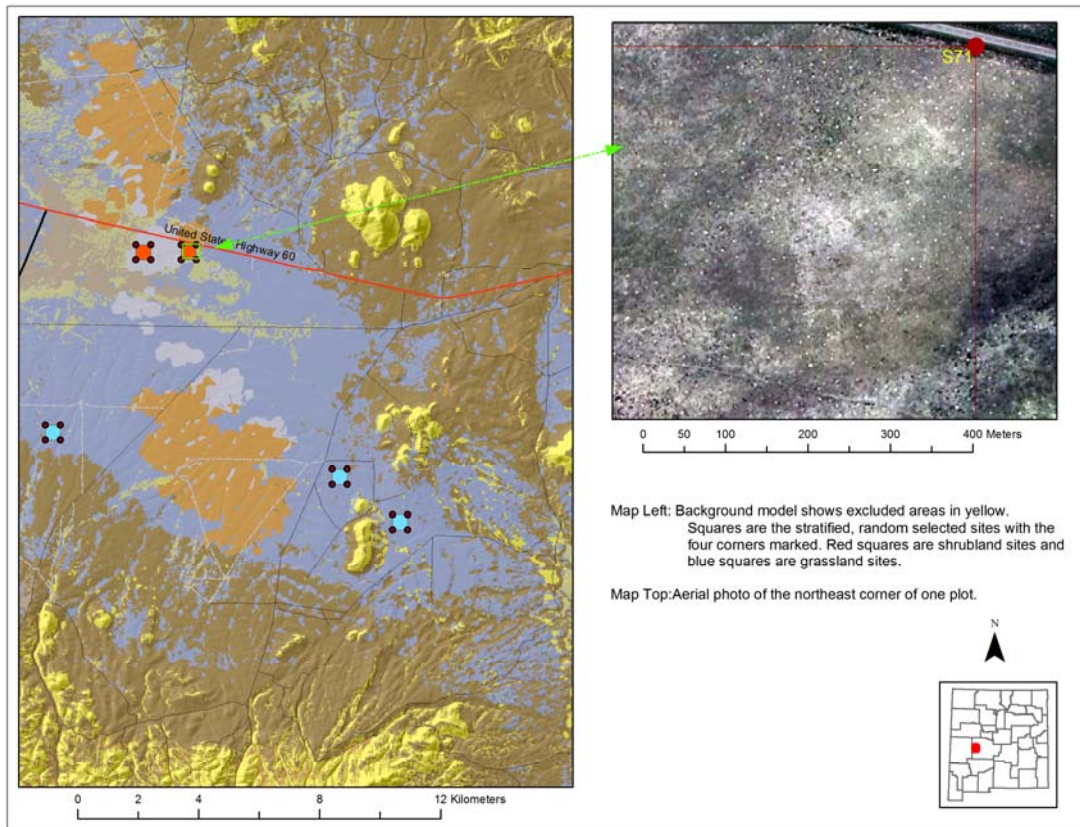


# Gunnison's Prairie Dog Predictive Range Model and Survey Site Selection for New Mexico



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## **Introduction**

As a member of the Prairie Dog Interstate Working Group, the New Mexico Department of Game and Fish (NMDGF), along with other member states, has adopted a common survey protocol for Gunnison's prairie dogs (GPD, *Cynomys gunnisoni*). The sampling protocol involves field survey of a pre-determined number of quadrats within the GPD range in each state (Andelt and Seglund 2007). The choice of survey sites relies on a GIS predictive range map based on GPD use of known land cover types. Natural Heritage New Mexico (NHNM)<sup>1</sup> completed a rapid assessment of existing predictive habitat/range maps for the GPD and derived a new predictive range map for GPD in New Mexico. Within this range map, we chose sampling sites based on the protocol established by Andelt and Seglund (2007) and created field maps of survey sites.

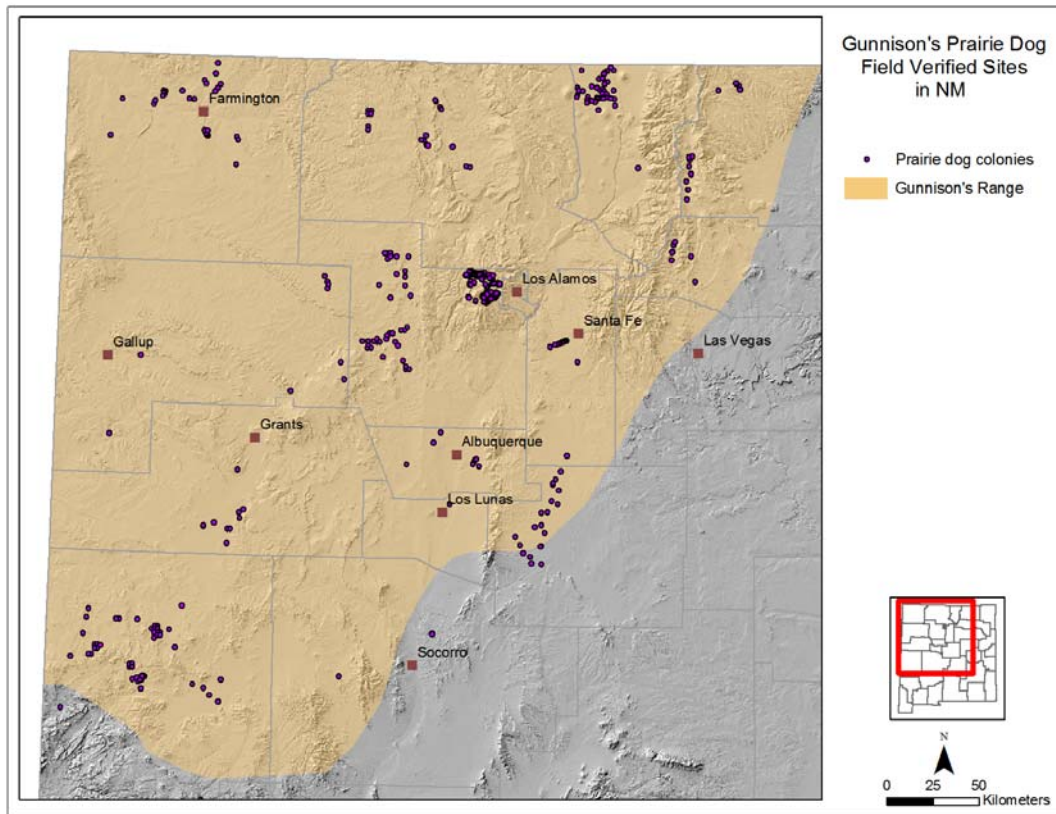
## **Methods**

### **Compile and Analyze Existing Models**

The current GPD range includes Colorado, New Mexico, Arizona, and Utah. Two GPD predictive range maps were available for New Mexico (New Mexico Cooperative Fish and Wildlife Research Unit 2005, Seglund et al. 2005). Both models were developed from the land cover classification developed under the USGS National Gap Analysis Program (2004) using Ecological Systems (Comer et al. 2003). We had previously compiled field verified data from tribes, federal agencies, state agencies, private companies, and conservation groups into a GIS of GPD colonies in New Mexico (Johnson et al. 2004). In addition to these data, NHNM used observation data from NMDGF (James Stuart), an update of field observations from Hawks Aloft, and archived data from the NHNM sensitive species database (NMBiotics, Natural Heritage New Mexico 2007). We used these data in a GIS (Figure 1) to determine the suitability of using either of the existing predictive range maps. We used localities representing current and past GPD colonies in a GIS over each of the range maps and analyzed the results in an Excel spreadsheet.

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<sup>1</sup> Under New Mexico Department of Game and Fish Professional Services Contract #07-516-0000-03596.



**Figure 1. Field verified Gunnison's prairie dog colonies in New Mexico.**

### **Predictive Range Model**

Initially, we tried to increase accuracy of the Seglund et al. (2005) predictive range map by adding land cover classes that contained known GPD towns in New Mexico but that were not represented in the model. If more than 10% of the field verified sites were represented by a class not in the Seglund model, we incorporated those classes into the modified Seglund et al. (2005) model. These map units were: Rocky Mountain Ponderosa Pine Woodland, Southern Rocky Mountain Pinyon-Juniper Woodland, and Inter-Mountain Basins Semi-Desert Grassland. Although Inter-Mountain Basins Semi-Desert Grassland was used in the Seglund et al. model, parts of this map unit had not been included, probably because other factors such as slope or elevation limited the actual distribution of this map unit. In the end, we decided that further “remodel” efforts would be more time consuming than developing a new model from scratch. For the new model, we followed the approximate methodology established by Seglund et al. (2005) and Southwest ReGAP (New Mexico Cooperative Fish and Wildlife Research Unit 2005). We selected map units for the model based on our data for existing and historical GPD towns.

We used the Southwest ReGAP land cover (USGS National Gap Analysis Program 2004, Lowry et al. 2005) digital map to identify land cover classes that directly overlay our field verified datasets. We calculated the area of each map unit class by determining its

contribution to the entire range in New Mexico. We evaluated map units in the model by comparing the number of known towns to the distribution within the GPD range of the map unit in question. We assumed that GPD would be fairly generally distributed in suitable land cover types. For example, if relatively few confirmed prairie dog localities occurred within a map unit that was abundant within the GPD range, or if many towns occurred in a very small map unit or part of a map unit, we re-examined the map units. In many cases, we concluded that the towns actually belonged in a neighboring map unit and were misplaced due to inaccuracy of the land cover map or town locations. In addition, some map units were eliminated based on literature or our knowledge of GPD biology; for example, Colorado Plateau Mixed Bedrock Canyon and Tableland (S010, Table 2). It seems unlikely that prairie dogs would occupy this land cover class because burrowing would be difficult in rocky habitats. Using a combination of on-screen visual interpretation of neighboring map units, topographic position, and GPD field locality, we made qualitative assessments for including or eliminating map units. Following both Seglund et al. (2005) and the SWReGAP (New Mexico Cooperative Fish and Wildlife Research Unit 2005) models, we further restricted the land cover classes by slope. Using our data points in a GIS with a slope image (10 m), we calculated the mean, minimum, and maximum slopes.

### **Sample Field Sites**

Following a discussion with James Stuart (NMDGF), we decided on the following sampling design:

1. Create 500 m x 500 m quads to be sampled.
2. Eliminate quads that include unsuitable habitat; i.e. the quad must contain only land use classes included in the model. This method would help field teams to determine habitat type and simplify stratification by biome.
3. Stratify the sample selection by biome as follows: Woodland (20%), Shrubland (20%), Grassland (55%), and Other (5%). Randomly select 400 quads for sampling, following the above stratification scheme.

## ***Results and Discussion***

### **Analysis of Existing Models**

Field verified GIS datasets totaled 557 GPD locations, comprising a mix of polygons and points. Using a direct overlay method (without considering any offsets for errors in either the classification of the maps or geographic precision of locations for the field verified localities), we determined that 81% of our field verified locations fell within the Seglund et al. (2005) predictive range model. Using the same method for the Southwest ReGAP predictive range model, we found that 38% of field verified locations fell within the model (Table 1).

Our direct overlay method is not a comprehensive assessment of the models but satisfied our need for a rapid assessment. Using an error buffer to account for variable location accuracies surrounding each of the field verified localities would have been preferable. A potentially more influential source of error is the limited nature of the field verified data,

which are not comprehensive and probably not representative of the actual GPD distribution. For example, the poor performance of the SWReGAP model was largely due to a large sample of field verified polygons in our dataset that fell within a land cover class not included in the SWReGAP model (Southern Rocky Mountain Montane-Subalpine Grassland). Considering that both models were developed for the entire range of the GPD, and few data for New Mexico were available to either of the modelers, we decided to create a new predictive range map.

**Table 1. Assessment of predictive range models using a direct overlay method.**

	Overlay	No Overlay	% Overlay	% No Overlay
Seglund <i>et al.</i> 2005	452	105	81.1	18.9
SWReGAP	213	344	38.2	61.8

### Predictive Range Model

Table 2 shows the percentage of field verified localities that fell within a given SWReGAP land cover class. The majority of our field data fell within the Southern Rocky Mountain Montane-Subalpine Grassland, which was not included in the SWReGAP GPD model. In addition, we had received a large number of GPD town locations from this map unit in the Valles Caldera National Preserve. Thus, the low accuracy of the SWReGAP model (38.2%, Table 1) can be explained at least in part by these two factors.

We eliminated eight land cover classes from the model set and kept some minor classes (see Methods, Predictive Range Model). See Table 3 for reasons for eliminating or keeping selected classes. Those not mentioned in the table were either very well represented in the field data or justified by literature review and used in other models. Slopes for the data points ranged from 0-86% with a mean of 6%. We further limited the map unit classes by eliminating slopes > 20%, as suggested by Seglund *et al.* (2005).

The NHNM predictive range model uses 17 land use classes and covers 81% (7,282,698 ha, 17,995,547 ac) of the total gross GPD range in New Mexico (8,952,011 ha (22,120,419 ac), whereas the Seglund *et al.* (2005) uses 19 land use classes and covers 56% (4068821 ha, 10054283 ac) of the total gross GPD range in New Mexico. The Seglund model includes a different set of land cover classes (Table 4). As Seglund *et al.* (2005) state, the predictive range models were designed to “help locate appropriate areas for more intensive field surveys” and do not imply mapped areas are suitable GPD habitat.

The land use classes in our final model (Table 4) comprise 44% woodland, 25% shrubland, 28% grassland, and 1.5% Other. The other class includes agriculture and developed landscapes. The GPD uses woodland environments at their periphery. However, it was beyond the scope of this project to employ image processing or other GIS techniques to delineate these landscapes. This weakness in the model contributes to the large percentage of woodland that is included in the model. We chose not to use

elevation in the model because a large and varied topography occurs within the study area, and GPD uses habitats from montane meadows to basin grasslands.

**Table 2. Overlay results of field verified data and SWReGAP land cover classes.**

Map Code	SWReGAP Land Cover Classes	% Field Verified
S010	Colorado Plateau Mixed Bedrock Canyon and Tableland	0.4
S011	Inter-Mountain Basins Shale Badland	0.2
S036	Rocky Mountain Ponderosa Pine Woodland	5.4
S038	Southern Rocky Mountain Pinyon-Juniper Woodland	0.2
S039	Colorado Plateau Pinyon-Juniper Woodland	5.6
S047	Rocky Mountain Lower Montane-Foothill Shrubland	0.4
S054	Inter-Mountain Basins Big Sagebrush Shrubland	4.6
S056	Colorado Plateau Mixed Low Sagebrush Shrubland	0.6
S057	Mogollon Chaparral	0.2
S059	Colorado Plateau Blackbrush-Mormon-tea Shrubland	0.2
S065	Inter-Mountain Basins Mixed Salt Desert Scrub	1.9
S071	Inter-Mountain Basins Montane Sagebrush Steppe	0.2
S074	Southern Rocky Mountain Juniper Woodland and Savanna	0.4
S077	Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	0.2
S079	Inter-Mountain Basins Semi-Desert Shrub Steppe	10.0
S085	Southern Rocky Mountain Montane-Subalpine Grassland	45.7
S086	Western Great Plains Foothill and Piedmont Grassland	3.1
S088	Western Great Plains Shortgrass Prairie	4.8
S090	Inter-Mountain Basins Semi-Desert Grassland	10.4
S093	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0.2
S096	Inter-Mountain Basins Greasewood Flat	1.9
N21	Developed, Open Space - Low Intensity	2.7
N22	Developed, Medium - High Intensity	0.2
N80	Agriculture	0.4
D09	Invasive Annual and Biennial Forbland	0.4

**Table 3. Justification for elimination of selected map units from the model set.**

Map Code	SWReGAP Land Cover Classes	% Field Verified	Notes	Eliminated
S010	Colorado Plateau Mixed Bedrock Canyon and Tableland	0.38	Class covers a large area. Data point precision was fine since the locality was in a small grassland near a drainage with bedrock above. The spatial resolution of the classification was insufficient to pick up this detail. The other data point was fine, error due to a misclassification. Correct classification already included in model set.	X

Map Code	SWReGAP Land Cover Classes	% Field Verified	Notes	Eliminated
S011	Inter-Mountain Basins Shale Badland	0.19	Misclassification of the land use class for this area. Correct classification already included in model set.	X
S047	Rocky Mountain Lower Montane-Foothill Shrubland	0.38	Small, limited to the Valles Caldera, okay to keep.	
S054	Inter-Mountain Basins Big Sagebrush Shrubland	4.61	A very large class, especially within the central and north-central portion of the range. More likely the data points were in the contiguous classes, such as Inter-Mountain Basins Semi-Desert Shrub Steppe which is included in the model set.	X
S056	Colorado Plateau Mixed Low Sagebrush Shrubland	0.58	Although a small class, it occurs at the margins of the Inter-Mountain Basins Semi-Desert Grassland and has potential to be occupied.	
S057	Mogollon Chaparral	0.19	Possibly an error in the geographic precision, most likely in the contiguous area classified by Inter-Mountain Basins Semi-Desert Grassland.	X
S059	Colorado Plateau Blackbrush-Mormon-tea Shrubland	0.19	Although small, its occurrence is at the margins of the San Juan River and near agricultural fields surrounded by Inter-Mountain Basins Mixed Salt Desert Scrub which is more likely, but it is part of a larger group in the AZ extent of the prairie dog range.	
S071	Inter-Mountain Basins Montane Sagebrush Steppe	0.19	Unlikely, occurs as a scattered unit in the eastern portion of the GPD range. In the single case where it is the majority of the field polygon, two other classes that are part of the model set are more likely dominant and they are well represented for other field verified locations.	X
S074	Southern Rocky Mountain Juniper Woodland and Savanna	0.38	Misclassification - more likely abandoned ag field or short-grass prairie.	X
S077	Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	0.19	Identified by a point outside the area of interest at the margins of the GPD range. Keep in since grassland.	



Map Code	SWReGAP Land Cover Classes	% Field Verified	Notes	Eliminated
S093	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0.19	Questionable geographic precision of the data point, but is in close proximity to the Inter-Mountain Basins Semi-Desert Grassland already part of the model set.	X
N22	Developed, Medium - High Intensity	0.19	Keep in, many known occurrences are within the city limits	
D09	Invasive Annual and Biennial Forbland	0.38	Very small class in NM and occupied riparian areas within the northwest. We have found these areas are not occupied.	X

**Table 4. Land cover model sets for GPD range maps.**

Map Code	SWReGAP Land Cover Classes	Seglund	SWReGAP	NHNM
S013	Inter-Mountain Basins Volcanic Rock and Cinder Land		X	
S014	Inter-Mountain Basins Wash	X	X	
S015	Inter-Mountain Basins Playa	X		
S020	North American Warm Desert Wash	X		
S022	North American Warm Desert Playa	X		
S036	Rocky Mountain Ponderosa Pine Woodland			X
S038	Southern Rocky Mountain Pinyon-Juniper Woodland		X	X
S039	Colorado Plateau Pinyon-Juniper Woodland		X	X
S047	Rocky Mountain Lower Montane-Foothill Shrubland		X	X
S048	Western Great Plains Sandhill Shrubland	X		
S054	Inter-Mountain Basins Big Sagebrush Shrubland	X	X	
S056	Colorado Plateau Mixed Low Sagebrush Shrubland		X	X
S058	Apacherian-Chihuahuan Mesquite Upland Scrub		X	
S059	Colorado Plateau Blackbrush-Mormon-tea Shrubland		X	X
S063	Sonoran Paloverde-Mixed Cacti Desert Scrub			
S065	Inter-Mountain Basins Mixed Salt Desert Scrub	X	X	X
S071	Inter-Mountain Basins Montane Sagebrush Steppe		X	
S074	Southern Rocky Mountain Juniper Woodland and Savanna		X	
S075	Inter-Mountain Basins Juniper Savanna		X	
S077	Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe			X
S078	Inter-Mountain Basins Big Sagebrush Steppe		X	
S079	Inter-Mountain Basins Semi-Desert Shrub Steppe	X	X	X
S085	Southern Rocky Mountain Montane-Subalpine Grassland	X		X
S086	Western Great Plains Foothill and Piedmont Grassland	X	X	X
S087	Central Mixedgrass Prairie		X	
S088	Western Great Plains Shortgrass Prairie	X		X
S090	Inter-Mountain Basins Semi-Desert Grassland	X		X
S096	Inter-Mountain Basins Greasewood Flat		X	X

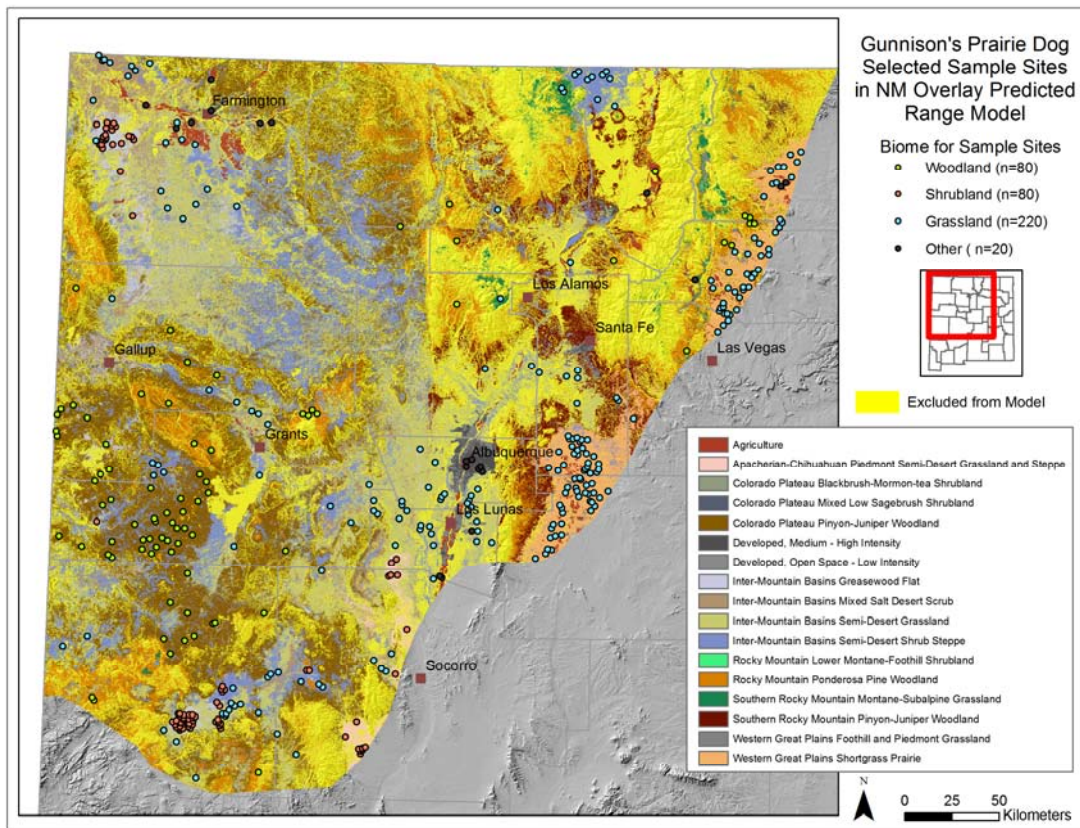
Map Code	SWReGAP Land Cover Classes	Seglund	SWReGAP	NHNM
S109	Chihuahuan-Sonoran Desert Bottomland and Swale Grassland	X		
S116	Chihuahuan Mixed Salt Desert Scrub		X	
N21	Developed, Open Space - Low Intensity	X		X
N22	Developed, Medium - High Intensity	X		X
N31	Barren Lands, Non-specific		X	
N080	Agriculture	X		X
D06	Invasive Perennial Grassland	X		
D09	Invasive Annual and Biennial Forbland	X		
D11	Recently Chained Pinyon-Juniper Areas	X	X	

### **Sample Field Sites**

Due to limited access to private property, tribal lands, and roadless areas, we developed the larger dataset of 400 sites, expecting that 260 sites would be visited (Figure 2). Provided all 260 quads are visited, field crews should collect data for 52 woodland and shrubland quads each, 143 grassland quads, and 13 sites classified as other. We created 26 field maps at a scale of 1:100,000 for the field crew. Maps had a Universal Transverse Mercator grid in the North American 1983 datum. The maps contained the sample quads and an overlay of the 1:100,000 scale digital maps showing roads, elevation contours, locales, and other ephemeris data to aid in finding the sample sites. We provided digital files to the NMDGF for printing additional field maps. In addition to the field maps, two overview maps were developed for reference, an index map that delineated the location of all 1:100,000 quads for the study area and another indicating the location of all 400 quad sites for the study area. We generated datasheets for the field crew (one datasheet held Zone 12 data, the other Zone 13, Table 5). Coincident with monitoring the 260 sample sites during the 2007 field season, field crews documented GPD colony observations and GPS coordinates. These data can be used to further assess the three GPD predictive range models.

**Table 5. Field datasheet categories and explantaions.**

IdPoly:	Unique ID for the associated polygon
Majority:	SWReGAP landuse class having the majority (100%) of the polygon
Biome:	Type of biome - 1=Woodland, 2=Shrubland, 3=Grassland, 4=Other
RandomID:	Polygon ID for the polygon given on the associated maps
Corner:	Corner of polygon in order of SE, SW, NW, NE
County:	County wherein the corner point lies
Ownership:	Ownership wherein the corner point lies (in some cases not consistent for entire polygon)
Quad100:	USGS Quad 1:100,000 wherein the corner point lies (in some cases not the same quad - those highlight in YELLOW)
Easting83_13:	Easting in NAD83, Zone 13
Northing83_13:	Easting in NAD83, Zone 13
ZoneUTM:	UTM Zone
Notes:	For the field person, possibly initial if complete



**Figure 2. Final predictive range model with an overlay of field visit sites.**

We created an additional spreadsheet containing public land survey system data (township, range, and section) to be used for acquiring permission from various tribal, state and federal agencies to establish the selected monitoring sites within their respective jurisdictions.

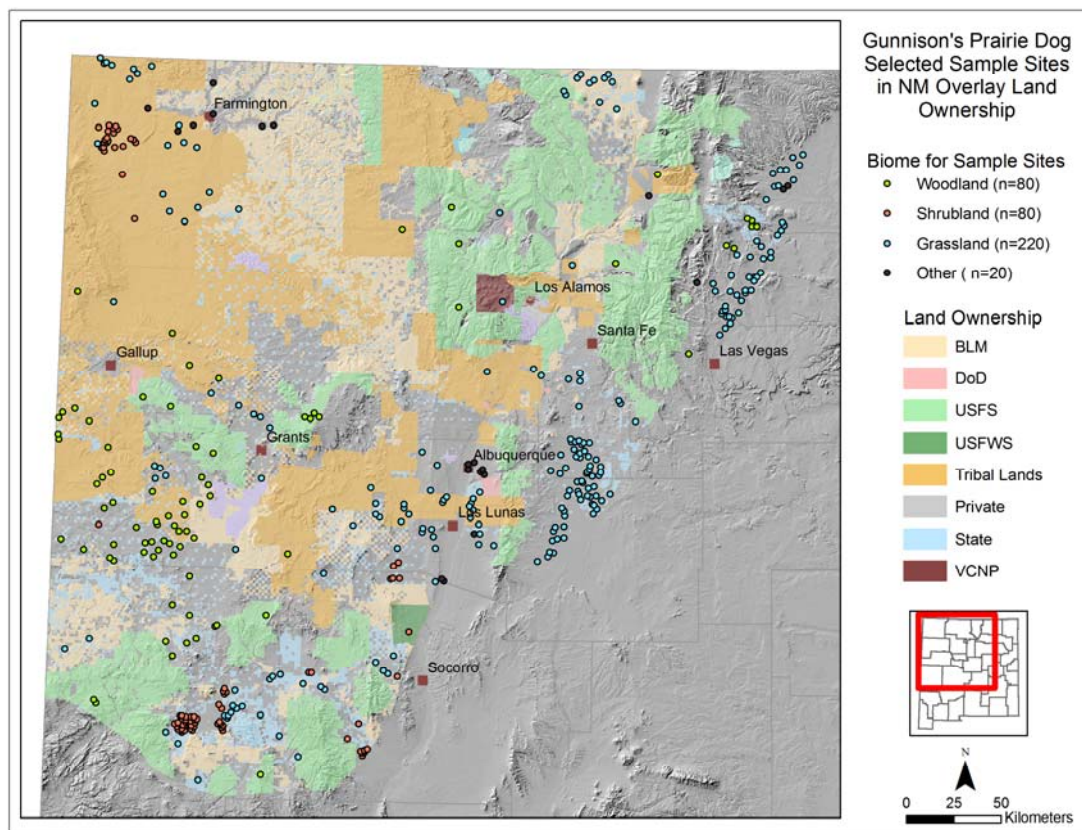
The randomly selected quads (n=400), were primarily on private (53%) and tribal lands (21%, Table 6, Figure 3). The percentages chosen in the random sample follow closely the representative land ownership within the GPD range. However, the State Land Office appears to be over-represented, probably because the SLO is typically either grassland or shrubland dominated, and we selected preferentially for those biomes. The USFS appears to be under-represented, probably due again to our stratified scheme and the removal of slopes greater than 20%.

The main potential weakness of our model is that our field data were not comprehensive, and the model could have been skewed accordingly. The final model was fit closely to the field verified sites and had an accuracy of 95%. (We eliminated some of the land cover classes as justified in Table 3, hence the accuracy of lower than 100%.) The NHNM and Seglund et al. (2005) models use roughly half of the same land use classes. Although the NHNM model uses fewer land cover classes (17) than the Seglund et al. model (19), our model covers 81% (7,282,698 ha, 17,995,547 ac) of the total gross GPD

range in New Mexico (8,952,011 ha (22,120,419 ac), compared to 56% (4068821 ha, 10054283 ac) for the Seglund et al. model. We believe that the inclusion of a larger proportion of the GPD range and the use of actual, albeit limited, field data provides a higher probability of including potential land cover types used by the GPD in New Mexico and thereby provides a better base for monitoring. However, we strongly recommend that our model not be the final basis of a long-term monitoring scheme for GPD in New Mexico. The model should be evaluated and revised, based on the results of the 2007 field season.

**Table 6. Ownership percentages for selected sample sites.**

	BLM	DoD	USFS	USFWS	VCNP	Private	Tribal	SLO
% Selected Sites	6.7	0.2	5	0.2	0.2	52.7	21.2	13.5
% GPD Range	13.6	.2	18.5	0.3	0.3	32.6	27.4	5.9



**Figure 3. Ownership and selected sample sites.**

## References

- Andelt, W.F. and A.E. Seglund. 2007. Draft protocol for conducting prairie dog occupancy surveys. Prepared for the Interstate Prairie Dog Working Group. 17 p.
- Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and I. Teague. 2003. *Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems*. NatureServe, Arlington, Virginia. 83 p.
- Johnson, K., T. Ostheimer, T. Neville, and J. Smith. 2004. Evaluation of Remote Sensing Methods to Survey for Gunnison's Prairie Dog. Publication No. 04-GTR-264. Natural Heritage New Mexico, Museum of Southwestern Biology, Department of Biology, University of New Mexico. 29 p.
- Lowry, J.H., Jr., R.D. Ramsey, K. Boykin, D. Bradford, P. Corner, S. Falzarano, W. Kepner, J. Kirby, L. Langa, J. Prior-Magee, G. Manis, L. O'Brien, T. Sajwaj, K.A. Thomas, W. Rieth, S. Schrader, D. Schrupp, K. Schulz, B. Thompson, C. Velasquez, C. Wallace, E. Waller and B. Wolk. 2005. Southwest Regional Gap Analysis Project: Final Report on Land Cover Mapping Methods, RS/GIS Laboratory, Utah State University, Logan, Utah.
- Natural Heritage New Mexico. 2007. NMBiotics Database. University of New Mexico, Albuquerque, NM. Last accessed 2007-08-14: <http://nhnm.unm.edu>.
- New Mexico Cooperative Fish and Wildlife Research Unit. 2005. SWReGAP Vertebrate Habitat Distribution Models, Gunnison's Prairie Dog, Version 1.0. Last accessed 2007-02-21: <http://fws-nmcfwru.nmsu.edu/swregap/habitatreview/ModelQuery.asp>.
- Seglund, A.E., A.E. Ernst, D.M. O'Neill. 2005. Gunnison's prairie dog conservation assessment. Western Association of Fish and Wildlife Agencies, August 2005. 86 p. + GIS Raster Model.
- USGS National Gap Analysis Program. 2004. Provisional Digital Land Cover Map for the Southwestern United States. Version 1.0. RS/GIS Laboratory, College of Natural Resources, Utah State University. Last accessed 2007-02-21: <http://earth.gis.usu.edu/swgap/archivaldata.html>.