NORTH DAKOTA GAME AND FISH DEPARTMENT

Final Report

Survey and faunal inventory of black-tailed prairie dog (*Cynomys ludovicianus*) colonies in southwestern North Dakota.

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June 5, 2011 – December 31, 2013

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Director

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State Wildlife Grant Proposal – Final Report

Project Title: Survey and faunal inventory of black-tailed prairie dog (*Cynomys ludovicianus*) colonies in southwestern North Dakota.

Species of Conservation Priority: Black-tailed Prairie dog (*Cynomys ludovicianus*)

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Activity Period: June 5, 2011 – December 31, 2013

Location: southwestern North Dakota (Morton, Grant, Sioux, Stark, Hettinger, Adams, Billings, Golden Valley, Slope, Bowman, Dunn, McKenzie counties)

Need: Black-tailed prairie dogs (*Cynomys ludovicianus*) have long been a focus of scientific inquiry, primarily due to their ability to significantly alter the vegetation and soils of grassland ecosystems. The black-tailed prairie dog is currently listed as a North Dakota Level 1 Species of Greatest Conservation Need. This designation recognizes the potentially important role that prairie dogs may serve in the prairie ecosystems of North Dakota and warrants their further study.

Black-tailed prairie dog colonies can be highly susceptible to extinction events. Prairie dog colony persistence is primarily negatively affected by habitat loss, pest control methods and exposure to sylvatic plague (*Yersinia pestis*). Plague episodes kill >99% of prairie dogs in infected colonies and are capable of profoundly reducing numbers of active prairie dog colonies over short time periods. Because of their susceptibility to extinction, continued monitoring of black-tailed prairie dog colonies is warranted throughout their range.

In accordance with this need, the North Dakota Game and Fish Department has conducted surveys of active and inactive black-tailed prairie dog towns in southwestern North Dakota on a 3-5 year cycle as part of the NDGF black-tailed prairie dog management plan. The last full inventory of black-tailed prairie dog colonies in North Dakota was completed in 2006, necessitating the initiation of a new survey in order to accurately assess the status of prairie dogs in North Dakota.

Additionally, black-tailed prairie dogs colonies have been documented to be important landscape features for a number of associated vertebrates and invertebrates. This has led some to suggest that prairie dogs may fulfill the role of keystone species in prairie ecosystems. A recent

inventory of the species associated with black-tailed prairie dog towns in North Dakota has not yet been undertaken. The current need for a comprehensive survey of prairie dog towns in North Dakota offers an opportunity to simultaneously inventory vertebrates and invertebrates present at prairie dog towns.

Finally, prairie dog colonies can be viewed as islands of isolated habitat within a greater 'sea' of grassland ecosystems. As 'islands', patterns of extinction, persistence and re-colonization of prairie dog towns may be better interpreted using equilibrium island biogeography theory. Extinction, persistence and re-colonization of prairie dog towns are likely intrinsically tied to the physical features of the towns (town size) as well as the distribution of the towns in the encompassing habitat (location and distance with respect to other towns). A better, more comprehensive understanding of these processes and their influence on the survival of black-tailed prairie dogs in southwestern North Dakota will increase the likelihood of successfully managing this species over the long term.

Summary: We completed surveys of 660 prairie dog towns (224 during field season 1 and 436 during field season 2). Of these towns, 81 were found to be extinct while 56 were newly established towns. We were not able to secure on-site permission to survey 121 prairie dog towns. Prairie dog towns appear to be distributed throughout North Dakota in two dominant metapopulations. Additionally, prairie dog town size appears to be a better indicator of persistence than isolation.

We also conducted four small mammal sampling sessions. A total of 20 prairie dog towns were sampled for small mammals over 1000 trap nights. Thirty-three small mammals were captured during this time representing two Orders, four Families, eight Genera and nine species. A second specimen of *Sorex merriami* (Merriam's shrew) was captured in McKenzie Co., extending the known range of the species in North Dakota 98.17 km further north.

Progress to Date: Two hundred and thirty-nine black-tailed prairie dog towns in southwestern North Dakota were surveyed during the 2011 field season. Towns were surveyed in McKenzie (75), Billings (63), Stark (13), Golden Valley (11), Slope (69), Dunn (7) and Bowman (1) counties. Of these, 25 towns were determined to be extinct and 11 towns were found to be new and previously undocumented across these counties. We were not able to secure permission to survey 20 towns in these areas.

The 2012 field season began the week of 12 May 2012 and continued through 6 August 2012. Prairie dog towns were surveyed continuously during this time. The field season was completed when all known towns (for which we had permission) were surveyed.

We focused our initial efforts on Sioux, Morton and Grant counties. Prairie dog town surveys were aided through cooperation with the Bureau of Indian Affairs in these counties. We are grateful and indebted to the Bureau for their invaluable assistance. Once completed, surveys moved west through the state until completed.

Prairie dog towns were surveyed in Dunn county (22), Sioux county (201), Morton county (68), Golden Valley county (12), McKenzie county (15), Bowman county (48), Grant county (50), Adams county (1), Hettinger county (1) and Slope county (3). Of these surveyed

towns, 56 were found to have become extinct. Forty-five new (previously undocumented) towns were found in Sioux (33), Morton (2), Bowman (4) and Dunn (6) counties.

Land access for surveys was denied for 121 total towns. These town locations were driven on public roads and, where possible, the town was checked to determine if it was active. Where town status could be determined, these towns were included in the survey data.

Twenty prairie dog towns were sampled for the presence of small mammals over the course of the project. Towns were located in Slope, Stark, Billings and McKenzie counties. Small mammals were sampled at prairie dog towns using 'Y'-shaped pitfall arrays and drift fences. Pitfall arrays consist of 10 pitfalls (not less than 14cm in diameter and 19cm deep) arranged in the shape of a "Y". Each arm is anchored by a single pitfall at the junction of the "Y" and consists of three pitfalls linearly separated by 5m of staked, plastic drift fencing. Pitfall arrays were operated for five consecutive nights and checked daily.

The first small mammal sampling session took place from 11 July 2011 through 16 July 2011. The second sampling session occurred from 18 July through 23 July 2011. Eighteen total specimens were collected over 500 trap nights. Five rodent species and three shrew species were captured. Captured rodents represented three families (Muridae, Heteromyidae, Geomyidae) and five genera. Shrews were present from one family (Soricidae) and two genera. Noteworthy captures included *Perognathus faciatus* (1), *Blarina brevicauda* (1) and *Sorex merriami* (1).

During Year 2 of the project, the first small mammal sampling session occurred from 10 July 2012 through 15 July 2012. The second sampling session occurred from 17 July through 22 July 2012. Fifteen total specimens were collected over 500 trap nights. Three rodent species and two shrew species were captured. Captured rodents represented two families (Muridae, Heteromyidae) and three genera. Shrews were present from one family (Soricidae) and one genera. Noteworthy captures included *Perognathus faciatus* (1) and *Sorex merriami* (1).

In total, these efforts constituted 1000 trap nights and yielded 33 total mammal specimens representing 9 species, 8 genera, 4 families and 2 orders. Twenty-five amphibians were also collected in 2011 in conjunction with mammal sampling (19 – *Scaphiopus bombifrons*; 6 – *Ambystoma tigrinum*).

The specimens of *S. merriami* were the first to be captured in North Dakota since 1913 and only the second and third specimens ever documented in the state. The identification of the specimens was confirmed by Dr. Neal Woodman, Curator of Mammals, National Museum of Natural History, Smithsonian Institution, Washington, D.C. Dr. Woodman mapped palatal breadth against palatal length of the skull. These measurements are proportionally unique to *S. merriami* and served as the basis of his (confirming) identification. Southwestern North Dakota defines the extreme northeastern limit of this species national range. Previously, this range was based upon data from a single specimen, almost 100 years old. As a result, the new specimens extend the known range of the species 98.17 km north and 5.6 km east, out of the immediate valley of the Little Missouri River and into the North Dakota badlands.

All captured specimens have been processed as skins and skulls, full skeletons or skulls only. All specimens are presently in the process of being catalogued and installed in the Dickinson State University Natural History Collection. The second *S. merriami* was sent to the Smithsonian Institution's National Museum of Natural History for permanent preservation. Total numbers of small mammals captured was insufficient to permit rigorous statistical analyses.

In addition to the collection and identification of small mammals at prairie dog towns, the trapping protocol proved to be extremely efficient in harvesting insects. In order that these data not be lost, on the final day of sampling, jars of ethyl alcohol were brought to the field. During the process of closing the traps, each pitfall was drained and filtered. The accumulated insects were preserved in ethanol, labeled according to the location of their capture and transported back to the Dickinson State University Natural History Collection for analysis. Presently, the insects are still in the process of being sorted, counted and identified. Undergraduate curatorial assistants are still sorting the order Coleoptera, but have also started pinning and sorting other orders.

Seven orders of insects plus arachnids and centipedes were collected at black-tailed prairie dog towns during the small mammal sampling sessions. The orders collected were Coleoptera, Hymenoptera, Diptera, Hemiptera, Orthoptera, Neuroptera and Lepidoptera. A total of 14,696 individuals were collected over the two field seasons (Table 1). Specimen identification and sorting of insect samples will continue at Northeastern State University in Tahlequah, OK.

The 2012 insect surveys resulted in significant increases in Coleoptera, Hymenoptera, and Hemiptera over the 2011 sampling period. One new order (Neuroptera) and a new Subphylum (Chilopoda) were also detected. The increase in Hemiptera was due to a superabundance of ants at the prairie dog towns.

Project Status: At present, all known prairie dog towns in southwestern North Dakota have been surveyed where permission to access the land was granted. In addition, all planned small mammal surveys have been completed; specimens have been prepared and have been or will be deposited in the Dickinson State University Natural History Collection.

Black-tailed prairie dog colonies appear to experience moderate turnover over the 5-6 years between surveys. Eighty-one towns surveyed in 2006 were found to have become extinct during the present surveys. This represents 15.58% of all towns surveyed during both periods. However, 56 new towns not previously surveyed were documented during the present census for an intrinsic rate of increase of 10.39%. These data would seem to indicate a general pattern of decline in black-tailed prairie dog colonies in southwestern North Dakota.

Sampling methodologies, however, appear to have the potential to impact perceptions of black-tailed prairie dog colony size and numbers. Prairie dog towns studied during past surveys were often visited to determine if alive and then surveyed aerially. We physically walked each town perimeter. This has produced variation in the nature of the data we collected as compared with past surveys. We suspect that aerial surveys have the effect of breaking large towns into

multiple smaller towns, because only the most active parts of the prairie dog town are identifiable from the air. During walking surveys, it is possible to identify portions of prairie dog towns that are less active but which unify more distant, active portions of the town. As a result, walking surveys typically produce larger, more unified towns than those surveyed aerially (Figure 1). This pattern, if true, has perception and management implications which affect the interpretation of our data. Survey methodologies can change perceptions of prairie dog status by producing data that reflects either many more, small acreage towns versus fewer, larger acreage towns. Our data reflect this trend (Figure 2).

Our sampling methodology would have the effect of combining smaller, closely associated towns from 2006 into larger, more unified towns. This would give the impression of increased town extinctions between the 2006 surveys and our surveys. The apparent decline in black-tailed prairie dog towns noted between the two surveys may simply be an artifact of the different sampling methodologies. The future of black-tailed prairie dog management in North Dakota will be largely dependent upon which view of towns is most accurate.

Black-tailed prairie dog towns are also not distributed evenly or uniformly throughout southwestern North Dakota. Black-tailed prairie dog town distributions exhibit a distinct separation between eastern and western portions of their range in North Dakota (Figure 3). The effect is to produce two unique (and possibly three) metapopulations of black-tailed prairie dogs.

Area and distance comparisons have been made between prairie dog towns that were active during the 2011/2012 surveys and those that were active during the previous survey (2006) but inactive in 2011/2012. We used data from Sioux county to compute the mean areas of prairie dog towns and to quantify isolation between prairie dog towns. Mean area of prairie dog towns that were active both in 2006 and 2011/2012 was larger than mean area of prairie dog towns that were active in 2006 but inactive in 2011/2012 (Table 2; 2-sample *t-test*, $p = 0.0005$).

We quantified isolation by computing the mean distance of each prairie dog town to its ten nearest neighbors. We compared the mean distances between towns active during the 2006 surveys and the 2011/2012 surveys to the mean distances between towns active only in 2011/2012. We found that mean distance of active colonies was not significantly different from the mean distance of inactive colonies to the nearest 10 neighbors (Table 2; 2-sample *t-test*, $p = 0.4246$).

These findings have potential management implications. Our preliminary data suggest that area may be a more important factor in determining long-term persistence of prairie dog towns in North Dakota than the degree of isolation. Larger prairie dog towns appear to have better survivorship over time than smaller or more isolated prairie dog towns. We intend to expand these analyses to the complete dataset.

We mapped town area by distance to nearest town for the Sioux county data (Figure 4). These data appear to indicate a minimum town size whereby achieving isolation is difficult. Beyond town sizes of 150 acres, black-tailed prairie dog towns do not appear to be able to separate themselves from other towns by more than 2000 meters. It may be that large towns are functioning as effective ‘source’ populations in Sioux county, whereby surplus individuals leave the large town and set up successful, smaller, ‘sink’ and populations nearby.

We also mapped town area by area of nearest town for the Sioux county data (Figure 5). Another trend emerges from these data affecting large towns. Beyond town sizes of approximately 150 acres, these large towns tend to be surrounded by only large towns. This pattern may indicate preferred habitats whereby prairie dog towns become established and thrive, becoming large over time. Additionally, once a large area prairie dog town becomes established and begins to export individuals, closer prairie dog towns may disproportionately benefit from the near proximity of the source population, permitting them to grow large as well.

The capture of a second Merriam's shrew has also raised interesting new questions about the importance of prairie dog towns to other grassland associated mammals. Shrews, in general, represented 33% of the total small mammal captures at prairie dog towns. While the role of prairie dog towns as 'keystone' features of the prairie environment may be overstated, prairie dog towns could provide unique microhabitats that favor specific taxa or guilds, such as insectivores.

During the field surveys of prairie dog towns, the field crews were instructed to record information about prairie dog town associates present at towns. Field crews were given a list of seven vertebrates of interest that may be associated with prairie dog towns and instructed to record them as 'present' at towns if they were observed (Table 3). A total of 142 vertebrate associates were documented at active towns over the course of the study. Golden eagles (25), burrowing owls (69), badgers (46), mountain plovers (1) and prairie chickens (1) were detected during town surveys. Single occurrences were recorded at 86 prairie dog towns. Two species were recorded simultaneously at 24 towns. Three species were recorded at two prairie dog towns. We compared mean town size and the number of species present at towns using single factor ANOVA (Figure 6). Presence of associated vertebrates appears to be influenced by town size ($F_{3,278} = 2.99$, $p = 0.0314$). Smaller towns ($\mu<50$ acres) never produced more than a single vertebrate associate, and in many cases recorded no associates. Multiple vertebrate associates were only recorded at larger towns ($\mu>50$ acres). It is important to note that these particular data are very preliminary and that more research on this question should be conducted. However, these data suggest that there may be a critical minimum town size required for attracting multiple vertebrate associates. Larger towns may offer more unique resources, provide better resource/risk trade-offs or simply be a bigger target for vertebrates identified as associates of prairie dog towns.

Finally, we developed and tested a GIS-based predictive spatial model for identifying potential prairie dog habitat in southwestern North Dakota. Four key habitat factors were identified that could influence the likelihood of a colony settling in a given area. The factors were land cover and land use, soil type, soil thickness, and distance to streams. Data on existing and extinct prairie dog towns in southwestern North Dakota were utilized in the form of point files as well as polygon shape files delineating the boundaries of the towns.

Geospatial and field data for Slope County, ND were used to create the model probabilities. For each of the four habitat factors, the occurrence of prairie dog towns in each land cover type, soil type, soil thickness class, and stream distance class was tabulated and converted to percentages. Results for Slope County show that prairie dogs have a tendency to prefer a combination of grass/shrubland, silt soils with an ideal thickness of about 100m, and a maximum distance from a stream at five miles. Probabilities were then applied to geospatial

data for the same four habitat factors for Billings County, ND as a test of the model. Results indicated that 82.8% of all prairie dog towns in Billings County fell within the highest category of probability.

We are currently in the process of refining the model and testing it against survey data from other areas of southwestern North Dakota. We have submitted an abstract to present the results of the model at the 2014 Midwest Fish and Wildlife Conference in Kansas City, MO from 26 January 2014 through 29 January 2014.

Tasks Completed from June 2011 to January 2014

- Conducted on-site walking surveys of 514 prairie dog towns in southwestern North Dakota.
- Recorded perimeter and area data for 514 prairie dog towns in southwestern North Dakota.
- Completed four full sampling sessions (20 prairie dog towns) for small mammals at prairie dog towns.
- Preserved, catalogued and accessioned all specimens captured during the summer sampling sessions.
- Established two national records of *Sorex merriami* in southwestern North Dakota.
- Collected insects from prairie dog towns sampled for small mammals
- Began sorting, counting and identifying insect specimens from the order Coleoptera.
- Continued analyses of survey data for black-tailed prairie dog towns in southwestern North Dakota.
- Presented data from prairie dog town biogeography and small mammal capture data at 2013 American Society of Mammalogist's annual meeting.
- Manuscript entitled, "New records of Merriam's shrew (Sorex merriami) from western North Dakota." accepted for publication in the Western North American Naturalist.

- Analyses of survey data for black-tailed prairie dog towns in southwestern North Dakota.
- Continue to sort, count and identify insects collected at prairie dog towns in southwestern North Dakota.

Other Activities Associated with this Project

- Five undergraduate field assistants have been trained in survey techniques of prairie dog towns and capture techniques for small mammals through this project.
- Three undergraduate field assistants have been supported over two summers through this project.
- Two undergraduate museum curatorial assistants have been trained in insect identification and museum curatorial techniques through this project.
- Small mammal holdings of the DSU Natural History Collection have been increased.
- Insect holdings of the DSU Natural History Collection have been increased.
- Present data at the Midwest Fish and Wildlife Conference in Kansas City, MO – January 2014.
- Prepare 1-2 additional manuscripts based upon the collected data

Table 1 – Insects, arachnids and centipedes collected at black-tailed prairie dog towns in southwestern North Dakota, 2011/2012.

Orders of Insects	**Total Insects Collected**
Coleoptera	5857
Hymenoptera	5151
Diptera	280
Hemiptera	1953
Orthoptera	498
Lepidoptera	31
Neuroptera	1
Araneae	919
Chilopoda	6
Total Specimens	14696

* Arachnids have not yet been counted.

Table 2 – Mean area and distance metrics of active and inactive prairie dog towns between 2006 and 2011/2012. * indicates significant differences.

	Active black-tailed prairie dog colonies	**Inactive black-tailed prairie dog colonies**
Mean area*	48.2	22.6
Mean distance to nearest 10 colonies (meters)	5969.8	5576.3

Table 3 – List of possible vertebrate associates of black-tailed prairie dog towns in southwestern North Dakota.

Common name	**Scientific name**
Black-footed ferret	*Mustela nigripes*
Badger	*Taxidea taxus*
Swift fox	*Vulpes velox*
Golden eagle	*Aquila chrysaetos*
Mountain plover	*Charadrius montanus*
Burrowing owl	*Athene cunicularia*
Prairie chicken	*Tympanuchus* spp.

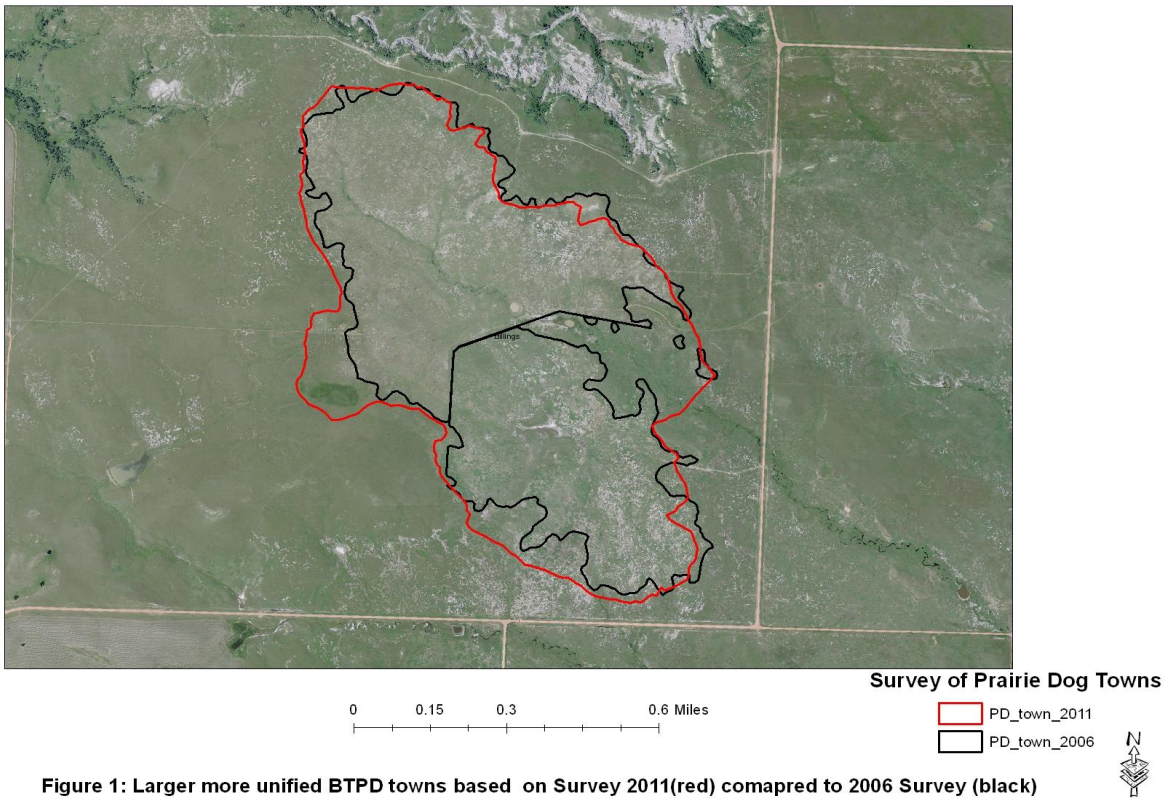

Figure 1: Larger more unified BTPD towns based on Survey 2011(red) comapred to 2006 Survey (black)

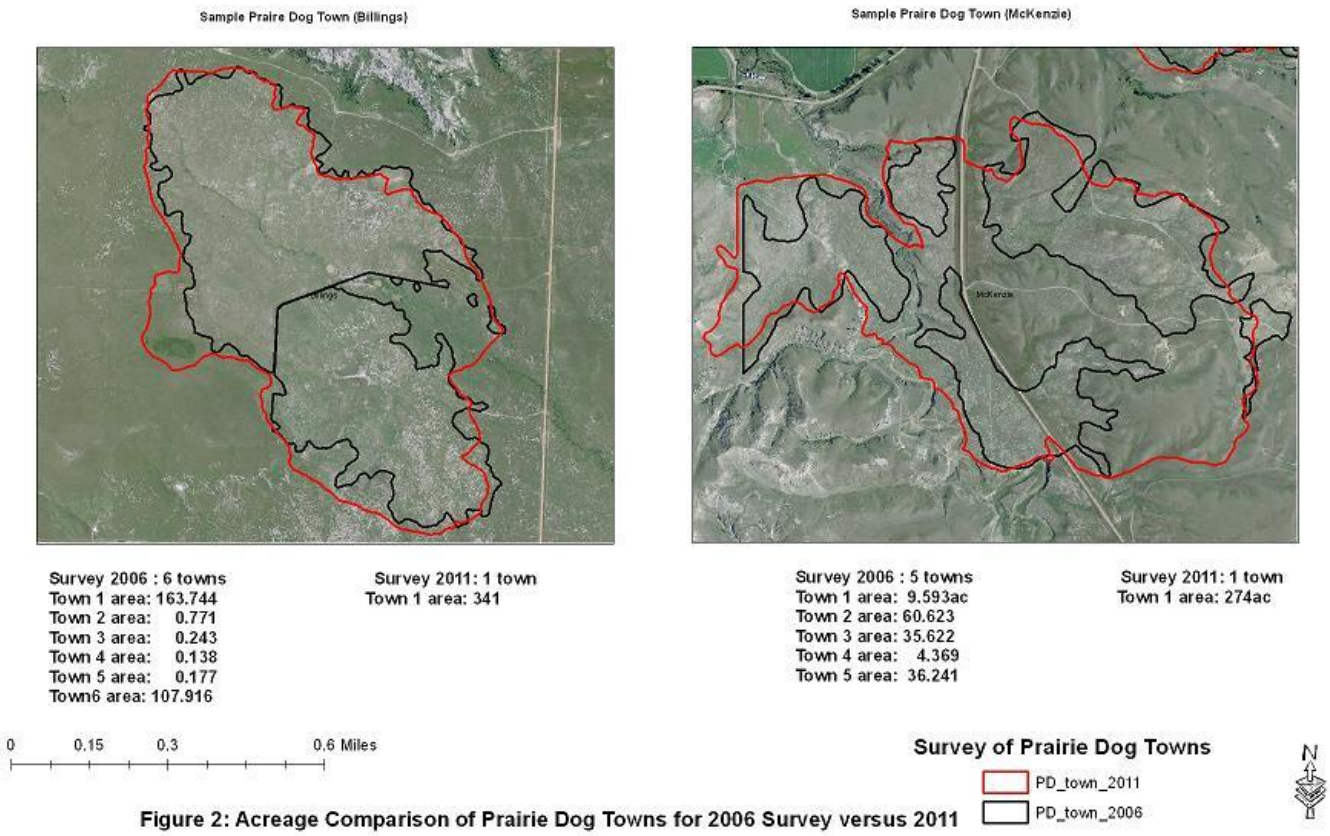

Figure 2: Acreage Comparison of Prairie Dog Towns for 2006 Survey versus 2011

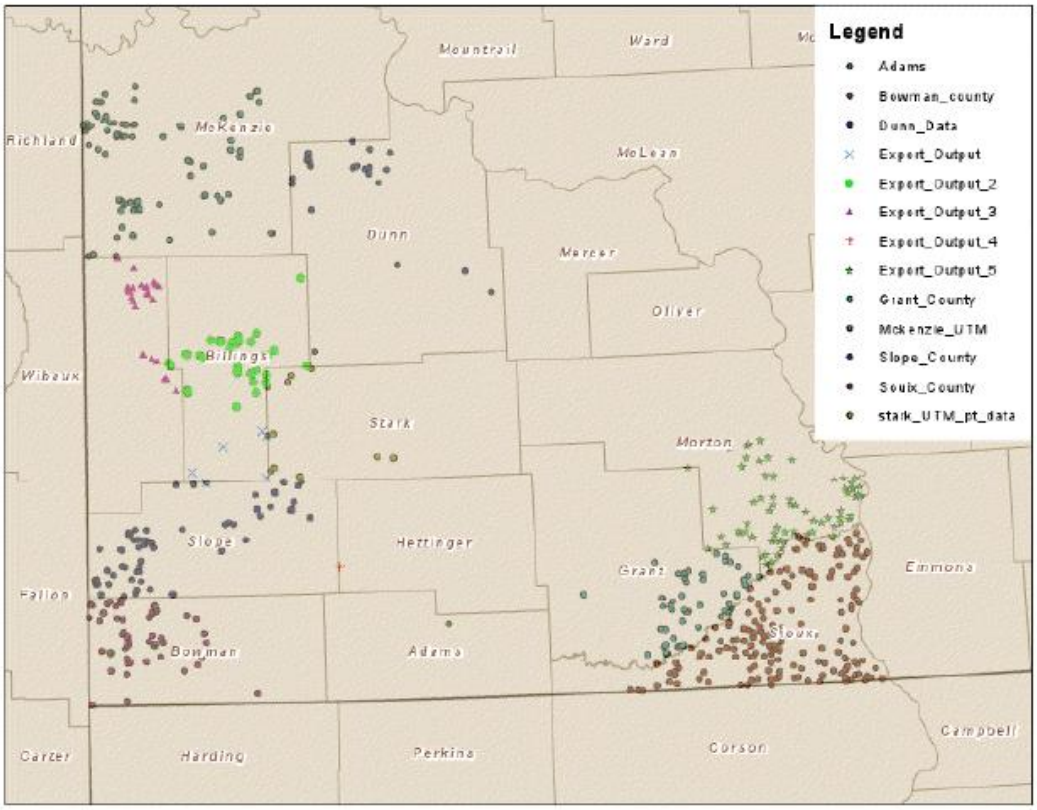

Figure 3 – Distribution of black-tailed prairie dog (*Cynomys ludovicianus*) towns in southwestern North Dakota.

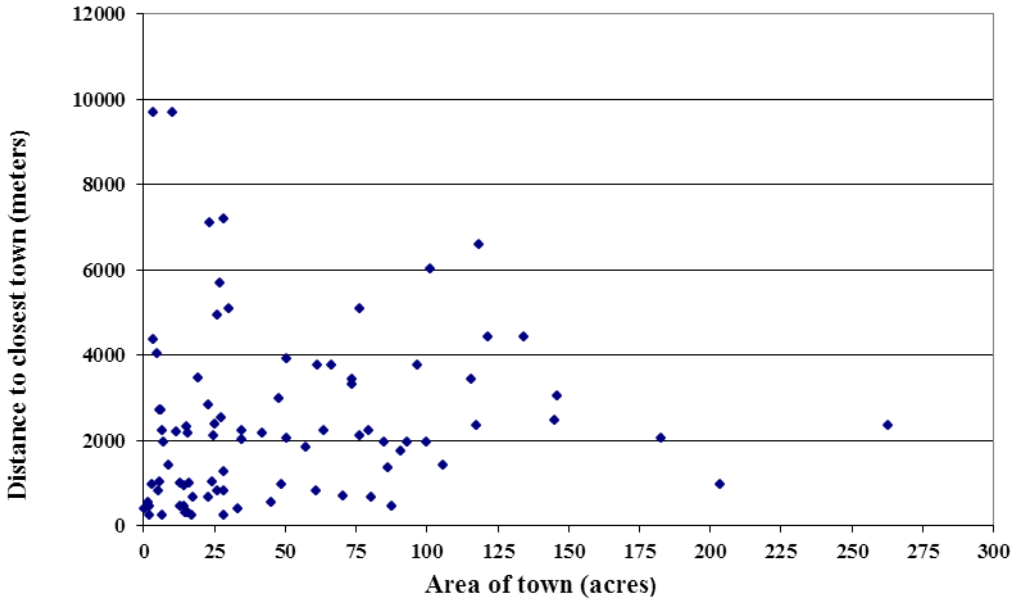

Figure 4 - Area of town versus distance to nearest town, Sioux Co.

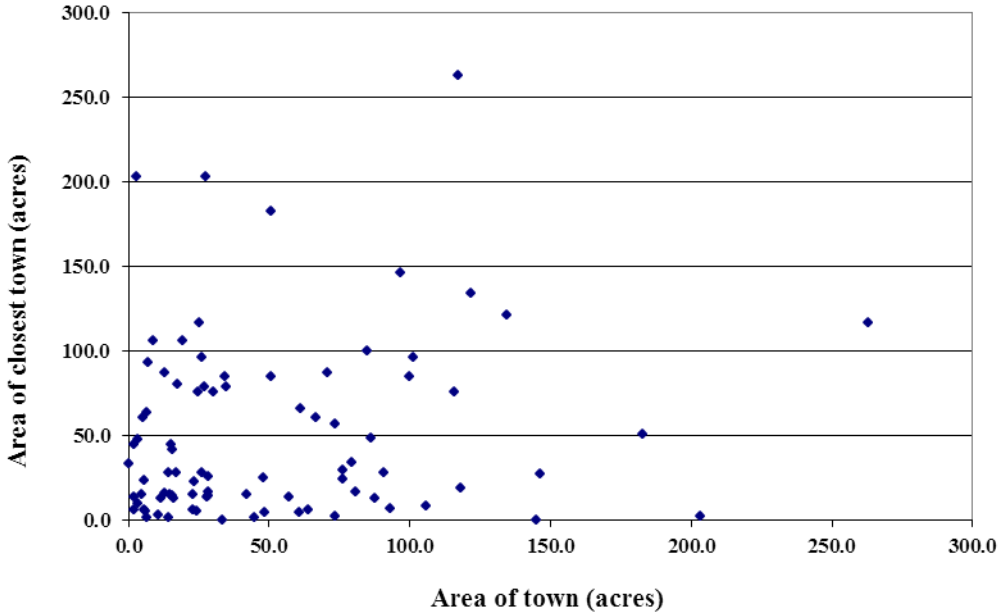

Figure 5 - Area of town compared to area of closest town, Sioux Co.

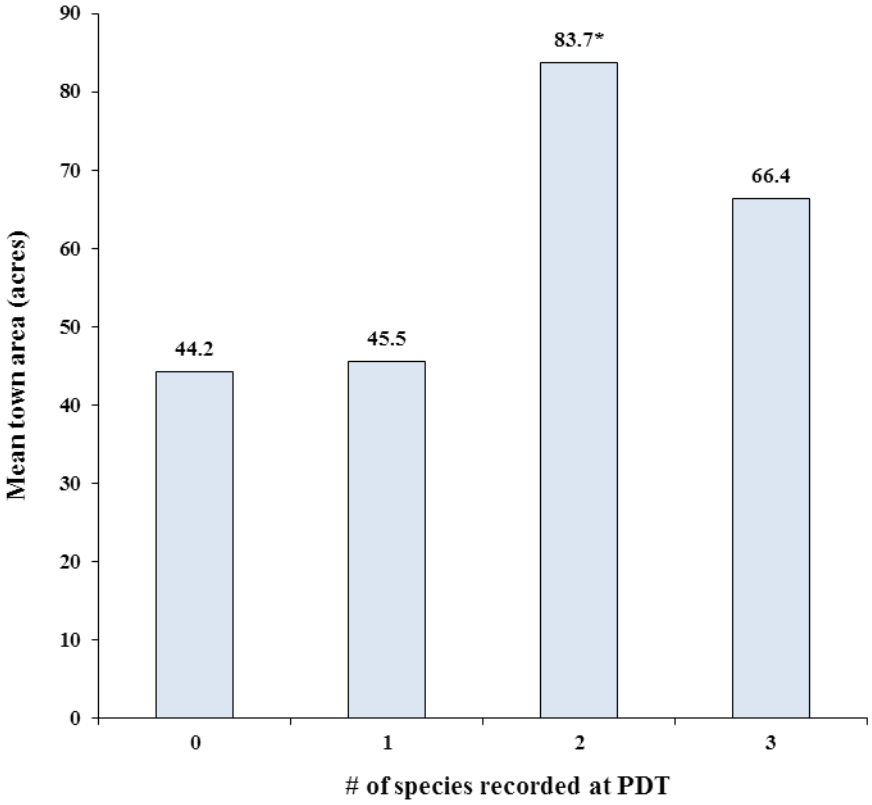

Figure 6 – Mean town area and numbers of town associated species in southwestern North Dakota (*$F_{3,278}$ = 2.99, p = 0.0314).