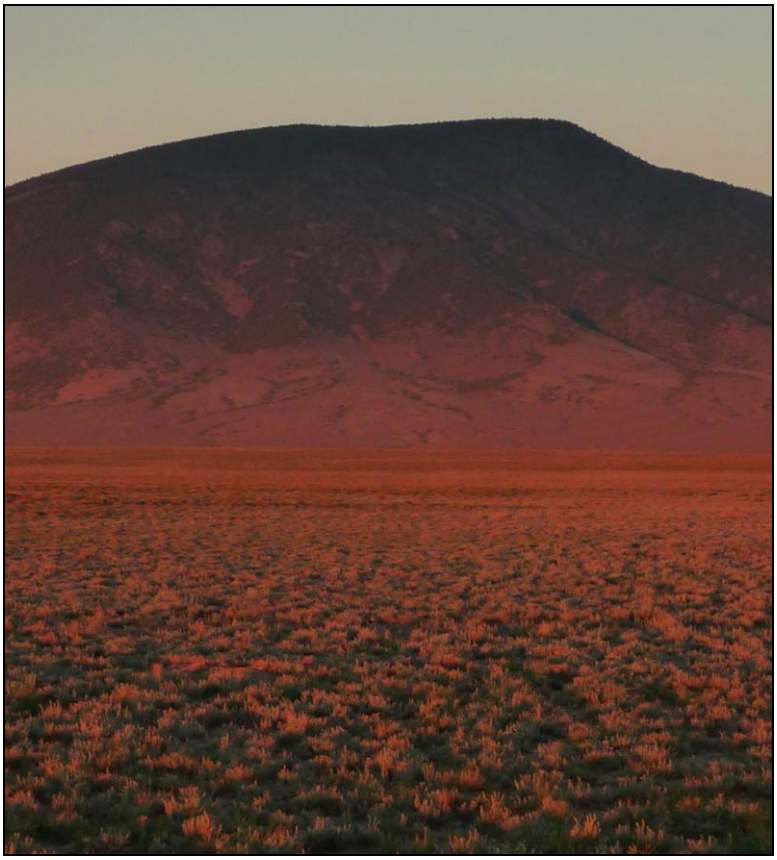
2010 MOUNTAIN PLOVER MONITORING ON THE NORTH UNIT

BUREAU OF LAND MANAGEMENT, TAOS FIELD OFFICE, NEW MEXICO



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December 2010

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EXECUTIVE SUMMARY

A potentially sizeable Mountain Plover (*Charadrius montanus*) population exists on the Bureau of Land Management's (BLM) North Unit in northern Taos County, New Mexico. BLM contracted Hawks Aloft, Inc., to conduct population monitoring studies on the North Unit in 2001. Initial monitoring determined general distribution patterns for Mountain Plovers on the North Unit, but a standardized method of estimating density and population size was needed. From 2005-2007, and 2010, we employed distance sampling at 245 roadside survey points along eight transects. Using DISTANCE 5.0, we calculated a density of 0.017 Mountain Plovers per ha (1.7 birds/km^2). To estimate population size, we projected the density on the entire North Unit (about 48,000 ha) and estimate the maximum breeding population to be 816 individuals. The detection rate in 2010 was 0.12 (±0.06), slightly higher than the 2005-2007 mean of 0.11. Detection rate analyses were also conducted for two different landscape subunits: soils and land cover. The two soil types which constituted 84.5% of the study area and contained 86.9% of the points had similar detection rates (0.13 and 0.10) and similar percentages of points with at least one detection (21.3% and 24.8%). Six land cover polygons were created; differences in plover detection rates indicated more variability between land cover subunits than soil subunits. Although effort between subunits was fairly representative of site percentages, three of the polygons contained less than ten survey points. These smaller samples may not be adequate to characterize plover utilization of the land cover type and facilitate comparison with subunits with more survey effort. Of the three subunits which contained at least 10% of the points, detection rates varied from 0.05 to 0.36. This indicates a possible preference for certain land cover types by breeding Mountain Plovers. Future

efforts should be made to ground truth land cover data, calculate density by land cover subunit, and project that density onto the separate subunits for a more accurate estimation of the North Unit population. Although the density of Mountain Plovers on the North Unit is seemingly less than those reported for populations in other regions, the large size of the North Unit makes this a valuable site for Mountain Plover conservation in New Mexico. To complement our plover research, we also recorded any Burrowing Owls (*Athene cunicularia*) found opportunistically or by revisiting previously occupied burrows. In 2010, we found 8 adult owls at 6 locations in the North Unit, and documented breeding at two of these sites. Owl monitoring was not rigorous and it is likely that breeding occurred at more than two of the 6 identified territories.

Mountain Plover on the BLM Taos North Unit, Taos County, NM. Photo by Mike Stake.

INTRODUCTION

Mountain Plovers (*Charadrius montanus*) inhabit shortgrass prairies and rangeland in the western Great Plains and the Colorado Plateau (Knopf 1996). Due to concerns over habitat loss and negative population trends (Knopf 1994), the U.S. Fish and Wildlife Service proposed to list the Mountain Plover as a threatened species under the Endangered Species Act in 1999 and again in 2002. Because data indicated that the degree of threats was not significant enough to endanger the species in the future, they withdrew the 2002 proposed listing in September 2003 (U.S. Department of Interior 2003). This decision was based, in part, on research documenting widespread use of cultivated fields by Mountain Plovers (Knopf and Rupert 1999). In November 2006, the Forest Guardians and the Biological Conservation Alliance filed a complaint against the U.S. Fish and Wildlife Service challenging the withdrawal, and as a result, the Service reinstated the proposal on 29 June 2010. The Service is expected to submit a final listing decision by May 2011 (U.S. Department of Interior 2010).

Population studies in Colorado (Wunder et al. 2003) and Wyoming (Plumb et al. 2005) indicate that the North American population might be 11,000 to 14,000 birds (Knopf 1996). Much of the research contributing to status decisions has focused on core breeding populations; relatively little is known about populations along the periphery of the breeding range, such as in New Mexico (but see Tolle 1976, Sager 1996). Monitoring Mountain Plover population sizes and trends in New Mexico can improve global estimates and assist future status decisions.

A potentially sizeable Mountain Plover population exists in Taos County, New Mexico, on land managed by the Bureau of Land Management (BLM) and referred to as

the North Unit. In 2001 and 2003, BLM contracted Hawks Aloft, Inc., to conduct Mountain Plover surveys on the approximately 48,000-ha North Unit. Results from these surveys indicated general plover distribution, as well as probable breeding status for at least some individuals. However, the surveys were not designed to estimate population size or trends. Beginning in 2004, we attempted to estimate population size using distance sampling techniques. Our methods evolved after the 2004 season; initially, off-road driving transects were our preferred method (see Wunder et al. 2003), but we switched to roadside point counts in 2005. We found that roadside surveys improved our sample size by allowing us to cover a greater portion of the North Unit and navigate through the network of grazing allotment fences. We decided that in addition to providing density information, point counts would ensure a standardized, repeatable framework for monitoring population changes over time. In this report, we present Mountain Plover density and population estimates on the North Unit, based on distance sampling at survey points from 2005-2007, and 2010; we also evaluate potential population changes on the North Unit during those years.

We complemented Mountain Plover surveys with monitoring for two associated species, Burrowing Owl (*Athene cunicularia*) and Gunnison's prairie dog (*Cynomys gunnisoni*). Burrowing Owl data were collected anecdotally during plover and prairie dog surveys and are presented in this report. Prairie dog research is presented in a separate report.

STUDY AREA

We conducted fieldwork on BLM's North Unit, a short-grass plain and rangeland in northern Taos County, New Mexico, about 20 km north of Tres Piedras (Fig. 1). The approximately 50,000-ha study site extends from Highway 285 east to the Rio Grande gorge, and from Cerro de la Olla north to the Colorado border. The North Unit 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 (*Artemesia 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

We conducted point counts using Mountain Plover survey guidelines suggested by Williams (1997) and the U.S. Fish and Wildlife Service (1999). Point counts are used to survey a variety of species and habitats (Bibby et al. 2000). This method can work well with Mountain Plovers, because birds are relatively easy to detect in their open habitat when they are present. In 2005, we established 245 survey points along eight roadside transects on the North Unit at 0.3-mile intervals (Fig. 2), as recommended by Williams (1997). We were satisfied with this distance, because we considered that 0.3 miles was

far enough to prevent the same individuals from being counted at multiple points, yet close enough to survey an adequate sample of points in one morning.

In each year from 2005-2007, and 2010, we visited the same 245 survey points, relocating them using Universal Transverse Mercator (UTM) coordinates (Appendix 1). Coverage of all points required eight survey mornings (one transect per morning, 25-35 points each). From 2005-2007, we surveyed four transects in late April, three in late May, and one in June. April surveys were conducted after the usual spring migration period (see Knopf 1996); therefore, most, if not all observed plovers were summer residents of the North Unit. In 2010, all surveys were conducted between 1 and 23 May. Surveys were conducted primarily during morning and late afternoon hours when lower sunlight angles made plovers easier to detect. To conduct point count surveys, the observer drove to each point and recorded all Mountain Plovers detected within three minutes. Upon arriving at a point, the observer noted the time and quickly scanned the immediate vicinity before leaving the vehicle. The observer then stepped out of the vehicle and thoroughly scanned every direction. Three minutes were usually enough to complete visual coverage of surrounding habitat; at some points, additional time was needed to complete our scans. As recommended by the U.S. Fish and Wildlife Service (1999), one observer conducted all surveys during a year.

We detected Mountain Plovers either by sight or by sound. No conspecific tape playback was used. When a plover was detected, we recorded the distance (in meters) of the bird from the survey point when first detected. This distance was determined with a Leupold RX-600 rangefinder, or, when obtaining precise readings of the target in the rather flat, sparsely-vegetated terrain proved difficult, the distance was estimated. Plovers

first observed in flight were recorded as flyovers unless we strongly suspected that we flushed them from surveyed habitat. In that case, we recorded the distance to where we thought they were disturbed.

We used detection rates to evaluate a potential population trend from 2005-2010. Detection rates do not measure absolute numbers of birds, but they can be useful as a relative measure for comparison among years. We define detection rate as the number of plovers observed divided by the number of points surveyed (245). Only plovers observed during point counts were included in detection rate calculations. We compare detection rates among years (2005-2007, and 2010), using 95% confidence intervals.

We used program DISTANCE 5.0 (Thomas et al. 1998) to calculate Mountain Plover density, based on 2005-2007, and 2010 point count data and a model of detection probability as a function of distance. We considered the six models suggested by Buckland et al. (2001), and used in Mountain Plover population studies by Wunder et al. (2003) and Plumb et al. (2005) in Colorado and Wyoming, respectively. These models included the uniform key function with cosine and simple polynomial expansion series (models 1 and 2), the half-normal key function with cosine and hermite polynomial expansion series (models 3 and 4), and the hazard-rate key function with cosine and simple polynomial expansion series (models 5 and 6). All models were based on data stratified by year. We selected the best model based on Akaike's Information Criterion (AIC). Because AIC only evaluates the strength of competing models relative to each other, we considered goodness-of-fit P values to determine if the models fit the data well. We used continuous distances and truncated the outer 3% of distances from the data (e.g. Wunder et al. 2003). We present a density estimate as the number of birds per hectare.

To estimate population size for the North Unit, we projected our density estimate on a portion of the site considered to be occupied habitat. Consistent with Wunder et al. (2003) and Plumb et al. (2005), we estimated the extent of occupied habitat based on a map of local Mountain Plover distribution and the average plover home range size (56 ha, Knopf 1996). We used ArcGIS to generate a grid of 56 ha cells overlaid on a map with plotted location coordinates for all Mountain Plovers observed on the North Unit from 2001-2007, and 2010 (Figure 3). Mountain Plovers were recorded in 190 of the 56 ha cells during that period, resulting in an estimate of occupied habitat of 10,640 ha. Because this area represents only 22% of the North Unit, and we can not be certain that the remaining portion is unoccupied, projecting the density onto the occupied habitat estimate likely results in a conservative estimate of population size for the North Unit. As a potential upper boundary, we also projected plover density on the entire 48,000-ha site.

Prior to 2010, our estimates of the Mountain Plover population on the North Unit were limited to the projection of density calculations onto the entire North Unit and onto an estimated occupied habitat. By projecting the density estimate onto the entire North Unit, we make the assumption that plover density along transects is representative of the entire area, a difficult claim to make when our survey area covers only approximately 15% of the unit (assuming a survey radius of ~300 m and factoring for overlap between points). Projecting the density onto the estimated occupied habitat is problematic because effort has been restricted to a limited part of the unit; increasing the search for plovers to a wider area would certainly increase the occupied habitat estimate, thus this projection is likely a low estimate of the true population. In 2010, an attempt was made to correlate Mountain Plover detections with landscape features that would enable us to better project

our density calculations onto the North Unit in the future. Plover detections were plotted over soil (SSURGO), elevation (NED shaded relief), and land cover (SWReGAP) layers with ArcGIS. The resolution of the elevation layer was insufficient for analysis, but soils and land cover layers were examined for patterns of correlation with plover detections. In 2010, detection rates were calculated for the different soil types and land cover polygons (polygons were created to encompass mosaics of patchy land covers into single units). The intention of these analyses was to uncover possible correlations between plover abundance and landscape layers which, after layer accuracy is verified by future ground-truthing, will enable the calculation of density estimates by subunit (i.e. soil type or land cover type) and result in better estimates of the North Unit population.

Burrowing Owl detections were recorded opportunistically, either early in the breeding season during Mountain Plover surveys, or late in the season during prairie dog surveys. We present the number of locations where owls were found, the number of different Burrowing Owls observed, and the minimum number of young observed.

RESULTS

Using DISTANCE 5.0, we calculated a Mountain Plover density of 1.7 birds/km^2 or 0.017 birds per ha (95% confidence interval = 0.01-0.31) on the North Unit, based on 114 detections during point count surveys from 2005-2007, and 2010. The half-normal key function with cosine series expansion provided the best fit to the detection function among competing models, based on lowest AIC. A goodness of fit test indicated that this model fit the data (P=0.38). Projecting a density of 0.017 birds per ha over an estimated 10,640 ha of occupied habitat, we estimate a population size of 181 Mountain Plovers in

documented habitat. Projecting over the entire North Unit (~48,000 ha) yields a potential upper boundary estimate of 816 Mountain Plovers.

The Mountain Plover detection rate in 2010 (0.12 ± 0.06 birds/pt, 30 detections) was similar to the 2005-2007 mean (Appendix 2). The addition of 2010 data increases the mean of all survey years to (0.12 ± 0.07 birds/pt, 114 detections). Detection rates were also calculated by soil type and land cover. Twelve soil types were identified as occurring in the North Unit. Of these, three distinct soil types and a fourth category, which was an amalgamation of the other eight types (which are widely scattered and uncommon in the study area), were used for analysis (Figure 5, Appendix 3). Of the four soil subunits, two (LtC and SVC—full names are given in Appendix 3) constituted 84.5% of the area and included 87.0% of the survey points. Detection rates for survey years between 2005 and 2010 for these types were similar (0.13 for LtC and 0.10 for SVC), as were the percentages of points with at least one detection (21.3% and 24.8% respectively). The SUC soil type, which constitutes 4.8% of the North Unit and includes 9.4% of the points, had a much lower detection rate (0.03) and percentage of points with at least one detection (8.7%) than the LtC and SVC subunits. The fourth category, which includes the eight least common soil types, comprises 10.7% of the study area, but includes only nine survey points (4% of the total). The detection rate for this category (0.25) was nearly twice as high as the second highest rate; however, the sample size is too small for reliable comparison.

Five major SWReGAP land cover types occur in the North Unit, but because several of these types occur only in patchy mosaics of two separate types, it was necessary to create six subunit polygons which included two distinct land cover types and

four mosaics (Figure 6, Appendix 4) for purposes of analysis. Comprising 41.6% of the North Unit, the Inter-mountain Basins Semi-desert Shrub Steppe (SDSS) polygon was the largest land cover type used for analysis. This classification included 102 survey points (41.6% of the total), but had the lowest detection rate (0.05) of all subunits with large sample sizes. The highest detection rate (0.36) occurred in the SDSS / Inter-mountain Basins Semi-desert Grasslands (SDG) mosaic polygon. This classification grouping covers 8.2% of the study area and includes 11.8% of the survey points. The other classification which is represented by high survey effort was the SDSS / Inter-mountain Basins Big Sage Shrubland (BSS). This subunit, which covers 35.8% of the site and contains 39.2% of the survey points, had a relatively low detection rate of 0.11. The remaining three classifications (BSS, SDSS / Inter-mountain Basins Greasewood Flats, and BSS / Agriculture), which constitute a combined 14.4% of the study site and include 7.4% of the points, had detection rates of 0.18, 0.04, and 0.13 respectively, but sample sizes are too small for meaningful comparison.

Six Burrowing Owl territories were documented in 2010 (Figure 7). Of these, two adult birds were observed at three sites and lone adults were observed at two. A juvenile owl was observed at one site and evidence of breeding was observed at another location (the site where no adult or juvenile owls were seen). Because no standardized effort to document Burrowing Owls has been made on the North Unit during recent years, little information other than annual minimum territories can be gleaned from our incidental observations.

DISCUSSION

Mountain Plover density on the North Unit is lower than reported densities from other regions, but the large size and relative accessibility of the North Unit makes this an important site for continued population monitoring and conservation in New Mexico. Our density estimate of 1.7 plovers per square kilometer is lower than estimates of 7.9 plovers/km^2 in South Park, Colorado (Wunder et al. 2003), 6.0 plovers/km^2 in the Pawnee National Grasslands (Graul and Webster 1976), and 4.5 plovers/km^2 in Wyoming (Plumb et al. 2005). Although Mountain Plovers are locally common elsewhere in New Mexico, mostly on private rangeland in the northeast plains (M. Wunder, pers. comm.), the North Unit, covering over 48,000 ha, likely contains the largest population in New Mexico under a single management authority.

Our population estimate depends greatly on the portion of the North Unit used to project the calculated density. We considered 10,640 ha to be occupied habitat, based on locations documented from 2001-2007, and 2010; however, it is highly unlikely that the remainder of the North Unit was unoccupied. If Mountain Plovers occupy the entire North Unit at the same density we calculated at survey points (0.017 birds/ha), our population estimate would approximate 816 birds. The eight transects might be fairly representative of the entire North Unit, because they covered a range of potential habitat types, including areas of apparent abundance and consistent absence. If the transects are representative, the actual population size might be closer to what could be projected for the entire North Unit (816 plovers) than to what is projected for documented habitat (181 plovers). We suggest that the true population size currently resides between those figures.

We feel that the average population of Mountain Plovers on the North Unit during the survey years likely falls between the two projected estimates of 181 and 816 individuals, but we feel that the precision of our population estimate leaves much room for improvement. The key to a more accurate population estimate is better confidence in the validity of the unit onto which we are projecting the density estimate. The preliminary analyses of landscape variables in relation to Mountain Plover detections conducted in 2010 were the first in what we hope will be a series of attempts to better identify patterns of distribution and land usage by Mountain Plovers on the North Unit. These analyses revealed patterns that should be further explored and expanded upon in future years. We are especially interested in the differences in detection rates calculated for different land cover types. The first step in establishing the reliability of using the landcover polygons as stratification (and eventually, projection) in Distance calculations would be the confirmation that the polygons represent real differences in habitat type. Ground-truthing in 2011, coupled with recording data on the habitat being utilized by plovers for each detection, is the first step in proceeding along this line of inquiry. We believe land cover may be an important factor in determining plover occurrence, but the scale of resolution necessary for establishing correlation may be higher than the layers we experimented with in 2010. Personal communication among researchers conducting Mountain Plover counts on the North Unit indicate that plovers can most reliably be found in degraded areas, often where prairie dog activity or concentrations of cattle (and especially, combinations of the two) have altered the vegetation. The ability to identify and map these areas of degradation would likely be a very useful step in achieving the goal of more precise population estimates.

Our North Unit Mountain Plover density and population estimates showed some change from what we reported in 2007, when surveys were last conducted. The additional data in 2010 allowed a more robust analysis, and the 114 observations from 2005-2010 surpass the standard of 60-80 observations recommended by Buckland et al. (2001) as a minimum for calculating density. Although the 30 detections in 2010 were an increase from the 2005-2007 mean of 28, the addition of 2010 data actually resulted in a decrease in the density estimate (0.020 for 2005-2007, 0.017 for 2005-2010). The mean distance of detections in 2010 was 152.7 m, an increase from the 2005-2007 mean of 129.1 m; this increase was the likely cause for the lower density estimate despite the higher number of detections.

Our density calculation might still be affected by possible bias associated with roadside surveys. Because Mountain Plovers use sparsely vegetated open areas, and have been seen on roads, roadside bias could be positive or negative, if indeed there is a bias. Conducting off-road surveys would remedy any bias, but the rough terrain and the network of allotment fences in the North Unit greatly reduce spatial coverage, thereby limiting the sample of Mountain Plover observations, as we discovered in 2004. We considered that roadside point count surveys were our best option for determining density on the North Unit, but we acknowledge the success of off-road survey techniques used at other sites (Wunder et al. 2003, Plumb et al. 2005). Although our 2005-2010 sample is sufficient for determining Mountain Plover density on the North Unit, we recommend continuing annual roadside point count surveys because they offer an efficient and standardized method for identifying population changes, as well as the flexibility to re-evaluate plover density at any time in the future.

The recent reinstatement of the proposal to list the Mountain Plover as a threatened species, should renew interest in developing a better understanding of the distribution and population of the species. It is important to monitor and identify population changes over time, and the identification of changes that occur on the North Unit may reveal information that relates to other New Mexico populations where monitoring and management opportunities are limited by private lands. Since 2001, BLM has demonstrated a commitment to monitoring the population and managing the North Unit in a manner compatible with Mountain Plover conservation. We encourage that commitment to continue with the realization that BLM's impact extends beyond the North Unit, helping biologists evaluate Mountain Plover status in New Mexico and elsewhere.

ACKNOWLEDGMENTS

The Bureau of Land Management, Taos Resource Area, provided funding for this project. We thank Valerie Williams for providing access and assisting with logistics. Ron Kellermueller conducted point count surveys. Report and cover photograph by Erik Andersen. This report was reviewed by Trevor Fetz and Gail Garber, executive director of Hawks Aloft.

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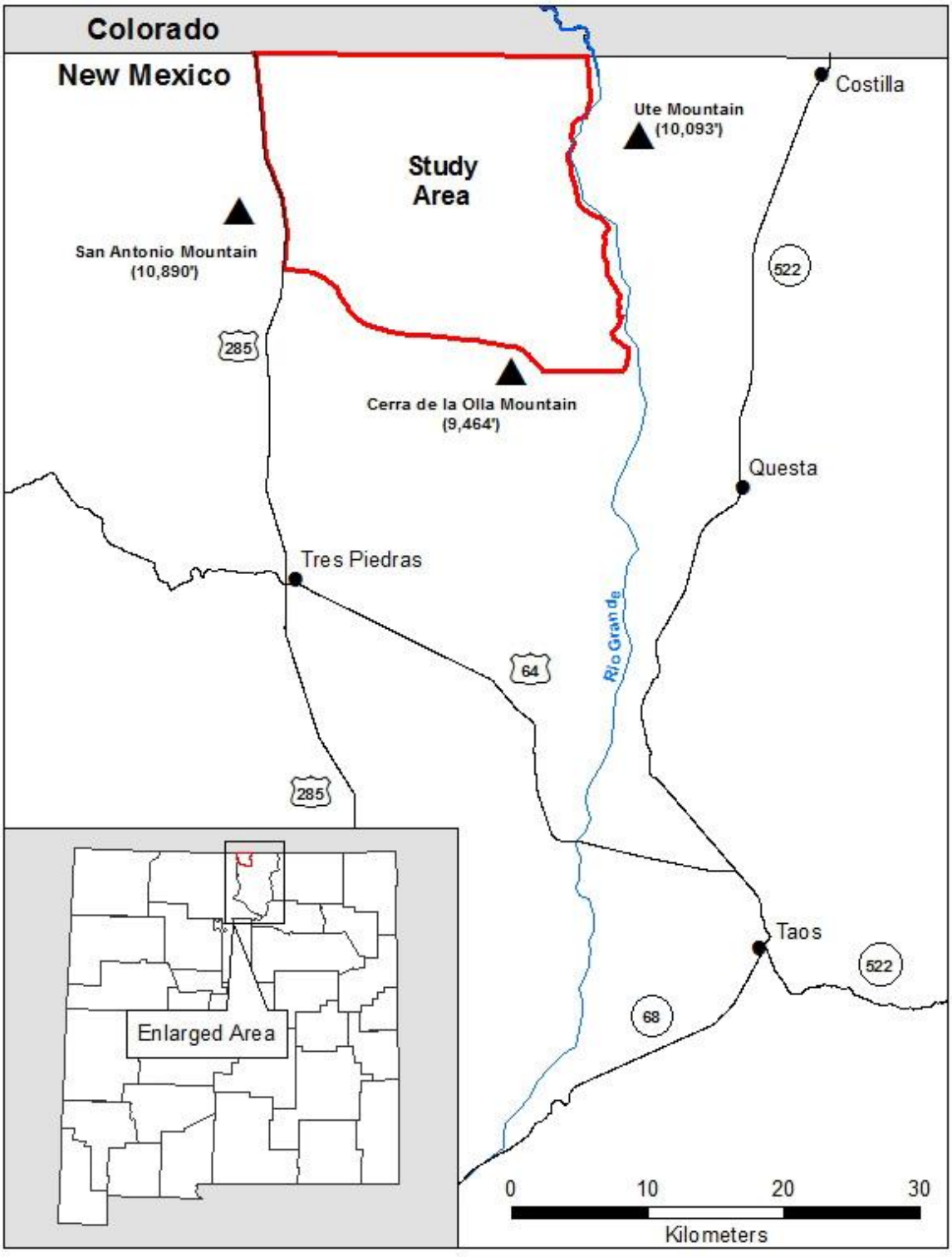

Figure 1. Location of the North Unit Mountain Plover study site, managed by the Bureau of Land Management, Taos County, New Mexico.

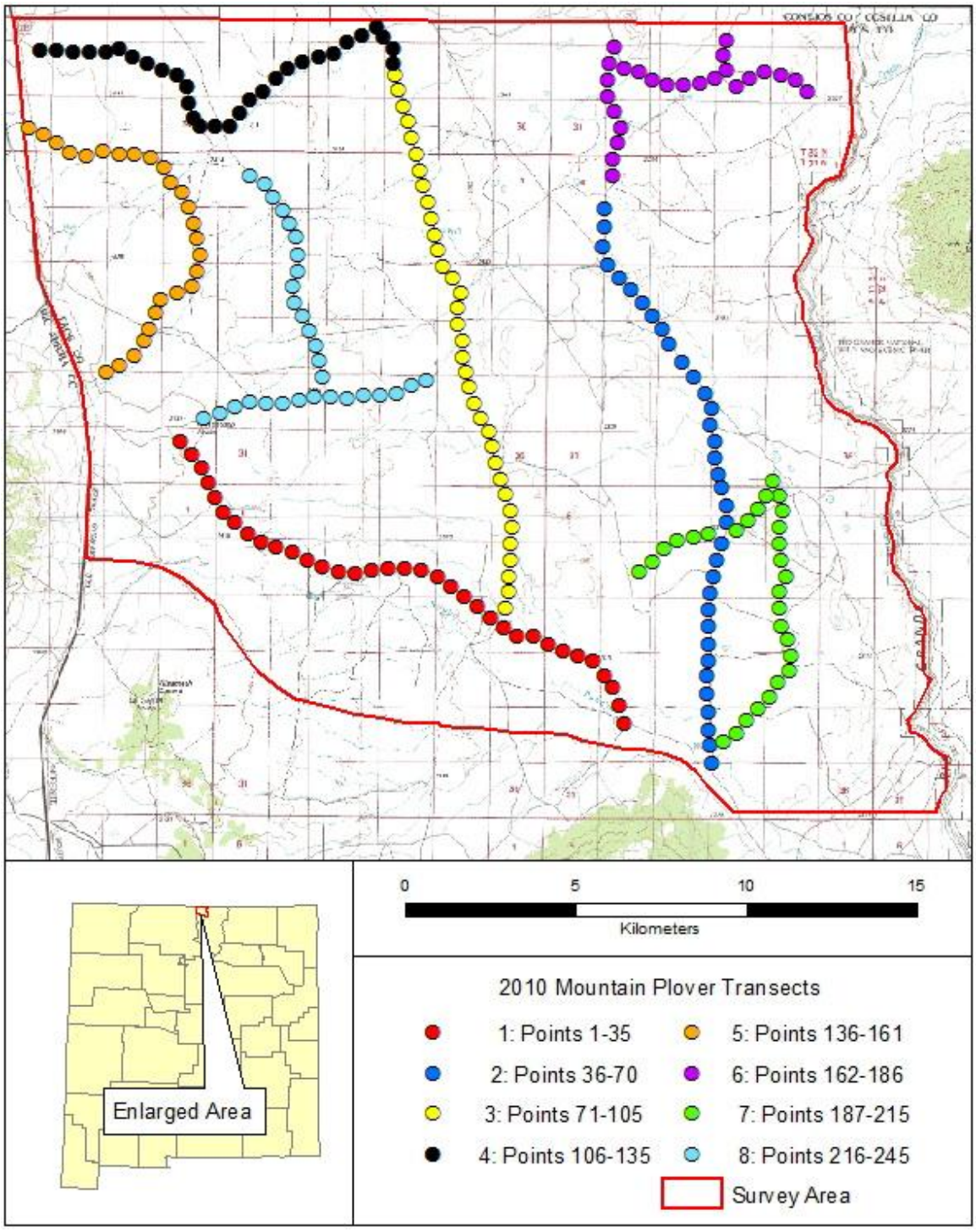

Figure 2. Location of 245 Mountain Plover point counts surveyed on the Bureau of Land Management's North Unit, Taos County, New Mexico from 2005-2007, and 2010.

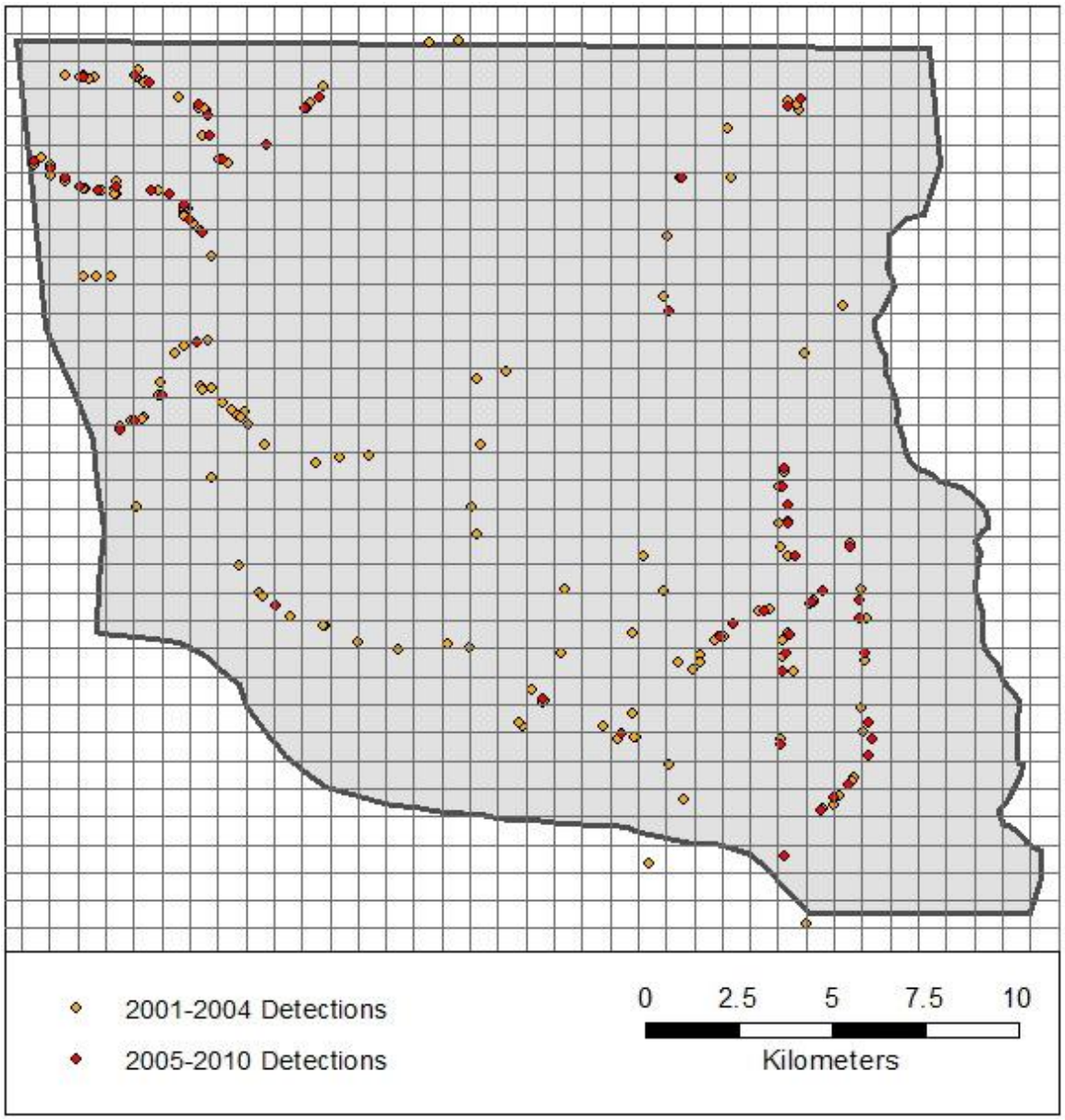

Figure 3. Locations of all non-migratory Mountain Plover detections from 2001-2007, and 2010 on the North Unit. Each cell of the overlaying grid measures 56 ha and was used to calculate the area of the unit known to have been occupied by Mountain Plovers during the survey periods.

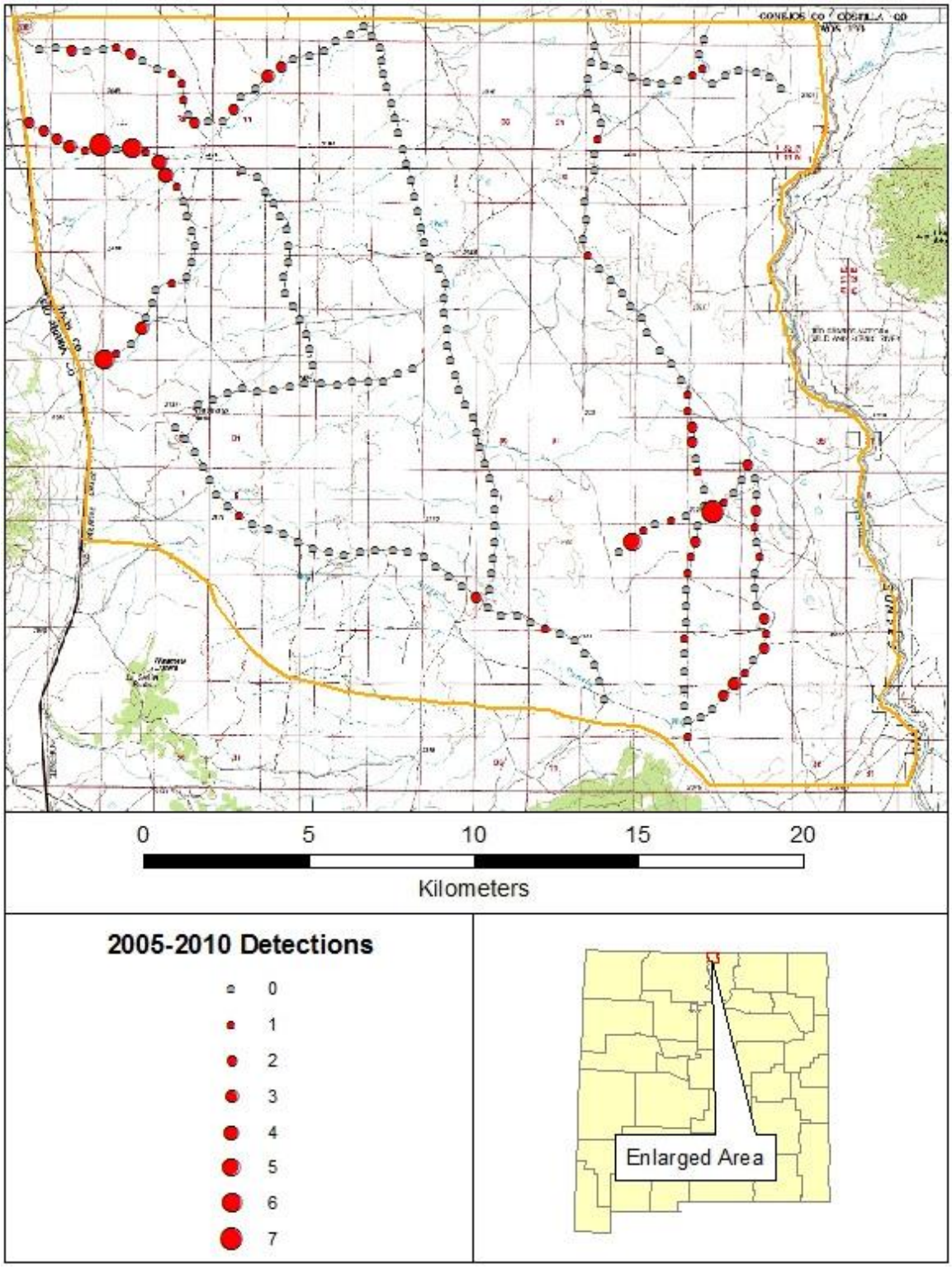

Figure 4. Number of Mountain Plovers detected at transect points from 2005-2007, and 2010. Circles represent survey points, color and size represent the total number of plovers detected during the four survey years.

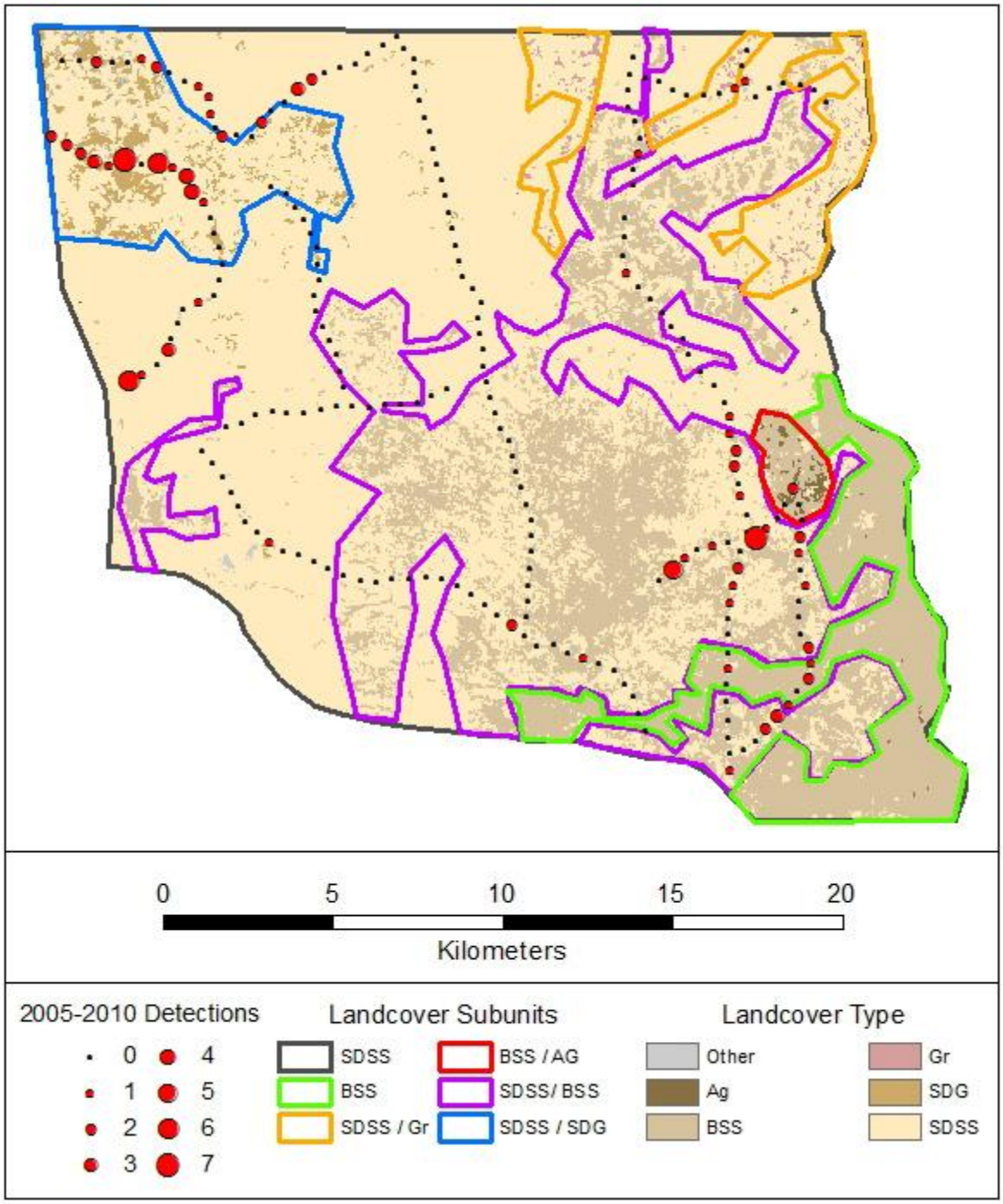

Figure 5. Mountain Plover detections from 2005-2007, and 2010 by land cover classifications. BSS is Inter-mountain Basins (IMB) Big Sage Shrubland; SDSS is IMB Semi-desert Shrub Steppe; SDSS / SDG is a mosaic of SDSS and IMB Semi-desert Grassland; SDSS / GF is a mosaic of SDSS and IMB Greasewood Flat; SDSS / BSS is a mosaic of SDSS and BSS; BSS / Ag is a mosaic of BSS and Agriculture.

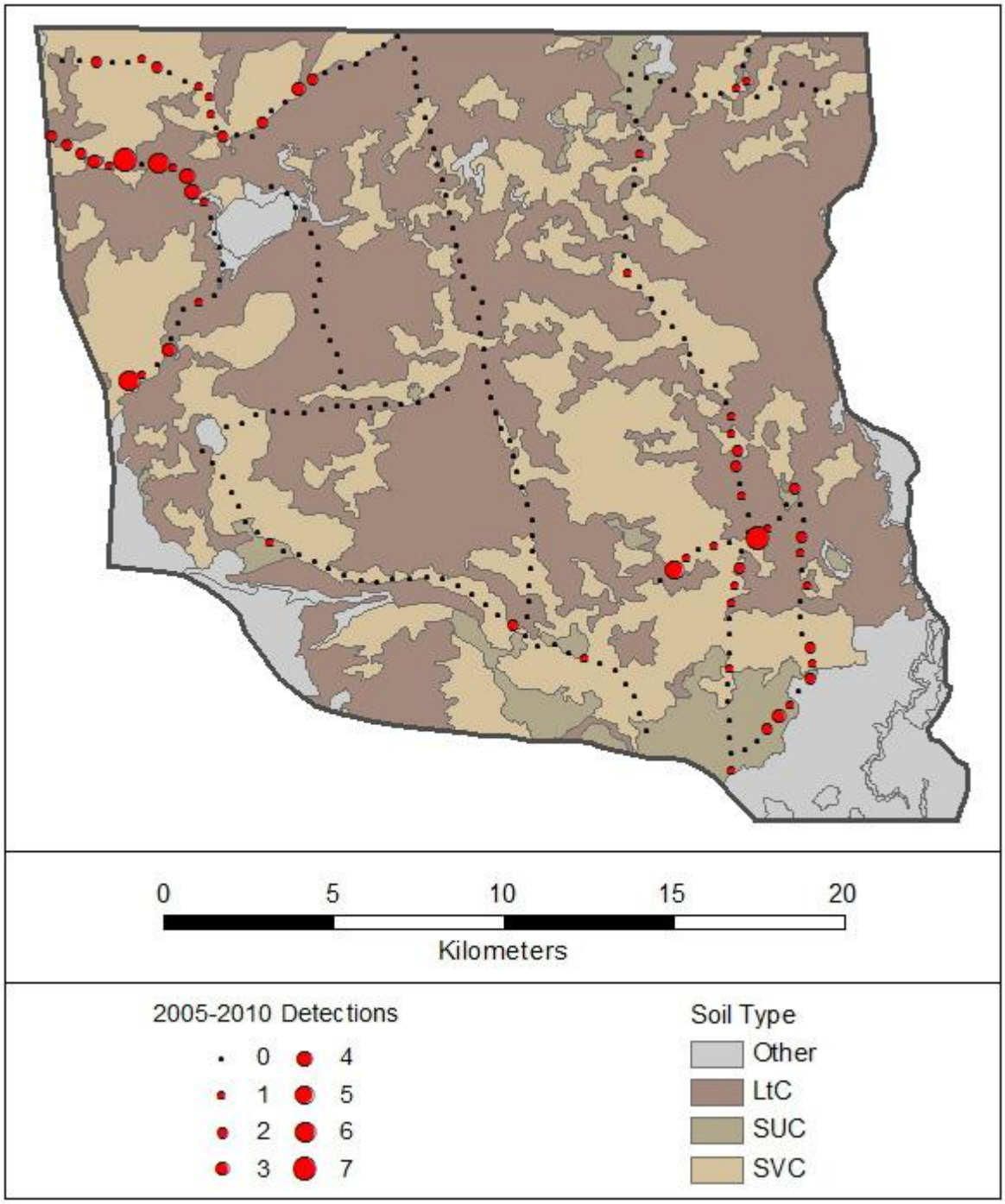

Figure 6. Mountain Plover detections from 2005-2007, and 2010 by soil type. The following soil types are dominant on the North Unit: Luhon-Travelers complex, 3-7% slopes (LtC); Stunner-Luhon association, gently sloping (SUC); and Stunner-Travelers association, gently sloping (SVC). The following soil types are less dominant, and are grouped into the "Other" category on the map: Stunner cobbly loam, 1-5% slopes (StC); Travler's very stony loam, 1-8% slopes (TVC); Petaca-Silva association, gently sloping (PGC); and Rock outcrop-Raton complex, moderately steep (RRE).

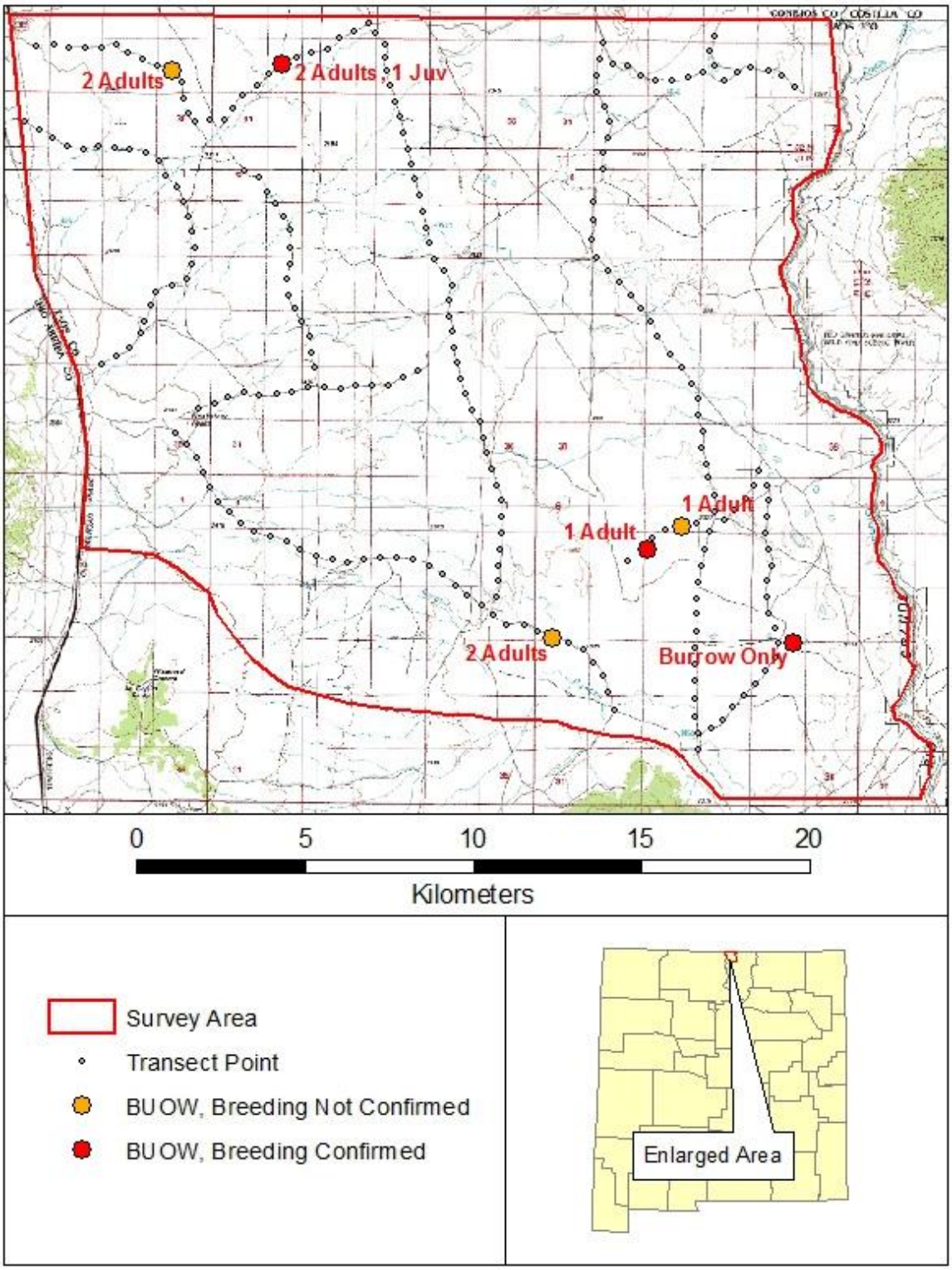

Figure 7. Locations and numbers of Burrowing Owls observed on the North Unit in 2010. Burrowing Owls were detected opportunistically during Mountain Plover and prairie dog surveys. Breeding was considered confirmed if chicks or active burrows were detected.

Appendix 1. Universal Transverse Mercator coordinates (North American Datum 27) of Mountain Plover survey points and 2010 results, BLM Taos North Unit, Taos County, New Mexico.

Transect	Point	Easting	Northing	Survey Date	# Plovers	Distance (m)
1	1	429270	4073948	May 1, 2010	0	-
1	2	429098	4074477	May 1, 2010	0	-
1	3	428933	4074992	May 1, 2010	0	-
1	4	428666	4075356	May 1, 2010	0	-
1	5	428352	4075761	May 1, 2010	0	-
1	6	427918	4075940	May 1, 2010	0	-
1	7	427465	4076092	May 1, 2010	0	-
1	8	427023	4076272	May 1, 2010	0	-
1	9	426610	4076502	May 1, 2010	0	-
1	10	426103	4076482	May 1, 2010	0	-
1	11	425707	4076747	May 1, 2010	0	-
1	12	425346	4077044	May 1, 2010	0	-
1	13	424936	4077364	May 1, 2010	0	-
1	14	424548	4077668	May 1, 2010	0	-
1	15	424161	4077971	May 1, 2010	0	-
1	16	423772	4078253	May 1, 2010	0	-
1	17	423313	4078422	May 1, 2010	0	-
1	18	422830	4078480	May 1, 2010	0	-
1	19	422329	4078461	May 1, 2010	0	-
1	20	421840	4078425	May 1, 2010	0	-
1	21	421369	4078337	May 1, 2010	0	-
1	22	420913	4078407	May 1, 2010	0	-
1	23	420427	4078537	May 1, 2010	0	-
1	24	419966	4078730	May 1, 2010	0	-
1	25	419535	4078952	May 1, 2010	0	-
1	26	419070	4079128	May 1, 2010	0	-
1	27	418608	4079244	May 1, 2010	0	-
1	28	418211	4079496	May 1, 2010	1	50
1	29	417849	4079816	May 1, 2010	0	-
1	30	417504	4080132	May 1, 2010	0	-
1	31	417288	4080586	May 1, 2010	0	-
1	32	417081	4080988	May 1, 2010	0	-
1	33	416858	4081433	May 1, 2010	0	-
1	34	416570	4081821	May 1, 2010	0	-
1	35	416254	4082189	May 1, 2010	0	-
2	36	431792	4072801	May 15, 2010	1	200
2	37	431755	4073290	May 15, 2010	0	-
2	38	431700	4073763	May 15, 2010	0	-
2	39	431699	4074276	May 15, 2010	0	-
2	40	431686	4074820	May 15, 2010	0	-

Transect	Point	Easting	Northing	Survey Date	# Plovers	Distance (m)
2	41	431681	4075332	May 15, 2010	0	-
2	42	431695	4075798	May 15, 2010	0	-
2	43	431711	4076277	May 15, 2010	0	-
2	44	431740	4076796	May 15, 2010	0	-
2	45	431734	4077266	May 15, 2010	0	-
2	46	431770	4077752	May 15, 2010	0	-
2	47	431871	4078247	May 15, 2010	0	-
2	48	431975	4078725	May 15, 2010	2	125,125
2	49	432090	4079233	May 15, 2010	0	-
2	50	432266	4079815	May 15, 2010	0	-
2	51	432264	4080330	May 15, 2010	0	-
2	52	432086	4080860	May 15, 2010	0	-
2	53	432023	4081234	May 15, 2010	0	-
2	54	431893	4081729	May 15, 2010	0	-
2	55	431901	4082203	May 15, 2010	2	225,225
2	56	431780	4082705	May 15, 2010	0	-
2	57	431794	4083193	May 15, 2010	0	-
2	58	431598	4083616	May 15, 2010	0	-
2	59	431291	4084112	May 15, 2010	0	-
2	60	430932	4084526	May 15, 2010	0	-
2	61	430563	4085048	May 15, 2010	0	-
2	62	430376	4085506	May 15, 2010	0	-
2	63	430067	4085865	May 15, 2010	0	-
2	64	429782	4086247	May 15, 2010	0	-
2	65	429426	4086664	May 15, 2010	0	-
2	66	429105	4086993	May 15, 2010	0	-
2	67	428747	4087402	May 15, 2010	1	175
2	68	428602	4087918	May 15, 2010	0	-
2	69	428681	4088487	May 15, 2010	0	-
2	70	428672	4089034	May 15, 2010	0	-
3	71	425775	4077304	May 16, 2010	0	-
3	72	425850	4077790	May 16, 2010	0	-
3	73	425857	4078224	May 16, 2010	0	-
3	74	425904	4078724	May 16, 2010	0	-
3	75	425934	4079226	May 16, 2010	0	-
3	76	425943	4079710	May 16, 2010	0	-
3	77	425930	4080184	May 16, 2010	0	-
3	78	425786	4080637	May 16, 2010	0	-
3	79	425638	4081115	May 16, 2010	0	-
3	80	425474	4081577	May 16, 2010	0	-
3	81	425392	4082044	May 16, 2010	0	-
3	82	425298	4082490	May 16, 2010	0	-
3	83	425041	4082861	May 16, 2010	0	-
3	84	424855	4083333	May 16, 2010	0	-

Transect	Point	Easting	Northing	Survey Date	# Plovers	Distance (m)
3	85	424721	4083792	May 16, 2010	0	-
3	86	424596	4084245	May 16, 2010	0	-
3	87	424507	4084687	May 16, 2010	0	-
3	88	424497	4085171	May 16, 2010	0	-
3	89	424392	4085646	May 16, 2010	0	-
3	90	424364	4086116	May 16, 2010	0	-
3	91	424456	4086571	May 16, 2010	0	-
3	92	424219	4086987	May 16, 2010	0	-
3	93	423919	4087338	May 16, 2010	0	-
3	94	423788	4087795	May 16, 2010	0	-
3	95	423698	4088254	May 16, 2010	0	-
3	96	423597	4088737	May 16, 2010	0	-
3	97	423485	4089208	May 16, 2010	0	-
3	98	423375	4089692	May 16, 2010	0	-
3	99	423270	4090152	May 16, 2010	0	-
3	100	423144	4090610	May 16, 2010	0	-
3	101	423023	4091098	May 16, 2010	0	-
3	102	422916	4091561	May 16, 2010	0	-
3	103	422789	4092014	May 16, 2010	0	-
3	104	422647	4092486	May 16, 2010	0	-
3	105	422543	4092926	May 16, 2010	0	-
4	106	412131	4093647	May 17, 2010	0	-
4	107	412625	4093684	May 17, 2010	0	-
4	108	413102	4093619	May 17, 2010	0	-
4	109	413592	4093589	May 17, 2010	0	-
4	110	414070	4093628	May 17, 2010	0	-
4	111	414485	4093704	May 17, 2010	0	-
4	112	414862	4093478	May 17, 2010	2	125,125
4	113	415265	4093287	May 17, 2010	0	-
4	114	415716	4093065	May 17, 2010	0	-
4	115	416152	4092918	May 17, 2010	0	-
4	116	416437	4092590	May 17, 2010	0	-
4	117	416490	4092098	May 17, 2010	0	-
4	118	416660	4091667	May 17, 2010	0	-
4	119	416812	4091430	May 17, 2010	0	-
4	120	417254	4091458	May 17, 2010	0	-
4	121	417707	4091454	May 17, 2010	0	-
4	122	417970	4091831	May 17, 2010	2	300,300
4	123	418259	4092217	May 17, 2010	0	-
4	124	418665	4092472	May 17, 2010	0	-
4	125	419032	4092819	May 17, 2010	0	-
4	126	419413	4093110	May 17, 2010	2	200,250
4	127	419831	4093327	May 17, 2010	0	-
4	128	420309	4093474	May 17, 2010	0	-

Transect	Point	Easting	Northing	Survey Date	# Plovers	Distance (m)
4	129	420756	4093584	May 17, 2010	0	-
4	130	421131	4093881	May 17, 2010	0	-
4	131	421573	4094104	May 17, 2010	0	-
4	132	421982	4094361	May 17, 2010	0	-
4	133	422190	4094033	May 17, 2010	0	-
4	134	422475	4093705	May 17, 2010	0	-
4	135	422479	4093293	May 17, 2010	0	-
5	136	414058	4084222	May 23, 2010	0	-
5	137	414476	4084439	May 23, 2010	0	-
5	138	414905	4084720	May 23, 2010	0	-
5	139	415210	4085155	May 23, 2010	0	-
5	140	415338	4085500	May 23, 2010	0	-
5	141	415539	4085953	May 23, 2010	0	-
5	142	415679	4086381	May 23, 2010	0	-
5	143	416134	4086562	May 23, 2010	0	-
5	144	416585	4086744	May 23, 2010	0	-
5	145	416742	4087199	May 23, 2010	0	-
5	146	416830	4087674	May 23, 2010	0	-
5	147	416750	4088167	May 23, 2010	0	-
5	148	416620	4088593	May 23, 2010	0	-
5	149	416503	4089049	May 23, 2010	0	-
5	150	416295	4089491	May 23, 2010	1	150
5	151	415943	4089809	May 23, 2010	1	225
5	152	415779	4090240	May 23, 2010	0	-
5	153	415380	4090504	May 23, 2010	1	100
5	154	414898	4090607	May 23, 2010	2	175,200
5	155	414453	4090623	May 23, 2010	0	-
5	156	413964	4090703	May 23, 2010	1	80
5	157	413503	4090590	May 23, 2010	0	-
5	158	413022	4090685	May 23, 2010	2	90,100
5	159	412621	4090939	May 23, 2010	0	-
5	160	412218	4091184	May 23, 2010	0	-
5	161	411796	4091413	May 23, 2010	0	-
6	162	428936	4090000	May 15, 2010	0	-
6	163	428933	4090473	May 15, 2010	0	-
6	164	429074	4090931	May 15, 2010	0	-
6	165	429147	4091399	May 15, 2010	0	-
6	166	428977	4091871	May 15, 2010	0	-
6	167	428771	4092316	May 15, 2010	0	-
6	168	428772	4092780	May 15, 2010	0	-
6	169	428837	4093257	May 15, 2010	0	-
6	170	428946	4093757	May 15, 2010	0	-
6	171	429263	4093142	May 15, 2010	0	-
6	172	429694	4093056	May 15, 2010	0	-

Transect	Point	Easting	Northing	Survey Date	# Plovers	Distance (m)
6	173	430087	4092801	May 15, 2010	0	-
6	174	430520	4092646	May 15, 2010	0	-
6	175	430998	4092626	May 15, 2010	0	-
6	176	431465	4092713	May 15, 2010	0	-
6	177	431930	4092858	May 15, 2010	0	-
6	178	432244	4093063	May 15, 2010	0	-
6	179	432132	4093520	May 15, 2010	0	-
6	180	432272	4093954	May 15, 2010	0	-
6	181	432539	4092612	May 15, 2010	0	-
6	182	432945	4092862	May 15, 2010	0	-
6	183	433339	4093023	May 15, 2010	0	-
6	184	433861	4092949	May 15, 2010	0	-
6	185	434269	4092792	May 15, 2010	0	-
6	186	434623	4092459	May 15, 2010	0	-
7	187	432152	4073394	May 16, 2010	0	-
7	188	432525	4073644	May 16, 2010	0	-
7	189	432810	4074039	May 16, 2010	0	-
7	190	433145	4074389	May 16, 2010	0	-
7	191	433500	4074734	May 16, 2010	0	-
7	192	433763	4075130	May 16, 2010	0	-
7	193	434073	4075489	May 16, 2010	2	250,250
7	194	434138	4075946	May 16, 2010	0	-
7	195	434040	4076393	May 16, 2010	0	-
7	196	433858	4076800	May 16, 2010	0	-
7	197	433815	4077311	May 16, 2010	0	-
7	198	433804	4077794	May 16, 2010	0	-
7	199	433980	4078254	May 16, 2010	0	-
7	200	433850	4078714	May 16, 2010	0	-
7	201	433791	4079189	May 16, 2010	0	-
7	202	433818	4079682	May 16, 2010	0	-
7	203	433884	4080161	May 16, 2010	0	-
7	204	433802	4080633	May 16, 2010	0	-
7	205	433588	4081070	May 16, 2010	0	-
7	206	433412	4080625	May 16, 2010	0	-
7	207	433191	4080208	May 16, 2010	0	-
7	208	432859	4079898	May 16, 2010	0	-
7	209	432533	4079595	May 16, 2010	4	30,50,125,150
7	210	431735	4079498	May 16, 2010	0	-
7	211	431265	4079382	May 16, 2010	0	-
7	212	430812	4079284	May 16, 2010	0	-
7	213	430428	4079048	May 16, 2010	1	50
7	214	430086	4078698	May 16, 2010	2	50,80
7	215	429700	4078398	May 16, 2010	0	-
8	216	416934	4082892	May 22, 2010	0	-

Transect	Point	Easting	Northing	Survey Date	# Plovers	Distance (m)
8	217	417411	4083030	May 22, 2010	0	-
8	218	417826	4083236	May 22, 2010	0	-
8	219	418298	4083370	May 22, 2010	0	-
8	220	418745	4083304	May 22, 2010	0	-
8	221	419253	4083318	May 22, 2010	0	-
8	222	419719	4083408	May 22, 2010	0	-
8	223	420179	4083526	May 22, 2010	0	-
8	224	420660	4083522	May 22, 2010	0	-
8	225	421152	4083477	May 22, 2010	0	-
8	226	421609	4083576	May 22, 2010	0	-
8	227	422092	4083568	May 22, 2010	0	-
8	228	422571	4083592	May 22, 2010	0	-
8	229	423000	4083838	May 22, 2010	0	-
8	230	423452	4084000	May 22, 2010	0	-
8	231	420408	4084097	May 22, 2010	0	-
8	232	420298	4084552	May 22, 2010	0	-
8	233	420219	4085021	May 22, 2010	0	-
8	234	420010	4085460	May 22, 2010	0	-
8	235	419813	4085856	May 22, 2010	0	-
8	236	419594	4086282	May 22, 2010	0	-
8	237	419545	4086750	May 22, 2010	0	-
8	238	419678	4087198	May 22, 2010	0	-
8	239	419661	4087692	May 22, 2010	0	-
8	240	419636	4088189	May 22, 2010	0	-
8	241	419446	4088574	May 22, 2010	0	-
8	242	419240	4088971	May 22, 2010	0	-
8	243	418960	4089346	May 22, 2010	0	-
8	244	418716	4089757	May 22, 2010	0	-
8	245	418280	4089972	May 22, 2010	0	-

Appendix 2. Detection rates of Mountain Plovers at survey points from 2005-2007, and 2010, BLM Taos North Unit, Taos County, New Mexico.

	2005	2006	2007	2010	All Years
Total Detections	38	24	22	30	114
Detection Rate	0.16	0.10	0.09	0.12	0.12
CI	0.07	0.05	0.04	0.06	0.07

Appendix 3. Point parameters, points with detections, and detection rates of Mountain Plovers by soil type, BLM Taos North Unit, Taos County, New Mexico. LtC is Luhon-Travelers complex, 3-7% slopes; SVC is Stunner-Travelers association, gently sloping; SUC is Stunner-Luhon association, gently sloping; the Others category includes eight soil types widely scattered in the unit, most of which do not contain survey points.

Soil Type	Hectares	Percent of site	Points	Percent of Pts	Pts with Detections		Detections 05-10	
					Number	Percent	Total	Rate
LtC	24249	50.4%	108	44.1	23	21.3%	58	0.13
SVC	16389	34.1%	105	42.9	26	24.8%	44	0.10
SUC	2299	4.8%	23	9.4	2	8.7%	3	0.03
Other	5161	10.7%	9	3.7	6	66.7%	9	0.25
Total	48098	100.0%	245	100.0	57	23.3%	114	0.12

Appendix 4. Point parameters, points with detections, and detection rates of Mountain Plovers by land cover type, BLM Taos North Unit, Taos County, New Mexico. BSS is Inter-mountain Basins (IMB) Big Sage Shrubland; SDSS is IMB Semi-desert Shrub Steppe; SDSS / SDG is a mosaic of SDSS and IMB Semi-desert Grassland; SDSS / GF is a mosaic of SDSS and IMB Greasewood Flat; SDSS / BSS is a mosaic of SDSS and BSS; BSS / Ag is a mosaic of BSS and Agriculture.

Land cover	Hectares	Percent of Site	Points	Percent of Pts	Pts with Detections		Detections 05-10	
					Number	Percent	Total	Rate
BSS	4125	8.6	7	2.9	4	57.1	5	0.18
SDSS	20006	41.6	102	41.6	12	11.8	22	0.05
SDSS / SDG	3936	8.2	29	11.8	16	55.2	42	0.36
SDSS / GF	2304	4.8	7	2.9	1	14.3	1	0.04
SDSS / BSS	17233	35.8	96	39.2	23	24.0	42	0.11
BSS / Ag	494	1.0	4	1.6	1	25.0	2	0.13
Total	48098	100.0	245	100.0	57	23.3	114	0.12