

2010 PRAIRIE DOG MONITORING IN THE NORTH UNIT OF THE  
BUREAU OF LAND MANAGEMENT, TAOS RESOURCE AREA



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## EXECUTIVE SUMMARY

A considerable number of Gunnison's prairie dog (*Cynomys gunnisoni*) colonies exist in the Bureau of Land Management (BLM), Taos Resource Area, particularly on the North Unit, a shrub-steppe plain in northern Taos County, New Mexico. We have monitored the status and size of prairie dog colonies on the North Unit annually from 2003 to 2006 and again in 2010. In 2010, we documented 39 active prairie dog colonies on the North Unit, a slight decrease from the 44 colonies we reported active in 2006. We estimated a cumulative spatial coverage of 1,201 acres for the 28 active colonies where perimeter was measured in 2010. This total spatial coverage was nearly identical to that measured in 2006; however, the number of colonies contributing to the cumulative total in 2006 was much higher (n=44), thus the mean acreage per colony increased from 27.5 acres in 2006 to 42.9 acres in 2010. We feel that the methodology currently utilized to monitor prairie dog populations on the North Unit is highly subjective, and we question the validity and inter-year comparability of some results, especially pertaining to the colony size component of the project. In 2010, a preliminary attempt was made to identify correlations between colony occurrence and soil type on the North Unit. Although analysis was limited, we found that certain soil types contained more colonies per acre than others, and also noted that, in many cases, sections of colony perimeters mirrored the boundaries of soil classifications. Increasing conservation concerns, and the fact that much remains to be learned about the species, lead us to believe that monitoring changes in the population of Gunnison's prairie dogs on the North Unit should remain a high priority of the BLM. We recommend significant changes to the monitoring protocol which we believe will better enable BLM to accomplish that goal.

## INTRODUCTION

Prairie dogs (*Cynomys* spp.) are colonial ground-dwelling herbivores that are considered keystone species throughout shrub-steppe and grassland habitats (Kotliar et al. 1999, Bangert and Slobodchikoff 2000, Hoogland 2001). Prairie dogs are considered keystone species because they create habitat (e.g., burrows, low vegetation structure) or provide a food source for a variety of taxa, including birds. Burrowing Owl (*Athene cunicularia*), Ferruginous Hawk (*Buteo regalis*), and Mountain Plover (*Charadrius montanus*) are examples of species that might be negatively affected by the loss of prairie dog colonies (Cully 1991, Dinsmore et al. 2003).

Although prairie dogs are key components of a healthy shrub-steppe ecosystem, research indicates that they have declined greatly since the late 1800s and early 1900s (Marsh 1984, Miller and Cully 2001). Declines have been attributed to poisoning, shooting, development, alteration of grazing regimes, and sylvatic plague (*Yersinia pestis*) (Cully and Williams 2001, Miller and Cully 2001). Some species (Utah prairie dog, *C. parvidens*, and Mexican prairie dog, *C. mexicanus*) have been listed as threatened or endangered (U.S. Department of Interior 2000, Scott-Morales et al. 2004). Black-tailed prairie dog (*C. ludovicianus*) was once a widespread and numerous species, but only a small portion of historic habitat is currently occupied (Sidle et al. 2001, Vermeire et al. 2004); this portion is less than 1% by some estimates (see Miller and Cully 2001). Gunnison's prairie dog (*C. gunnisoni*) has a more limited range (Colorado, New Mexico, Utah, and Arizona), and has experienced local declines in the past (e.g., Cully 1991, Cully et al. 1997). The U. S. Fish and Wildlife Service denied a petition to list Gunnison's prairie dog under the Endangered Species Act in 2008, but a September 2010

decision by a federal court in Arizona ruled that the denial must be reconsidered. Gunnison's prairie dog was again listed as a candidate species in 2010 (USDI 2010).

A Gunnison's prairie dog population resides on the North Unit, an approximately 50,000 ha short-grass plain managed by the Bureau of Land Management (BLM) in Taos County, New Mexico. In 2003, BLM contracted Hawks Aloft, Inc., to conduct aerial and ground surveys in the North Unit to identify prairie dog colonies. Starting in 2004, we returned to the North Unit to update the current status of colonies (i.e., active or inactive). In the process, we documented the locations of any additional colonies found opportunistically. Surveys were conducted annually through 2006. After a three year absence, Hawks Aloft resumed surveys on the North Unit in 2010. In this report, we present updated findings on the number and spatial coverage of active prairie dog colonies on the North Unit, and propose protocol amendments which we feel will improve the quality of the monitoring project.

## STUDY AREA

In 2010, prairie dog surveys occurred on the North Unit, a BLM managed short-grass plain in northern Taos County, New Mexico, about 15 km north of Tres Piedras (Fig. 1). The North Unit, which includes approximately 50,000 ha, is grazed by cattle, sheep, elk (*Cervus elaphus*), and pronghorn antelope (*Antilocapra americana*). Vegetation at the site primarily consisted of low stature (<0.25 m tall) blue grama (*Bouteloua gracilis*), prickleaf dogweed (*Thymophylla acerosa*), rabbitbrush (*Chrysothamnus* spp.), winterfat (*Eurotia lanata*), snakeweed (*Gutierrezia sarothrae*), four-winged saltbush (*Atriplex canescens*), big sagebrush (*Artemisia tridentate*), and

western wheatgrass (*Agropyron smithii*). Although a relatively flat landscape, the terrain of the North Unit includes a labyrinth of shallow depressions and crests with scattered volcanic rock.

## METHODS

In 2010, we determined the activity status of known prairie dog colonies on the North Unit and opportunistically identified new or undocumented colonies. Colonies were located or documented by GPS unit, and coordinates are provided in Appendix 1. We conducted all colony visits and area searches over the course of six days from late July to early August. A total of 15 person-days were spent conducting field surveys.

Due to funding limitations in 2010, survey methodology was amended from previous years in order to visit all colonies in a limited time. We classified each colony as active or inactive, regardless of any status previously reported. In 2010, we considered colonies to be active if prairie dogs or fresh sign (e.g. scat, tracks, or digging) at a burrow entrance were observed. In previous study years, colonies were only considered active if prairie dogs were seen or heard; if prairie dogs were not observed during the initial visit, but fresh sign was noted, the colony was revisited. In previous survey years, effort was made to count prairie dogs on the surface of the colony. The retiring nature of Gunnison's prairie dogs on the North Unit led observers to question the validity and repeatability of these counts; this component of the surveys was discontinued in 2010.

After a colony was determined to be active, we estimated the area covered by the active portion of the colony. Observers walked the colony perimeter (i.e., the outermost burrows deemed active) and recorded coordinates with GPS units. We plotted the

coordinates in ArcGIS and calculated the area within each colony's polygon of points. We made an effort to collect as many coordinates as possible along the perimeter, but the number of coordinates depended on the number of burrows present. We estimated the minimum occupied area for prairie dogs on the North Unit by adding the areas for each individual active colony. We present minimum coverage in acres, and we present an average area for active colonies.

Beginning in 2010, active prairie dog colony perimeters were plotted over soil layers (SSURGO) with ArcGIS, and a preliminary attempt was made to identify patterns of correlation between soil type and colony occurrence.

## RESULTS

Prior to 2010, 59 prairie dog colonies in the vicinity of the North Unit had been named; however, nine of these had later been merged with other colonies when perimeters began to overlap, resulting in 50 distinct historic colonies. In 2010, we surveyed 40 of these 50 colonies. Of the ten colonies not surveyed, six were excluded because, although proximate, they occur outside the boundary of the North Unit where our limited survey effort was concentrated in 2010. Of the four remaining colonies not surveyed, two were excluded due to inaccessibility within the survey period, one due to surveyor error, and one because the colony had not been active since before 2003. Of the 40 previously documented colonies that were surveyed in 2010, 25 were active and 15 were inactive. In addition, 14 new or previously undocumented colonies were opportunistically identified, bringing the total number of active colonies to 39. The

number of active colonies in 2010 was similar to the numbers for 2005 (n=40) and 2006 (n=44). Details of colony activity are provided in Figure 2 and Appendix 2.

Colony area, also shown in Appendix 2, was calculated for 28 of the active colonies (i.e. all historic colonies in the North Unit known to be active in 2010, and 3 of the 14 new colonies—perimeters of the other new colonies were not measured due to time constraints). The total area of the 28 colonies was 1,201.1 acres, and the mean colony size was 42.9 acres. If the mean area of the 11 colonies newly documented in 2010 where area was not measured was similar to the other 28, total spatial coverage in 2010 would approach 1,675 acres. This is a continuation of the trend of increasing cumulative and mean spatial coverage that has occurred since area calculations began in 2005. In 2010, colonies ranged in size from < 1 acre to 312.2 acres. We noted substantial expansion from 2006 to 2010 for colonies 20 (5.1 to 49.6 acres), 51 (5.3 to 85.3 acres), and 63 (14.8 to 312.2 acres). Substantial contraction occurred at colony 53 (169.1 to 1 acre) during the same period.

Gunnison's prairie dog colonies with measured perimeters were plotted over soil layers (SSURGO) with ArcGIS, and a preliminary attempt was made to identify patterns of correlation between soil type and colony occurrence. Twelve soil types were identified as occurring in the North Unit. The 28 active colonies with measured perimeters occurred in four distinct soil types (Table 1, Fig. 3). To adjust for differences in area covered by each soil type, colonies per 1,000 hectares of each soil classification were calculated. The two most common soil types, LtC and SVC (full names are given in Table 1), contained 86% of the colonies. More colonies occurred in the LtC classification (0.54 per ha) than in the SVC classification (0.31 per ha). Both the SUC and ShB classifications had high

numbers of colonies per ha (0.87 and 6.18, respectively), but these calculations were based on the occurrence of only three colonies.

Table 1. Active Gunnison's prairie dog colonies by soil type on the North Unit of the BLM Taos Resource Area, 2010. Of the 28 colonies where area was measured in 2010, 21 could be clearly associated with a single soil type. The remaining seven occurred in either LtC, SVC, or a combination of the two, but layer resolution may not be adequate for making that determination, and the colonies were excluded below. LtC is Luhon-Travelers complex, 3-7% slopes; SVC is Stunner-Travelers association, gently sloping; SUC is Stunner-Luhon association, gently sloping; ShB is Shawa clay loam, 0-3% slopes.

| Soil Type | Hectares | Percent of N. Unit | Active Colonies | Colonies/1000 ha |
|-----------|----------|--------------------|-----------------|------------------|
| LtC       | 24249.0  | 50.4               | 13              | 0.54             |
| SVC       | 16388.9  | 34.1               | 5               | 0.31             |
| SUC       | 2299.2   | 4.8                | 2               | 0.87             |
| ShB       | 161.7    | 0.3                | 1               | 6.18             |
| Other     | 4999.2   | 10.4               | 0               | 0.00             |
| Total     | 48098.0  | 100                | 21              | 0.44             |

## DISCUSSION

Based on the methodology employed to monitor Gunnison's prairie dog colonies on the North Unit in 2005, 2006, and 2010, the following patterns were found:

1) the number of active colonies has remained fairly consistent from year-to-year (n=39 to 44); 2) the number of inactive colonies is more variable (n=5 to 15); 3) total colony acreage increased substantially from 2005 to 2006 (363.0 to 1208.6 acres), but remained constant from 2006 to 2010 (1201.1 acres). However, had all new colonies been measured and mean colony size remained consistent, total spatial coverage would have increased by ~39% from 2006 to 2010; and 4) average colony acreage has increased substantially each year (9.1 acres in 2005, 27.5 acres in 2006, 42.9 acres in 2010).

However, for the reasons discussed below, we now question the validity and repeatability

of current methodology, and recommend an amended approach to prairie dog monitoring on the North Unit.

Compared to other prairie dog species and populations with which we have had prior experience, Gunnison's prairie dogs on the North Unit are especially elusive and retiring. Unlike congeners such as the black-tailed prairie dog, which inhabit colonies of densely spaced burrows in areas of denuded vegetation (cropped low by colony individuals), the colonies of Gunnison's prairie dogs on the North Unit often include widely spaced burrows interspersed among tall shrubby vegetation, which makes it difficult to observe individuals and burrows from a distance. The behavior and colony characteristics of this population cause difficulties in creating and replicating objective monitoring protocols.

Of the two primary components of the monitoring project, documenting colony activity and tracking colony area, the methodology and, therefore, the results of the former, are arguably the stronger. However, both components are highly subjective. When an attempt is made to survey a large area in a limited time, that subjectivity can be compounded by inadequate survey effort. Classifying a colony as active based on the observation of an individual or auditory call is the only means of removing subjectivity from the survey process. However, direct observations of prairie dogs occurred at only 60% of the historic colonies identified as active in 2010 (at several of these, only a single individual was observed). The remaining colonies identified as active were classified based on the presence of fresh sign (a colony was considered active even if only one burrow appeared to be active), a highly subjective identification. Even well-trained surveyors may have difficulties in estimating the contributing species and age of spoor

such as scat, tracks, and evidence of digging. Furthermore, environmental factors such as precipitation can further complicate activity classification based on sign. However, we feel that with the present scope of the project and the current funding, limiting the classification of a colony as active to only those sites where a prairie dog was seen or heard would grossly underestimate the number of active colonies on the unit, and could be highly variable among visits. Because of the unhabituated and retiring nature of the population, obtaining an accurate count of active colonies based on direct observation would necessitate spending increased time observing many of the colonies, ideally from a blind. This time-consuming practice would increase our confidence in the data being collected, but the cost may not be justified. Minimum counts at colonies depend greatly on activity patterns (Powell et al. 1994), which can be influenced by weather or time of day, and long periods of time may be needed to document active colonies as such. Despite the subjectivity, if the objective of surveying all historic colonies on the North Unit and documenting new colonies remains, and funding is limited, we recommend that classifying colonies as active based on fresh sign remain in the protocol. If more effort can be devoted to this component of the monitoring project, limiting active status to colonies with direct observation would yield less subjective, and more comparable, results.

Although it can be difficult to confidently classify a colony as active, it is much more challenging to classify a colony as inactive with confidence. Small colonies with few burrows offer limited opportunity to search for sign. A lack of evidence of occupancy does not preclude the possibility that a burrow is actively being utilized. On several occasions, we observed a prairie dog disappear into a burrow that we would have

counted as inactive. Even when burrows appeared old, partially filled with soil, or blocked by vegetation or spider webs, we could never be certain that the colonies we considered inactive were actually uninhabited. Therefore, the colonies we report as active may underestimate the actual number of active colonies surveyed. Furthermore, survey effort has been concentrated along roads, and the large size of the unit leads us to suspect that the colonies documented represent only a percentage of the actual number of colonies that exist on the North Unit.

Accurately documenting colony activity can be problematic; however, we feel that measuring and tracking changes in colony area is a much less reliable means of monitoring Gunnison's prairie dog colonies. For a colony to be considered active based on sign, only a single burrow needed to contain strong evidence of occupancy. In order to measure the active area of a colony, it was necessary to classify all peripheral burrows as active or inactive, and walk the outside edge of all active burrows. This necessitated a much more relaxed, and subjective, standard of what constituted an active burrow. In our experience in 2010, only a small percentage of burrows in a North Unit colony can be easily classified as "definitely active" or "definitely inactive"; the majority of burrows are "maybes" that fall in between. In addition to the difficulties of identifying peripheral burrows as active or inactive, area estimation is further complicated by colony perimeters that are not always clearly discernible. Because Gunnison's prairie dog colonies often contain widely spaced burrows, often not easily seen from a distance, two equally skilled observers could visit the same colony on the same day and achieve different results.

An example of this occurred by means of an unintentional experiment. After mapping the perimeter of Colony 71 with GPS units one afternoon, an apparently new

colony was noted nearby on the drive to camp. The next morning, the same two observers, both of whom had previous experience with classifying burrows as active or inactive and measuring the extent of colonies, returned to the new colony and measured the perimeter. When these two perimeters were mapped in ArcGIS (Fig. 4), it became clear that major flaws exist with the present methodology. The two colonies overlapped, meaning that, in fact, they constituted one colony. Measuring the perimeter on two occasions should have resulted in two nearly identical polygons, but instead resulted in one polygon with an area of 22.1 acres and the second measuring 49.5 acres; only approximately 9 acres of the two overlapped. Although this may represent an extreme case, the fact that the same observers could obtain such different results from replicates spaced one day apart leads us to question the comparability of results from different observers in different years.

The preliminary analysis of soil type in relation to colony occurrence conducted in 2010 was the first in what we hope will be a series of attempts to better identify patterns of distribution and land usage by Gunnison's prairie dogs on the North Unit. No definitive correlation was found between colony location and soil type (colonies occurred in four soil classifications, three of which make up 89.3% of the North Unit), but the data indicate that certain types may be preferred over others. Of perhaps greater interest, many of the colony perimeters seem to follow the boundaries between two different soil types (Fig. 5). Because it is easier to map the perimeters of colonies when presently inactive sections are included, and because it is likely that the placements of previously active (but now inactive) burrows were subject to the same preferences of soil type as currently active burrows, mapping the entire historical colony may yield clearer patterns of

correlation between soil and colony occurrence. Better precision and accuracy in colony perimeter mapping would increase the sample size (seven of the 28 mapped colonies were not included in the analysis because it was not clear whether they fell in both LtC and SVC types, or only in one of the two) and would lead to a better understanding of possible patterns.

A variety of factors could affect the size of prairie dog colonies, including human-caused disturbance (e.g., persecution), weather patterns, and disease outbreaks. Many of the North Unit prairie dog colonies are located in remote areas, far from paved roads or human habitation. The large size and rugged terrain of the North Unit probably provides some measure of protection from human-caused disturbance, and the degree of human-caused disturbance probably has changed very little over time, or at least not decreased to the extent of causing an increase in prairie dog colony sizes. Weather patterns might be a more reasonable explanation for changes in population and colony size on the North Unit. Increased forage production spurred by wet years could improve prairie dog productivity.

The occurrence of sylvatic plague also can greatly affect colony sizes. Since the early 20<sup>th</sup> century, plague has affected prairie dog numbers in some years, including Gunnison's prairie dog. Cully and Williams (2001) describe the consequences of plague, including "local extirpation of colonies, reduced colony size, increased variance in local population sizes, and increased distances between colonies." We have no evidence of any historic plague in the North Unit or data on prairie dog colony sizes prior to 2003, but plague could have occurred in recent decades. Cully et al. (1997) describe an outbreak in the Moreno Valley, New Mexico in the mid 1980s, and mention that another plague was underway at the same time near Taos and Tres Piedras (i.e., at or near the North Unit).

Although highly speculative, we can not discount the possibility that prairie dog colonies in the North Unit could be regularly impacted by plague events.

Despite the observed increases in prairie dog colony sizes on the North Unit, the colonies might not be at their greatest capacity. In northeastern New Mexico, Clark et al. (1982) reported an average Gunnison's prairie dog colony size of 46.0 ha (113.7 acres), higher than the 2010 average of 42.9 acres on the North Unit. In a separate study conducted in 2006 on BLM land in Cibola County (west New Mexico), we estimated an average colony size of 342 acres for Gunnison's prairie dog colonies (Hawks Aloft 2006). Both estimates were based on a very limited sample of colonies (N=11, Clark et al. 2006 and N=7, Hawks Aloft 2006) and a wide range of values, but they demonstrate that Gunnison's prairie dog colonies can be larger than the colonies we have observed on the North Unit to date. Area estimates for other prairie dog species include 67.4 acres (average of 319 colonies) for black-tailed prairie dogs (Cheatheat 1977) and 308.9 acres (average of 33 colonies) for white-tailed prairie dogs (*C. leucurus*, Clark et al. 1982). Sidle et al. (2001) indicate that most black-tailed prairie dog colonies are less than 100 acres. The perceived increase in prairie dog colony sizes on the North Unit is encouraging, but better monitoring methodology is needed to support the trend.

Increasing conservation concerns, and the fact that much remains to be learned about the species, lead us to believe that monitoring changes in the population of Gunnison's prairie dogs on the North Unit should be a high priority of the BLM. However, the highly subjective nature of prairie dog counts, activity classification, and area estimation lead us to suspect that the results of previous monitoring efforts may be as much a reflection of survey variability as actual changes in prairie dog populations.

We feel that with present levels of funding, attempting to monitor the activity of all historic North Unit colonies and map the areas of all active colonies results in insufficient effort to accomplish either task adequately. For future monitoring, we recommend the following:

- Continue to visit historic North Unit colonies annually and classify each site as active or inactive. With an increase in funding, it would be possible to modify the protocol to include as active only those colonies where prairie dogs were seen or heard. This would necessitate observing colonies from a distance and spending increased observation time at many sites. Colonies where prairie dogs were not directly observed, but signs of activity were found, would necessitate subsequent visits, a costly logistical addition in the more remote section of the unit. This amendment would remove the subjectivity of the methodology, and thus increase the comparability of inter-year results, but would likely double the expenditure of effort required from including the presence of fresh sign as a qualifier to classify a colony as active.
- We feel that there are three options to address the problems associated with the colony size component of the monitoring project: 1) if funding is limited, this component could be dropped and resources could be devoted to strengthening the activity classification of the historic colonies component (or a biennial schedule could be adopted). 2) Limited resources could be devoted to tracking the areas of a subset of the colonies. Subjectivity and limits to comparability would remain, but likely would

be decreased if more effort could be expended measuring the perimeters of fewer colonies. 3) A new protocol could be implemented that would decrease subjectivity, increase comparability between years, and also address density of burrows within a colony, a component that is not attended to with current methodology (we currently measure colony size by the perimeter of seemingly active outer burrows; two equally sized colonies could have vastly different densities of active burrows inside that perimeter, a likely occurrence with Gunnison's prairie dogs on the North Unit). We suggest the establishment of a number of rectangular plots on the North Unit. Plots could be established randomly in suitable habitat, or could be established to include presently active colonies (ideally, plots should be large enough to cover entire, medium-sized colonies). The size and number of plots could be adjusted according to initial funding, and a rotating and varying number of plots could be surveyed annually based on funding during that year. At each plot, surveyors would intensively walk the interior and every prairie dog-sized burrow (or cluster of burrows) would be marked by GPS and assigned a score. We propose the development of a clear scoring classifications based on sign (i.e. 3 for definitely active [clear opening, and one of the following: fresh scat, evidence of recent digging, or tracks], 2 for likely active [opening may have some blockage, the abovementioned sign could appear less fresh], 1 for likely inactive [lacking clear evidence of the abovementioned sign, but not clearly inactive, and 0 for inactive [no sign and extensive blockage of the burrow opening]). These criteria would be improved upon and surveyors would score burrows with a photo-supplemented guide that clearly explains the developed system. This should decrease subjectivity between observers and would allow a means of

addressing burrows that are not clearly active or inactive (the majority of burrows in a colony do not clearly fit into definitive categories of active or inactive, and when marking colony perimeters, it is necessary to classify all peripheral burrows as such; this leads to highly subjective results). Each plot would receive a quantitative activity score that could be used to compare changes in population from year to year. Results would also be mapped in ArcGIS which would allow for a variety of spatial analyses. We feel that this method would result in more accurate assessments of change in Gunnison's prairie dog populations at individual colonies.

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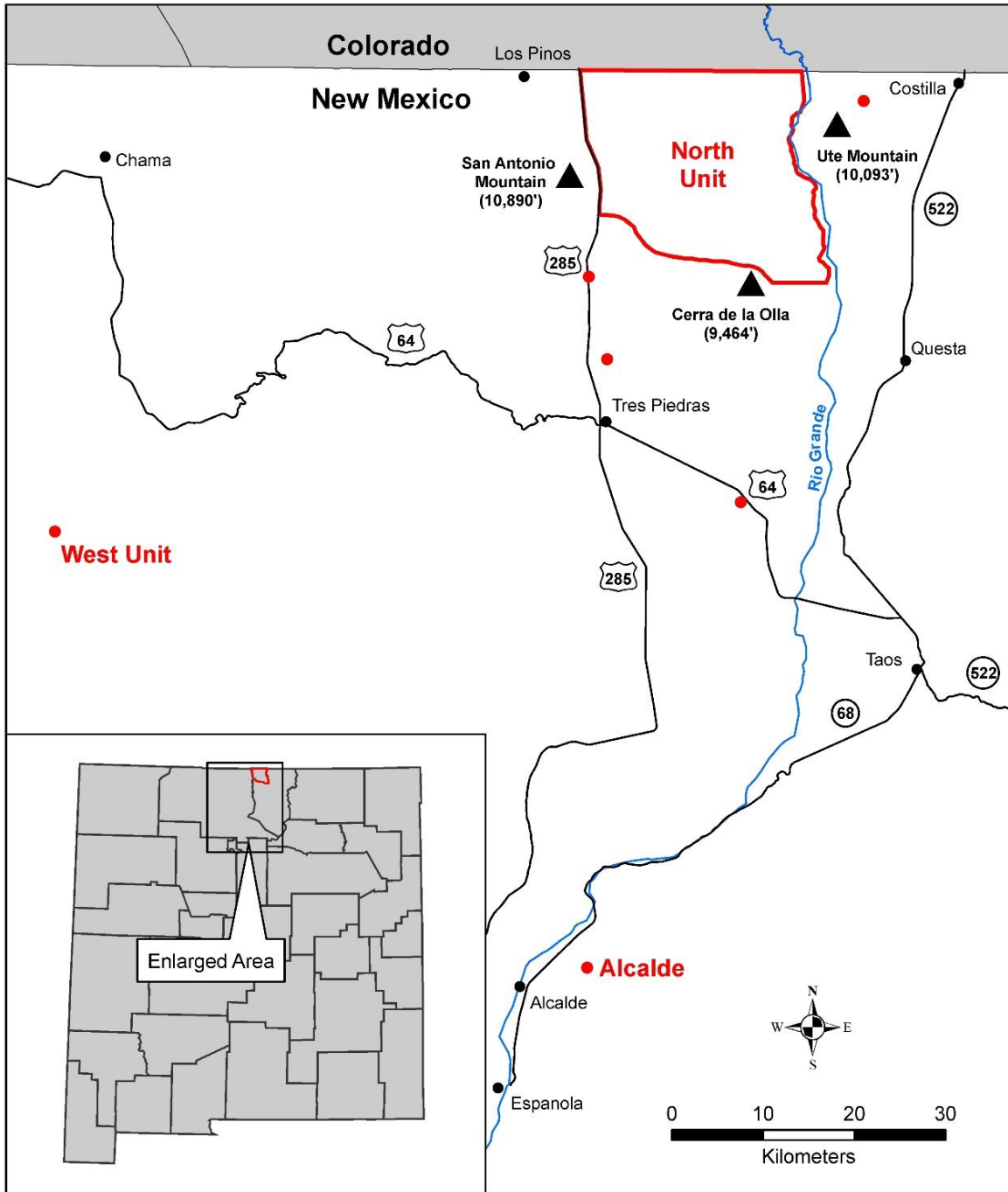


Figure 1. Location of the North Unit and other historic prairie dog monitoring sites (indicated by red dots) in the Bureau of Land Management, Taos Resource Area.

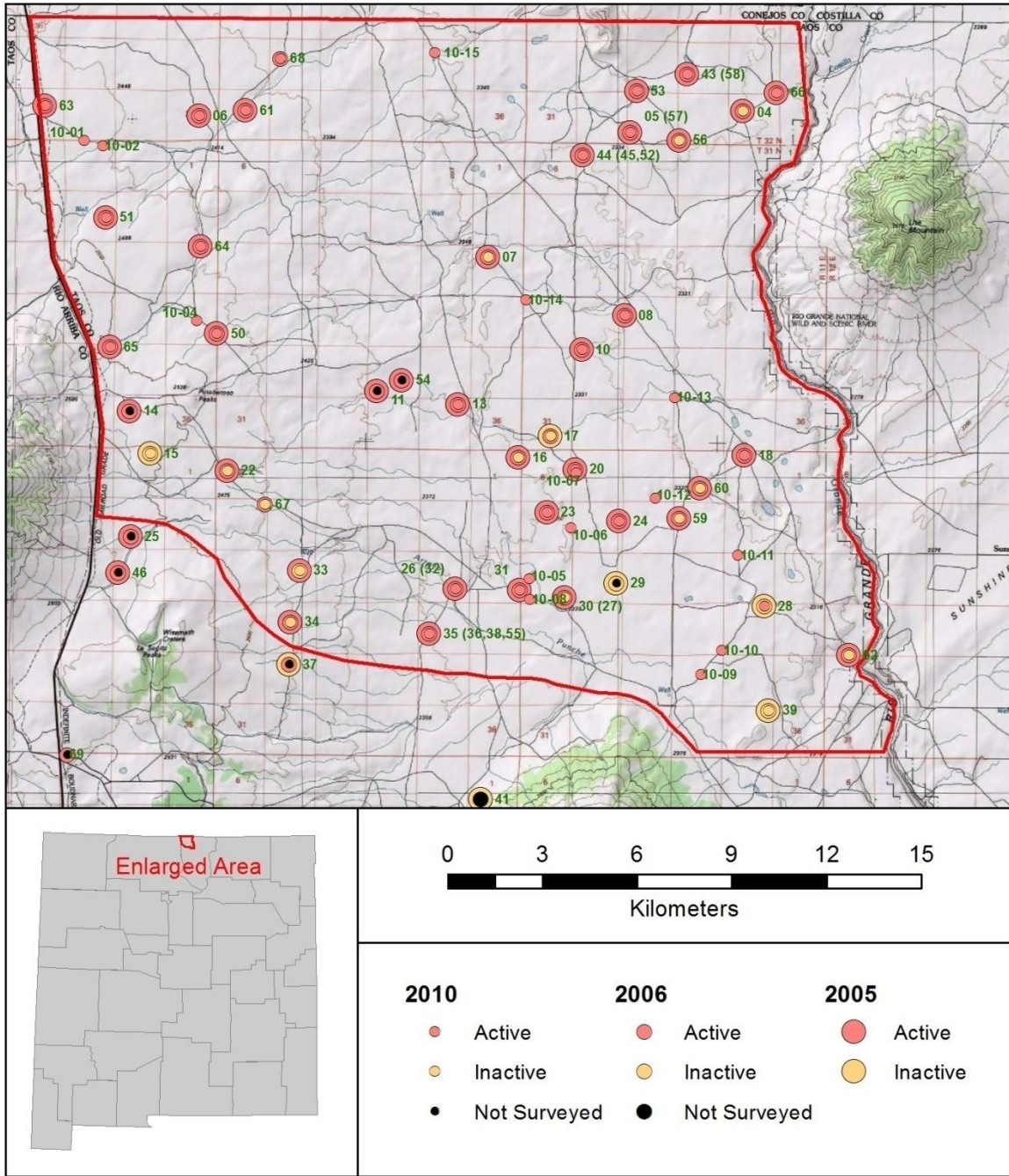


Figure 2. Locations of active and inactive Gunnison’s prairie dog colonies in 2005, 2006, and 2010 on the North Unit, Taos County, New Mexico. Colony names in parentheses indicate historic colonies that were merged when perimeters overlapped.

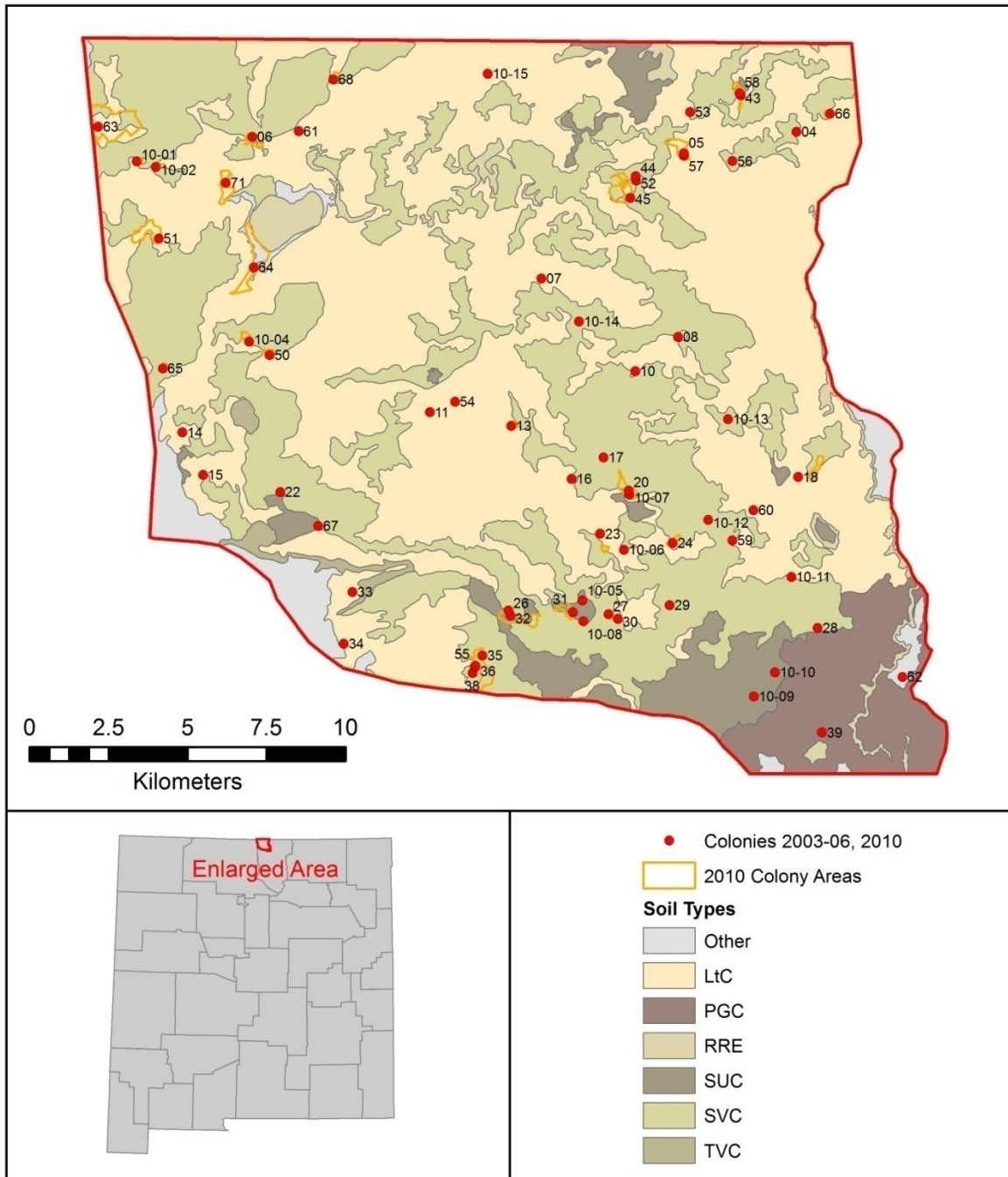


Figure 3. Soil types and locations of Gunnison’s prairie dog colonies from 2003-2006, and 2010 on the North Unit, Taos County, New Mexico. The following dominant soil types are shown: Luhon-Travelers complex, 3-7% slopes (LtC); Stunner-Luhon association, gently sloping (SUC); Stunner-Travelers association, gently sloping (SVC); Travler’s very stony loam, 1-8% slopes (TVC); Petaca-Silva association, gently sloping (PGC); and Rock outcrop-Raton complex, moderately steep (RRE).

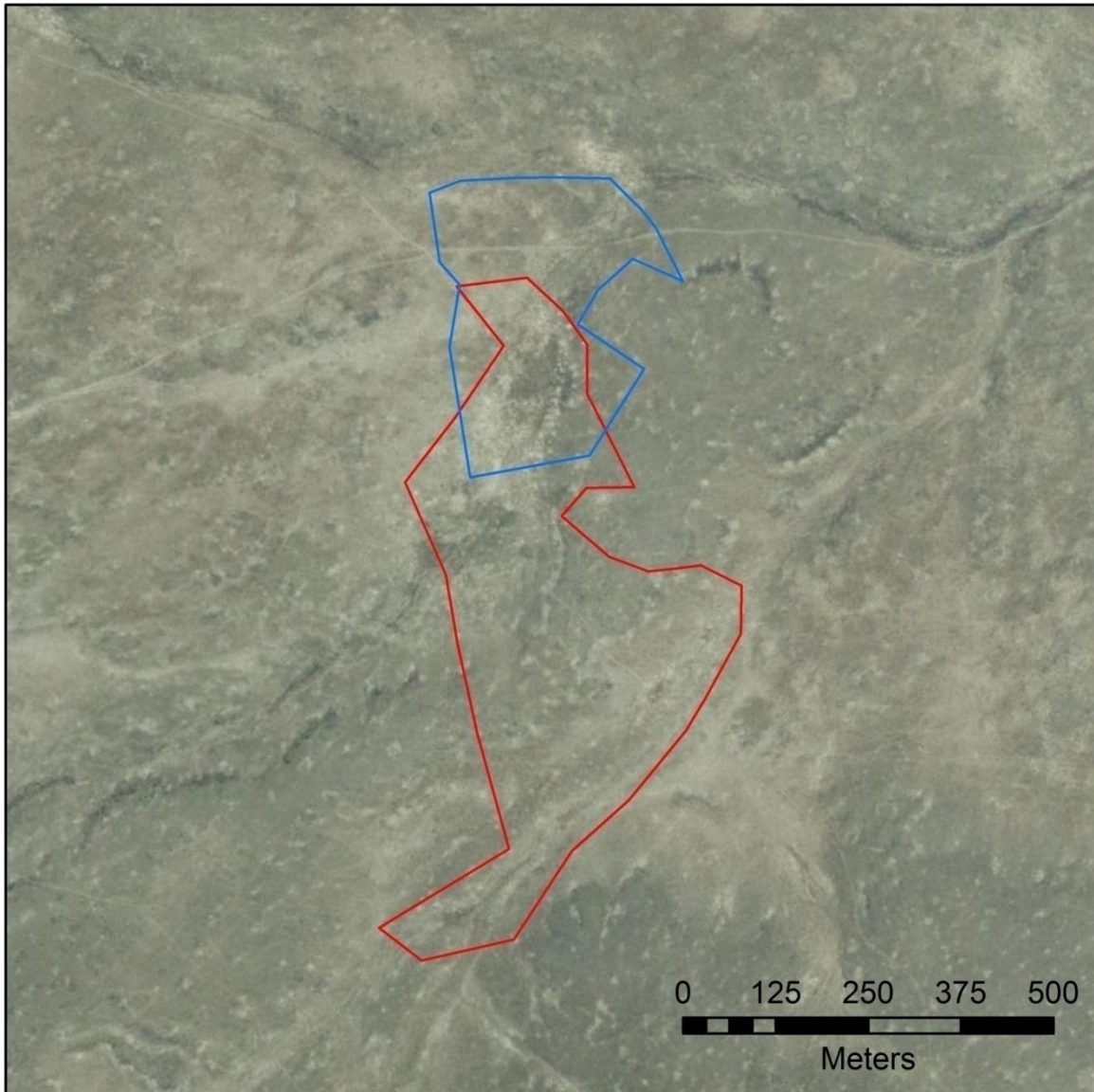


Figure 4. Perimeters of two Gunnison's prairie dog colonies (71 shown in red, a colony originally thought to be new is shown in blue) mapped on two different days by the same observers on the North Unit, Taos County, New Mexico. Originally believed to be two separate colonies, it was not realized that these colonies overlapped until the perimeters were plotted in ArcGIS. Based on current methodology, the two polygons should be nearly identical.

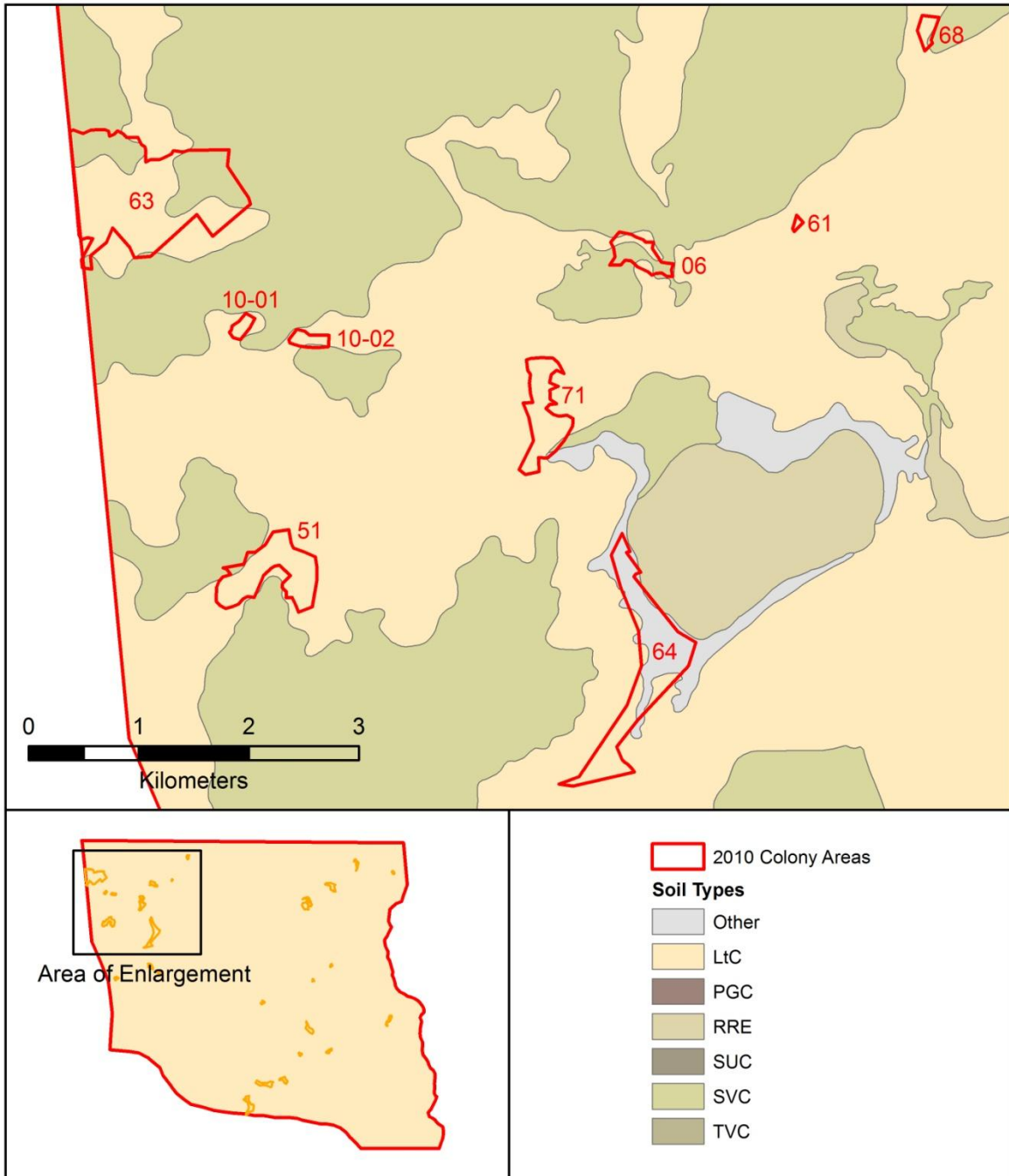


Figure 5. Enlargement of the northwest corner of the North Unit, Taos County, New Mexico. Perimeters of Gunnison’s prairie dog colonies in 2010 are shown with soil types. The following dominant soil types are shown: Luhon-Travelers complex, 3-7% slopes (LtC); Stunner-Luhon association, gently sloping (SUC); Stunner-Travelers association, gently sloping (SVC); Travler’s very stony loam, 1-8% slopes (TVC); Petaca-Silva association, gently sloping (PGC); and Rock outcrop-Raton complex, moderately steep (RRE).

Appendix 1. UTM coordinates (Zone 13N, NAD27) of prairie dog colonies on the North Unit, Taos County, New Mexico. Several colonies were merged with pre-existing colonies in later years, based on close proximity. We shade these colonies gray and indicate the new colony number and year first merged. Although proximate, six colonies are located outside of the North Unit boundary and were not surveyed in 2010. These colonies are shaded yellow.

| Colony | Easting | Northing | Merged    |
|--------|---------|----------|-----------|
| 4      | 433956  | 4091633  | -         |
| 5      | 430390  | 4090944  | -         |
| 6      | 416726  | 4091468  | -         |
| 7      | 425883  | 4086988  | -         |
| 8      | 430207  | 4085138  | -         |
| 10     | 428851  | 4084053  | -         |
| 11     | 422351  | 4082753  | -         |
| 13     | 424927  | 4082324  | -         |
| 14     | 414519  | 4082117  | -         |
| 15     | 415171  | 4080771  | -         |
| 16     | 426838  | 4080644  | -         |
| 17     | 427848  | 4081323  | -         |
| 18     | 434005  | 4080705  | -         |
| 20     | 428646  | 4080271  | -         |
| 22     | 417613  | 4080228  | -         |
| 23     | 427746  | 4078909  | -         |
| 24     | 430035  | 4078617  | -         |
| 25     | 414559  | 4078134  | -         |
| 26     | 424844  | 4076476  | -         |
| 27     | 428002  | 4076367  | 30 (2006) |
| 28     | 434626  | 4075928  | -         |
| 29     | 429945  | 4076653  | -         |
| 30     | 428299  | 4076211  | -         |
| 31     | 426885  | 4076428  | -         |
| 32     | 424902  | 4076319  | 26 (2005) |
| 33     | 419904  | 4077062  | -         |
| 34     | 419626  | 4075426  | -         |
| 35     | 424012  | 4075054  | -         |
| 36     | 423789  | 4074731  | 35 (2006) |
| 37     | 419571  | 4074073  | -         |
| 38     | 423703  | 4074500  | 35 (2006) |
| 39     | 434765  | 4072618  | -         |
| 41     | 425651  | 4069805  | -         |
| 43     | 432187  | 4092792  | -         |

| Colony | Easting | Northing | Merged    |
|--------|---------|----------|-----------|
| 44     | 428869  | 4090224  | -         |
| 45     | 428699  | 4089537  | 44 (2006) |
| 46     | 414167  | 4076985  | -         |
| 50     | 417281  | 4084566  | -         |
| 51     | 413766  | 4088251  | -         |
| 52     | 428875  | 4090085  | 44 (2005) |
| 53     | 430592  | 4092260  | -         |
| 54     | 423149  | 4083091  | -         |
| 55     | 423778  | 4074690  | 36 (2005) |
| 56     | 431930  | 4090700  | -         |
| 57     | 430388  | 4090879  | 5 (2005)  |
| 58     | 432148  | 4092851  | 43 (2005) |
| 59     | 431928  | 4078704  | -         |
| 60     | 432594  | 4079656  | -         |
| 61     | 418198  | 4091646  | -         |
| 62     | 437310  | 4074378  | -         |
| 63     | 411848  | 4091791  | -         |
| 64     | 416774  | 4087334  | -         |
| 65     | 413895  | 4084140  | -         |
| 66     | 435016  | 4092206  | -         |
| 67     | 418817  | 4079157  | -         |
| 68     | 419297  | 4093287  | -         |
| 69     | 412551  | 4071218  | -         |
| 70     | 413496  | 4075288  | -         |
| 71     | 415889  | 4090013  | -         |
| 10-01  | 413065  | 4090694  | -         |
| 10-02  | 413676  | 4090512  | -         |
| 10-04  | 416633  | 4084984  | -         |
| 10-05  | 427176  | 4076801  | -         |
| 10-06  | 428493  | 4078403  | -         |
| 10-07  | 428664  | 4080144  | -         |
| 10-08  | 427206  | 4076137  | -         |
| 10-09  | 432606  | 4073762  | -         |
| 10-10  | 433276  | 4074524  | -         |
| 10-11  | 433794  | 4077540  | -         |
| 10-12  | 431162  | 4079343  | -         |
| 10-13  | 431792  | 4082539  | -         |
| 10-14  | 427072  | 4085627  | -         |
| 10-15  | 424181  | 4093466  | -         |

Appendix 2. Characteristics of prairie dog colonies on the North Unit, Taos County, New Mexico. We indicate active (Y) and inactive (N) colonies from 2003-2006, and 2010, and we estimate active colony area in 2005, 2006, and 2010. Gray shading indicates colonies that were merged when perimeters began to overlap with other colonies (numbers indicate the retained colony name). Yellow shading indicates proximate colonies that are located outside of the North Unit boundary and were not surveyed in 2010.

| Colony | Active (Y), Inactive (N), or Not Surveyed (NS) |      |      |      |      | Area (Acres) |       |      |
|--------|--|------|------|------|------|--------------|-------|------|
|        | 2003   | 2004 | 2005 | 2006 | 2010 | 2005         | 2006  | 2010 |
| 4      | N  | N    | Y    | Y    | N    | 12.4         | 16.9  | -    |
| 5      | Y  | Y    | Y    | Y    | Y    | 10.2         | 48.6  | 57.7 |
| 6      | Y  | N    | Y    | Y    | Y    | 2.5          | 9     | 29.5 |
| 7      | Y  | N    | Y    | Y    | N    | 7.8          | 22.2  | -    |
| 8      | Y  | Y    | Y    | Y    | Y    | 3.6          | 19    | 5.5  |
| 10     | N  | N    | Y    | Y    | Y    | 2.8          | 10.4  | 3.2  |
| 11     | N  | N    | Y    | Y    | NS   | 4.5          | 10.8  | -    |
| 13     | N  | N    | Y    | Y    | Y    | 1.9          | 4     | 9.2  |
| 14     | N  | N    | Y    | Y    | NS   | 5            | 9.8   | -    |
| 15     | Y  | N    | N    | N    | N    | -            | -     | -    |
| 16     | Y  | N    | Y    | Y    | N    | 1            | 18.4  | -    |
| 17     | N  | N    | N    | Y    | N    | -            | 1.2   | -    |
| 18     | N  | N    | Y    | Y    | Y    | 2.6          | 72    | 25.3 |
| 20     | N  | N    | Y    | Y    | Y    | 1.6          | 5.1   | 49.6 |
| 22     | Y  | N    | Y    | Y    | N    | 1.1          | 11.8  | -    |
| 23     | Y  | N    | Y    | Y    | Y    | 3.9          | 14.2  | 7.9  |
| 24     | N  | N    | Y    | Y    | Y    | 2.8          | 23.2  | 15.5 |
| 25     | Y  | Y    | Y    | Y    | NS   | 0.7          | 26.5  | -    |
| 26     | Y  | Y    | Y    | Y    | Y    | 7.5          | 39.8  | 74.6 |
| 27     | N  | N    | N    | ~30  | ~30  | -            | -     | -    |
| 28     | N  | N    | N    | N    | Y    | -            | -     | 1.0  |
| 29     | N  | N    | N    | N    | NS   | -            | -     | -    |
| 30     | N  | N    | Y    | Y    | N    | 10.5         | 47.4  | -    |
| 31     | N  | N    | Y    | Y    | Y    | 4.4          | 23    | 33.3 |
| 32     | Y  | Y    | ~26  | ~26  | ~26  | -            | -     | -    |
| 33     | N  | N    | Y    | N    | N    | 0.9          | -     | -    |
| 34     | Y  | N    | Y    | Y    | N    | 0.4          | 9.9   | -    |
| 35     | N  | N    | Y    | Y    | Y    | 4.8          | 108.9 | 92.6 |
| 36     | N  | Y    | Y    | ~35  | ~35  | 28.7         | -     | -    |
| 37     | Y  | Y    | N    | Y    | NS   | -            | 0     | -    |
| 38     | Y  | Y    | Y    | ~35  | ~35  | 2.5          | -     | -    |
| 39     | N  | N    | N    | N    | N    | -            | -     | -    |
| 41     | N  | N    | N    | -    | NS   | -            | -     | -    |
| 43     | Y  | Y    | Y    | Y    | Y    | 8.7          | 29.8  | 20.8 |
| 44     | N  | N    | Y    | Y    | Y    | 37.8         | 79.1  | 80.7 |
| 45     | N  | N    | N    | ~44  | ~44  | -            | -     | -    |

| Colony         | Active (Y), Inactive (N), or Not Surveyed (NS) |      |      |      |      | Area (Acres) |        |        |
|----------------|--|------|------|------|------|--------------|--------|--------|
|                | 2003   | 2004 | 2005 | 2006 | 2010 | 2005         | 2006   | 2010   |
| 46             | Y  | Y    | Y    | Y    | NS   | 2.4          | 19     | -      |
| 50             | -  | Y    | Y    | Y    | Y    | 8.5          | 34.8   | 15.0   |
| 51             | -  | Y    | Y    | Y    | Y    | 3.4          | 5.3    | 85.3   |
| 52             | -  | Y    | ~44  | ~44  | ~44  | -            | -      | -      |
| 53             | -  | Y    | Y    | Y    | Y    | 52           | 169.1  | 1      |
| 54             | -  | Y    | Y    | Y    | NS   | 8.6          | 52.6   | -      |
| 55             | -  | Y    | ~36  | ~36  | ~36  | -            | -      | -      |
| 56             | -  | Y    | Y    | Y    | N    | 18.9         | 21.9   | -      |
| 57             | -  | Y    | ~5   | ~5   | ~5   | -            | -      | -      |
| 58             | -  | Y    | ~43  | ~43  | ~43  | -            | -      | -      |
| 59             | -  | -    | Y    | Y    | N    | 1.5          | 4.3    | -      |
| 60             | -  | -    | Y    | Y    | N    | 4.6          | 8.7    | -      |
| 61             | -  | -    | Y    | Y    | Y    | 4.4          | 9      | 1.6    |
| 62             | -  | -    | Y    | Y    | N    | 1.9          | 5      | -      |
| 63             | -  | -    | Y    | Y    | Y    | 11.3         | 14.8   | 312.2  |
| 64             | -  | -    | Y    | Y    | Y    | 66.2         | 58.1   | 152.0  |
| 65             | -  | -    | Y    | Y    | Y    | 3.2          | 24.8   | 11.1   |
| 66             | -  | -    | Y    | Y    | Y    | 5.5          | 21.3   | 6.5    |
| 67             | -  | -    | -    | Y    | N    | -            | 2.1    | -      |
| 68             | -  | -    | -    | Y    | Y    | -            | 5.5    | 9.2    |
| 69             | -  | -    | -    | Y    | NS   | -            | 41     | -      |
| 70             | -  | -    | -    | Y    | NS   | -            | 35.8   | -      |
| 71             | -  | -    | -    | Y    | Y    | -            | 14.5   | 63.6   |
| 10-01          | -  | -    | -    | -    | Y    | -            | -      | 7.0    |
| 10-02          | -  | -    | -    | -    | Y    | -            | -      | 10.3   |
| 10-04          | -  | -    | -    | -    | Y    | -            | -      | 19.9   |
| 10-05          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-06          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-07          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-08          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-09          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-10          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-11          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-12          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-13          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-14          | -  | -    | -    | -    | Y    | -            | -      | -      |
| 10-15          | -  | -    | -    | -    | Y    | -            | -      | -      |
| Total Active   | 16   | 19   | 40   | 44   | 39   | -            | -      | -      |
| Total Inactive | 21   | 27   | 9    | 5    | 15   | -            | -      | -      |
| Total Acres    | -  | -    | -    | -    | -    | 363.0        | 1208.6 | 1201.1 |
| Avg. Acres     | -  | -    | -    | -    | -    | 9.1          | 27.5   | 42.9   |