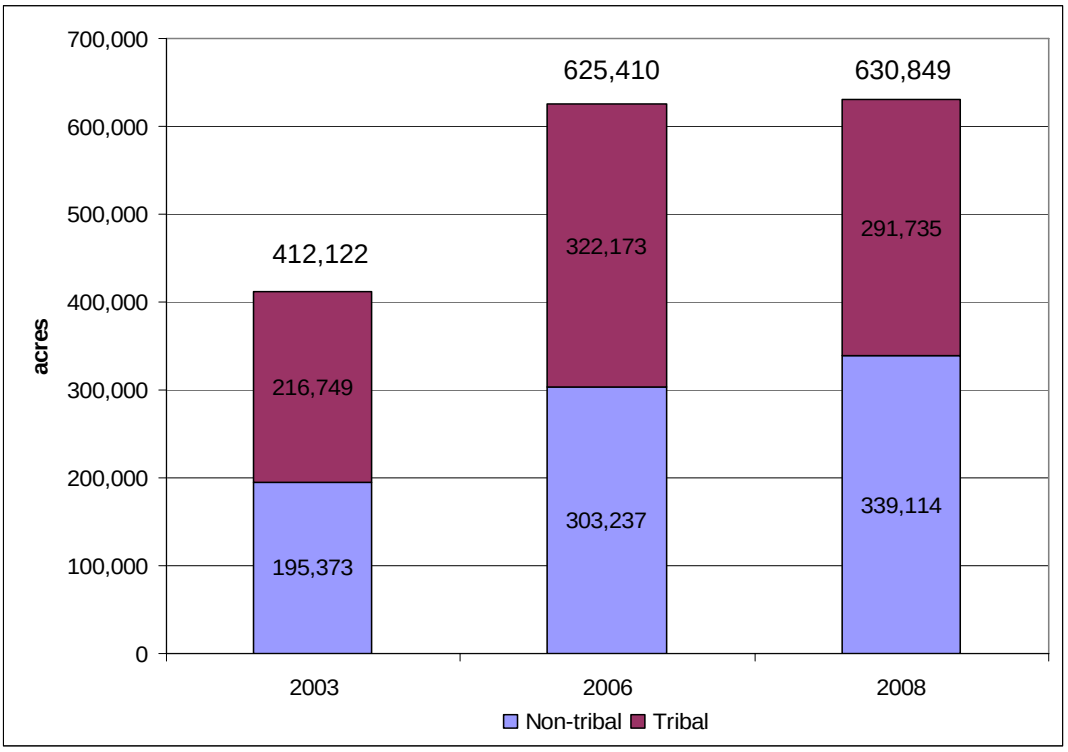


Figure 7.Comparison of estimated black-tailed prairie dog colony acreage in South Dakota. Please refer to Dowd Stukel et al. (2004), Kempema (2007) and the methods section of this report for detail on study area and methods used during each study.

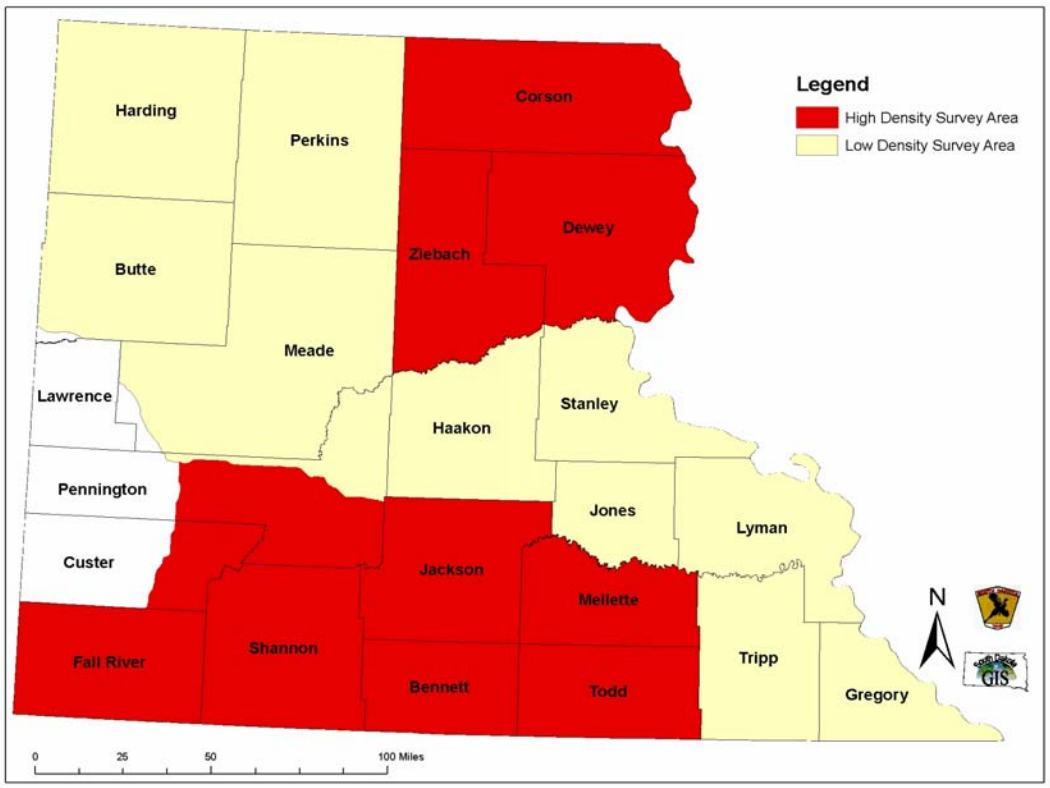


Figure 8. Stratification of counties or portions of counties from Kempema (2007).

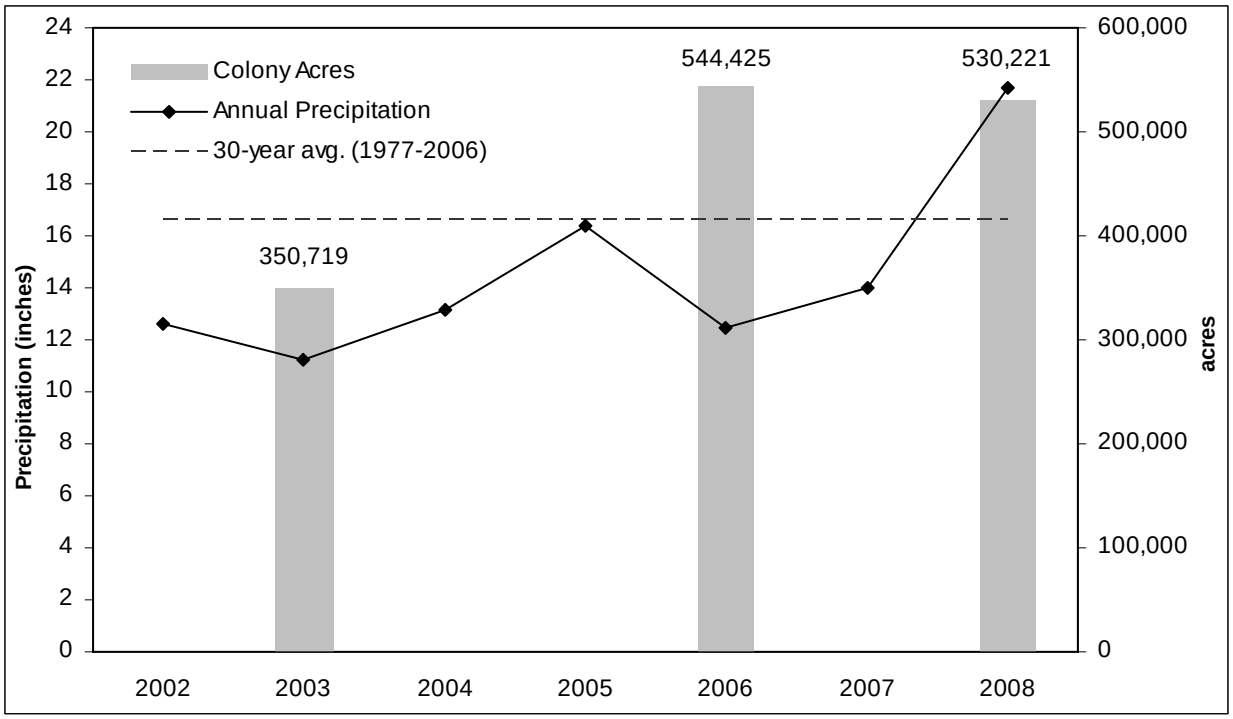


Figure 9. Temporal change in black-tailed prairie dog colony acreage in South Dakota counties designated in 2006 as high-density. Annual precipitation values from weather station near Cottonwood, South Dakota.

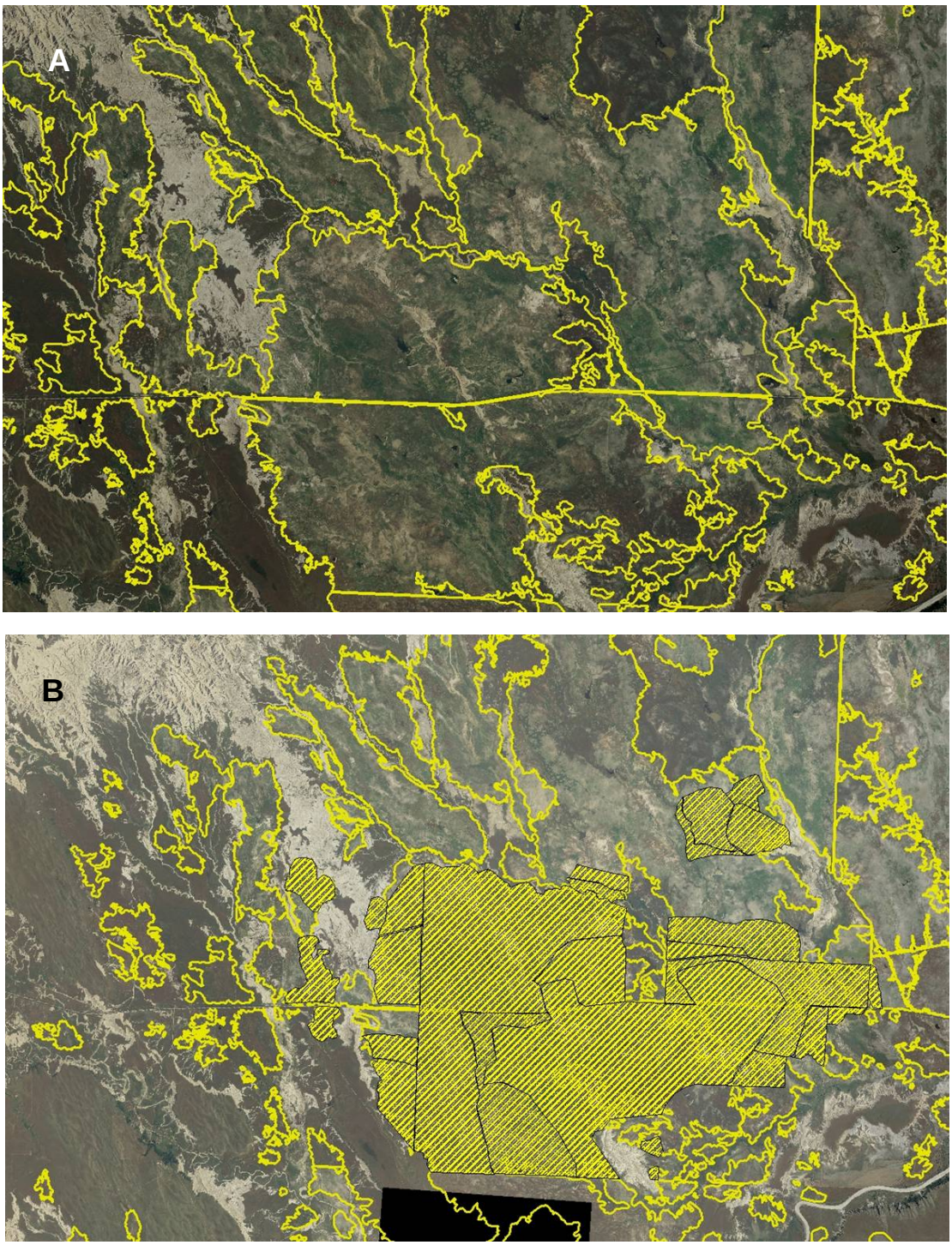


Figure 10. Photo A - Results of photograph interpretation of black-tailed prairie dog colonies in the Conata Basin area of Pennington County. Photograph was taken on July 4, 2008. Photo B - Shaded areas outline areas impacted by plague from May through November 2008.

Appendix A. Black-tailed prairie dog colony acres poisoned in South Dakota in response to colony expansion from public lands onto private lands. Poisoning on private lands is done in accordance with the State Prairie Dog Conservation and Management Plan and conducted by the South Dakota Department of Game, Fish and Parks Wildlife Damage Management Program. Poisoning on public lands is conducted or contracted out by the respective public land management agency.

	Acres Poisoned		
Year[a]	Private	Public	Total
2004[b]	24,255	7,800	32,056
2005	14,726	9,700	24,426
2006	30,020	11,856	41,875
2007	23,460	6,307	29,768
2008	24,833	2,867	27,700

[a] Year is defined as the time period in which poisoning may legally occur according to pesticide label restrictions which is July 1 through February 28 of the following year.
[b] Poisoning occurred primarily in Custer, Fall River, Jackson, and Pennington Counties as part of an emergency interim prairie dog private lands control program.