WYOMING POCKET GOPHER (*Thomomys clusius*)
SURVEYS IN SOUTH-CENTRAL WYOMING

Prepared for

PETROLEUM ASSOCIATION OF WYOMING
951 Werner Court Suite 100
Casper, Wyoming 82601

Prepared by
HAYDEN-WING ASSOCIATES, LLC
P.O. Box 1689
Laramie, Wyoming 82073

NOVEMBER 2008

INTRODUCTION

The Wyoming pocket gopher (*Thomomys clusius*) is the only vertebrate wildlife species that occurs exclusively in Wyoming, apparently only in south-central Wyoming, specifically Sweetwater and Carbon counties (Clark and Stromberg 1987). It recently was petitioned for listing under the Endangered Species Act. One of the petitions rationales for the species' listing is the potential negative effects of energy development taking place within their known range (Keinath et al. 2008).

The species appears to occupy dry and gravelly ridges, as opposed to valley bottoms with deeper soils that typically are associated with other gopher species (Wilson and Reeder 1993). Current species knowledge is based predominantly on evidence (i.e. museum specimens, anecdotal reports) nearly 30 years old (Keinath and Beauvais 2006). Consequently, there is a paucity of up-to-date information on Wyoming pocket gopher abundance, morphology, habitat use, distribution, and potential threats to its persistence. The predicted distribution for Wyoming pocket gopher has been estimated using computer modeling techniques, but additional occurrence locations are needed to validate or improve models (Keinath and Beauvais 2006). Trapping efforts that provide spatial, genetic, and morphological data for Wyoming pocket gopher are needed to improve our understanding of the species' ecology. In addition, this information may provide aid for the logistics and trapping success of future efforts.

The Wyoming pocket gopher is smaller and paler than other pocket gophers in its geographic range; its dorsal pelage is uniform in color, and the margins of the pinnae are fringed with whitish hairs (Thaeler and Hinesely 1979, Keinath and Beauvais 2006). Two similar looking species of pocket gopher (northern pocket gopher, *Thomomys talpoides* and Idaho pocket gopher, *T. idahoensis*) may occur within the known range of the Wyoming pocket gopher, making reliable identification in the field difficult (Keinath and Beauvais 2006). Differentiating between juvenile Wyoming and northern pocket gophers can be especially arduous. Given the difficulty of distinguishing species in the field, positive identification requires karyotype (chromosomal) analysis (Thaeler and Hinesley 1979). Although more advanced genetic analyses exist today, the majority of Wyoming pocket gopher samples and specimens were collected in a time when karyotype analysis was the accepted analytical method. By employing karyotype analyses on current and future specimens, comparisons with historical data can be made. This linkage of information can help elucidate our knowledge of Wyoming pocket gopher ecology and taxonomy.

Objectives of this survey effort were: 1) to collect live specimens for karyotype analysis; 2) to collect tail clippings of all pocket gopher specimens for genotyping and mitochondrial DNA sequencing; 3) to determine whether different trap types and sizes influence trapping success; 4) to collect spatially referenced data for all trapping locations and captures; and 5) to examine how capture locations compare to the predicted distribution model for Wyoming pocket gopher.

STUDY AREA AND METHODS

In September and October 2008, Hayden-Wing Associates (HWA) initiated trapping efforts for Wyoming pocket gopher in cooperation with the Wyoming Natural Diversity Database (WYNDD) and the University of Wyoming's Department of Zoology and Physiology. The Wyoming Pocket Gopher survey areas (WPGSA) encompassed a large portion of southeastern Sweetwater and southwestern Carbon Counties, Wyoming (Figure 1). Survey areas within the WPGSA were selected because they encompassed historical capture locations, were accessible to trapping crews, and included public lands that fell within the predicted distribution for Wyoming pocket gopher (Keinath and Beauvais 2006).

The WPGSA is located within the Wyoming Basin Omernik Level III Ecoregion and included portions of the Rolling Sagebrush Steppe and Salt Desert Shrub Basins Level IV Ecoregions (Chapman et al. 2004). Topography was characterized by rolling plains interrupted by hills and strike-dip ridges dissected by alluvial and outwash fans that empty into broad, level basins. Ridges, hills, and rolling plains support vast areas of mixed-grass prairie and Wyoming, mountain, and basin big sagebrush communities. Active and stabilized sand dunes, as well as disjunct playas and alkaline flats, were interspersed throughout where existing conditions were favorable for their formation. Vegetation communities in the poorly drained, alkaline basins are dominated by arid-land shrubs like greasewood, shadscale, and Gardner's saltbush. Riparian and wetland habitats were scarce and found only at a few locations.

Data Collection

Hayden-Wing Associates, LLC biologists navigated and collected data using Garmin iQue® M5 Pocket PCs with integrated Global Positioning System (GPS) receivers running ArcPad® 7.1 mobile GIS software. We collected all data using the North American Datum 1983 projected in UTM Zone 13 North. Each observer also carried a Garmin eTrex® GPS unit and hardcopy maps as backups for navigation and spatial data collection. We used ArcGIS® 9.2 (Environmental Systems Research Institute, Inc.; Redlands, CA) and Hawth's Analysis Tools (Beyer 2004) to select survey areas, perform all spatial analyses, and create all cartographic products.

Survey Design

We used Sherman live-traps (H.B Sherman Traps, Tallahassee, Florida) and traps locally manufactured and specifically designed for live trapping pocket gophers (hereafter gopher traps; see Baker and Williams 1972 for design details). We found trapping locations using two methods. In the first method, we randomly selected 1-mile^2 public land survey sections within the WPGSA. We then systematically searched for active burrows within the randomly selected sections. However, because capture of Wyoming pocket gophers was essential to several of our survey objectives, in the second method we searched all potential habitat (dry and gravelly ridges) subjectively selected while in the field. Once we located areas of pocket gopher activity, we placed traps in lateral or main tunnel systems (Baker and Williams 1972) that showed signs of recent use. Traps were checked daily and remained in an area for up to three days or until a capture was made. We collected each trapping and capture location via GPS, and recorded trap type, size, and whether or not a trap was backfilled or plugged. Backfilled traps are an indication of gopher presence but do not allow for species identification. We weighed and measured all specimens captured, and clipped and preserved the distal portion (< 2 mm) of each specimen's tail for genetic testing. We transported live Wyoming pocket gopher specimens to the University of Wyoming for genetic analyses.

Statistical Tests

We tested for differences between trap types and sizes using Fisher's Exact and Pearson Chi-Square statistics at a significance level of $P < 0.05$ (Zar 2005). We also analyzed capture locations of Wyoming pocket gophers in relation to the species' predicted distribution model, and determined the likelihood of occurrence for each capture site (present-very high, present-marginal, absent-marginal, absent-very high; M. D. Anderson, WYNDD, personal communication).

RESULTS

From August 27 to October 9, we accrued 351 trap-nights (i.e., one trap set for one night) yielding 30 pocket gopher captures (Figures 2 and 3). Based on field identification, 10 specimens were *T. clusius* and 20 were *T. talpoides*. Two live Wyoming pocket gophers and tail clippings from all specimens were successfully transported to the University of Wyoming for genetic testing. Specimens identified as *T. clusius* had a distinctive karyotype ($2N = 46$) and clustered as a monophyletic clade in genetic analyses of AFLP (Amplified Fragment Polymorphism) genotypes conducted by Dr. David B. McDonald and associates at the University of Wyoming (Dr. David McDonald, personal communication).

Overall, approximately 8.5% of trap-nights were successful in capturing pocket gophers. However, 16.5% ($n = 58$) of traps were backfilled, indicating pocket gopher presence in those trapping areas. Capture success for Sherman live-traps was greater than gopher traps (Fisher's Exact, one-tailed $P = 0.036$, df = 1). Capture success for Sherman live-traps and gopher traps was 14.9% ($n = 16$ of 123) and 6.5% ($n = 15$ of 228), respectively. The probability of a trap being backfilled was greater for gopher traps than for Sherman live-traps (Fisher's Exact, one-tailed $P = 0.008$, df = 1). Twenty percent ($n = 46$ of 228) of gopher traps were backfilled while only 9.8% ($n = 12$ of 123) of Sherman live-traps were backfilled. The influence of gopher trap size on capture success was not different from expectation (Pearson $\chi^2 = 0.0892$, df = 2).

Twenty-three public land survey sections were inspected for recent pocket gopher activity (i.e., freshly dug burrows). In 65% ($n = 15$) of sections surveyed recent pocket gopher activity was observed. All Wyoming pocket gopher capture locations were located within the area where the species is predicted to be present (Figure 4). According to the predictive model, five capture locations were classified as present-very high and five were classified as present-marginal.

DISCUSSION

Our trapping success was similar to previous recent effort within the WPGSA (Doug Keinath, WYNDD, personal communication), but was well below reported values from other pocket gopher studies (i.e., 28 – 70%; Baker and Williams 1972, Gates et al. 1988, Williams and Cameron 1990, Proulx 2004). Lower capture rates in the WPGSA may be caused by low *Thomomys* densities brought about by reduced resource availability (Williams and Cameron 1990) or interspecific competition among species. Species of pocket gopher are thought to exclude one another from particular environments (Miller 1964), but sympatry could occur between northern and Wyoming pocket gophers. For example, northern pocket gophers capture sites were located 114, 262 and 269 m from three of the 10 Wyoming pocket gopher capture sites, and with all capture sites exhibiting little difference in environmental conditions. The potential interaction, if any, between these two species is an area that deserves further attention.

The genetic results from the University of Wyoming suggested that the field assessment of phenotype is a reliable indicator of genotype. All individuals identified in the field as small and lacking a dark ear patch had genotypes that placed them very strongly with the two individuals with the distinctive $2N$=46 karyotype described for the species by Thaeler and Hinesley (1979). The monophyletic clade that included all the *T. clusius* specimens was strongly supported (all 1,000 bootstrap replicates placed the *T. clusius* specimens in the monophyletic clade). Furthermore, the *T. clusius* clade fell further from *T. talpoides* than did the clade for *T. idahoensis* in the phylogenetic tree. Thus, the preliminary genetic results strongly support the distinctiveness of *T. clusius* as a species-level taxon (Dr. David McDonald, personal communication).

Unlike Gates et al. (1988) we experienced higher capture rates with Sherman live-traps rather than gopher traps. This finding could be attributed to several reasons. First, different species of *Thomomys* likely exhibit behavioral differences based on adaptations through natural selection and caution should be taken when making comparisons among various species of *Thomomys* or other gophers. Secondly, the back ends of our gopher traps were not constructed of a solid material but rather by metal mesh. This metal mesh allows the gopher tunnel to be exposed to more light than would a traditional Sherman live-trap, especially when traps are not fully covered with soil, as was often the case when trapping lateral tunnels. Pocket gophers may be more willing to explore traps that allow less light into the tunnel, rather than immediately engaging in backfilling behavior. This “light threshold” concept is untested and deserves further attention.

The perceived advantage of the top mounted trip mechanism on some live traps is that by placing the tripping mechanism and other moving parts away from the trap floor, dirt and debris are less likely to engender interference (Baker and Williams 1972). However, we found the solid floor pan trip mechanisms on Sherman live-traps may be more effective than the top mounted wire trip mechanisms on the locally produced gopher traps. Finally, traps that are locally produced and appear technically sound may lack the potential benefits of mass-produced traps (i.e. standardization and refinement through trial and error). The observed difference in trapping success between Sherman live-traps and our gopher traps suggests that these postulations cannot be ruled out.

We observed fresh burrow mounds in 65% of the public land survey sections we inspected, suggesting that the distribution of pocket gopher species is patchy and discontinuous. Unfortunately, no published research has been performed to ascertain detection probabilities for Wyoming pocket gopher or other species of the genus *Thomomys*. Consequently, it would not be prudent to claim that sections where fresh mounds were not observed are completely absent of pocket gophers. Repeated surveys of sections previously sampled, coupled with increased sampling of additional areas could provide management agencies and researchers with vital parameters (i.e. detection probability) and a refined methodology for surveying for pocket gophers at a specified scale.

According to the WYNDD model, all of our Wyoming pocket gopher captures were located within the predicted distribution of the species. Although our objective was not to test the model, capture locations from the present and future studies may be beneficial for refining and validating its predictive capacity.

CONCLUSION

The lack of knowledge regarding Wyoming pocket gopher abundance, morphology, habitat use, distribution, and potential threats will not be mollified without additional field studies. Foremost, studies that encompass larger spatial and temporal scales are needed. The locations of all trapping and capture sites from this survey will be combined with existing WYNDD databases and genetic samples will be analyzed by the University of Wyoming. These additional data will aid our understanding of Wyoming pocket gopher genetics, ecology, and current distribution. In the future we recommend that a variety of trap types be incorporated into trapping efforts. Specifically, we recommend the use of Sherman live-traps as they proved to be more effective at trapping pocket gophers during our survey. In addition, we stress the importance of future collaboration between the various agencies and stakeholders as an effective means of acquiring and disseminating information that pertains to this unique species.

LITERATURE CITED

Baker, R.J. and S.L. Williams. 1972. A live trap for pocket gophers. Journal of Wildlife Management 36: 1320-1322.

Beyer, H.L. 2004. Hawth's analysis tools for ArcGIS. Available at: http://www.spacialecology.com/htools.

Chapman, S.S., S.A. Bryce, J.M. Omernik, D.G. Despain, J. ZumBerge, and M. Conrad. 2004. Ecoregions of Wyoming. U.S. Geological Survey, Reston, Virginia.

Clark, T.W. and M.R. Stromberg. 1987. Mammals in Wyoming. University Press of Kansas, Lawrence, Kansas.

Gates, C.A., G.W. Tanner, and B.K. Gates. 1988. A modified live trap for the capture of southeastern pocket gophers. Florida Scientist 51: 156-158.

Keinath, D.A. and G.P. Beauvais. 2006. Wyoming pocket gopher (*Thonomys clusius*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available online: http://www.fs.fed.us/r2/projects/scp/assessments/wyomingpocketgopher.pdf.

Keinath, D.A., H. Griscom, and A. Redder. 2008. Survey for Wyoming pocket gopher (*Thomomys clusius*) in central Wyoming. Report prepared for The Nature Conservancy - Wyoming Field Office by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming. Available online: ftp://ftp.wygisc.uwyo.edu/pub/gis/wyndd/THCLReport07_15Feb07.pdf

Miller, R.S. 1964. Ecology and distribution of pocket gophers (*Geomyidae*) in Colorado. Ecology 45: 256-272.

Proulx, G. 2004. Effects of female scents on the trappability of northern pocket gophers (*Thomomys talpoides*). Crop Protection 23: 1055-1060.

Thaeler, C.S., Jr. and L.L. Hinesley. 1979. *Thomomys clusius*, a rediscovered species of pocket gopher. Journal of Mammalogy 60: 480-488.

Williams, L.R. and G.N. Cameron. 1990. Intraspecific response to variation in food resources by Attwater's pocket gopher. Ecology 7: 797-810.

Wilson, D.E. and D.M. Reeder, editors. 1993. Mammal species of the world: a taxonomic and geographic reference, second edition. Smithsonian Institute Press, Washington, D.C.

Zar, J.H. 2005. Biostatistical analysis, third edition. Prentice Hall, Upper Saddle River, New Jersey.

Table 1. Moprhologhical measurements, spatial locations, and trapping information for all *Thomomys* captures during trapping efforts conducted by Hayden-Wing Associates, LLC in south-central Wyoming.

Capture Date	Species	Post Auricular Dark Patch	Shade of Pinnae Fringe	Body Length (mm)	Hind Foot Length (mm)	Mass (g)	UTM NAD 83	
							Easting	Northing
8/27/2008	*Thomomys talpoides*	Yes	Dark	unknown[a]	unknown[a]	unknown[a]	743887	4580035
9/4/2008	*Thomomys clusius*	No	White	96	21	58	811930	4613254
9/4/2008	*Thomomys talpoides*	Yes	Dark	114	26	80	812334	4612576
9/4/2008	*Thomomys talpoides*	Yes	Dark	120	25	80	812333	4612549
9/4/2008	*Thomomys talpoides*	Yes	Dark	110	35	60	738532	4579412
9/4/2008	*Thomomys talpoides*	Yes	Dark	137	26	80	738583	4579363
9/4/2008	*Thomomys talpoides*	Yes	Dark	126	27	60	739160	4580668
9/4/2008	*Thomomys talpoides*	Yes	Dark	82	23	50	743477	4579867
9/4/2008	*Thomomys talpoides*	Yes	Dark	129	32	59	743491	4580021
9/4/2008	*Thomomys talpoides*	Yes	Dark	100	36	58	738763	4579515
9/4/2008	*Thomomys talpoides*	Yes	Dark	120	36	60	738736	4579547
9/4/2008	*Thomomys talpoides*	Yes	Dark	121	24	87	739258	4580315
9/4/2008	*Thomomys talpoides*	Yes	Dark	115	26	70	739290	4580113
9/4/2008	*Thomomys talpoides*	Yes	Dark	147	26	85	739293	4580032
9/10/2008	*Thomomys talpoides*	No	Dark	125	23	65	810275	4611228
9/11/2008	*Thomomys clusius*	Yes	White	95	20	44	810423	4611003
9/24/2008	*Thomomys talpoides*	Yes	Dark	110	25	65	812040	4613284
9/24/2008	*Thomomys clusius*	No	White	100	17	49	812298	4613230
9/25/2008	*Thomomys talpoides*	Yes	Dark	110	18	59	805585	4612043
9/26/2008	*Thomomys talpoides*	Yes	Dark	92	20	57	738873	4603893
9/26/2008	*Thomomys talpoides*	Yes	Dark	130	20	90+	810337	4614546
9/27/2008	*Thomomys clusius*	No	White	95	15	67	812252	4610019
9/27/2008	*Thomomys clusius*	No	White	100	16	61	812508	4610227
10/1/2008	*Thomomys talpoides*	Yes	Dark	unknown[a]	unknown[a]	unknown[a]	809080	4616344
10/3/2008	*Thomomys clusius*	No	White	100[b]	15[b]	65[b]	739708	4603060
10/3/2008	*Thomomys clusius*	No	White	100[b]	15[b]	65[b]	739677	4604334
10/3/2008	*Thomomys clusius*	No	White	100[b]	15[b]	65[b]	739440	4604322
10/3/2008	*Thomomys clusius*	No	White	100[b]	15[b]	65[b]	739707	4604014
10/9/2008	*Thomomys talpoides*	Yes	Dark	111	32	54	745777	4613936
10/10/2008	*Thomomys clusius*	No	White	110	18	59	742483	4593837

[a] unknown measurements due to observer error

[b] measurements are approximations due to digital data logger failure

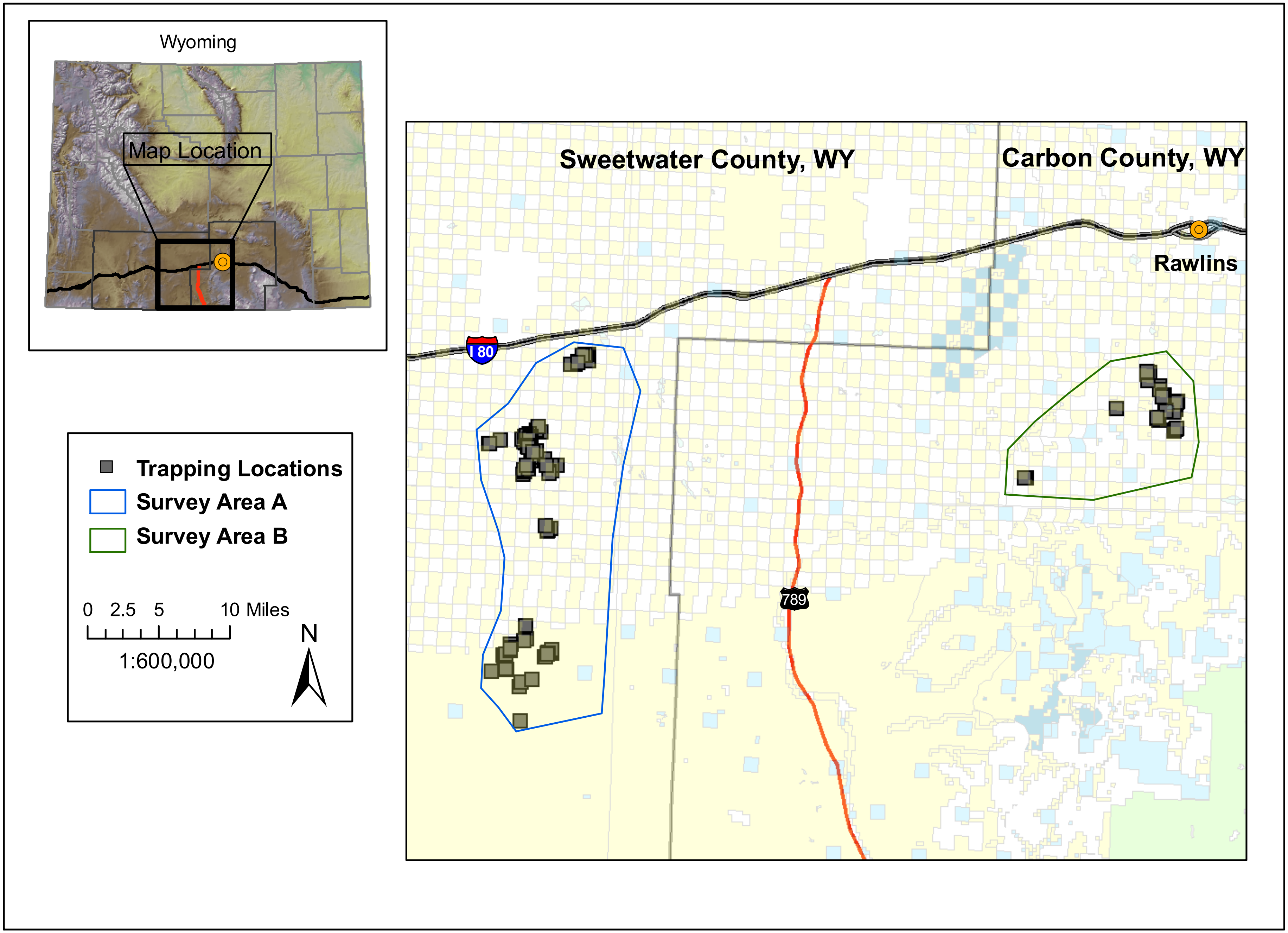

Figure 1. Locations of Wyoming pocket gopher survey areas and trap sites in south-central Wyoming.

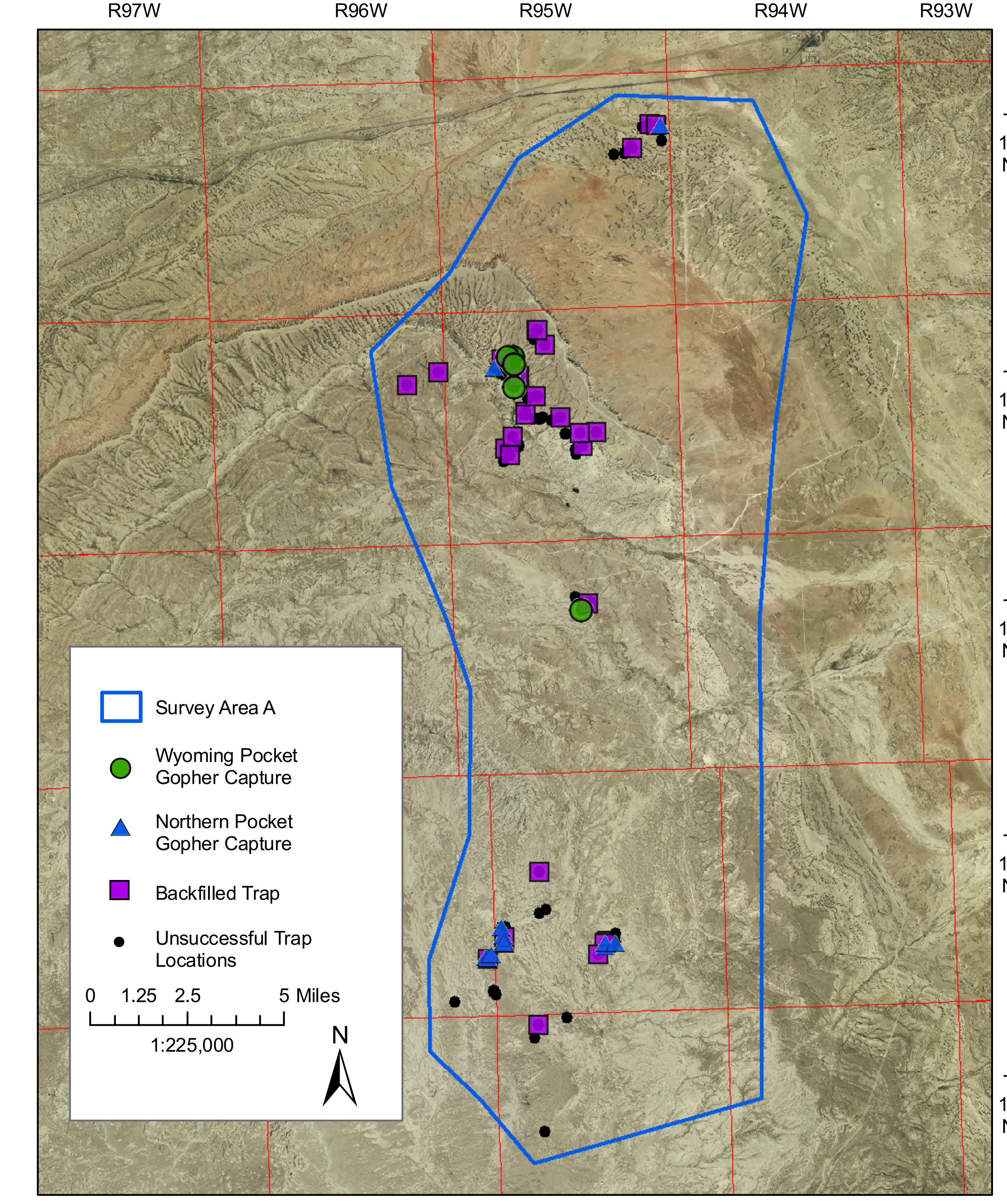

Figure 2. Wyoming pocket gopher capture locations, northern pocket gopher capture locations, backfilled trap locations, and unsuccessful trap locations in Survey Area A.

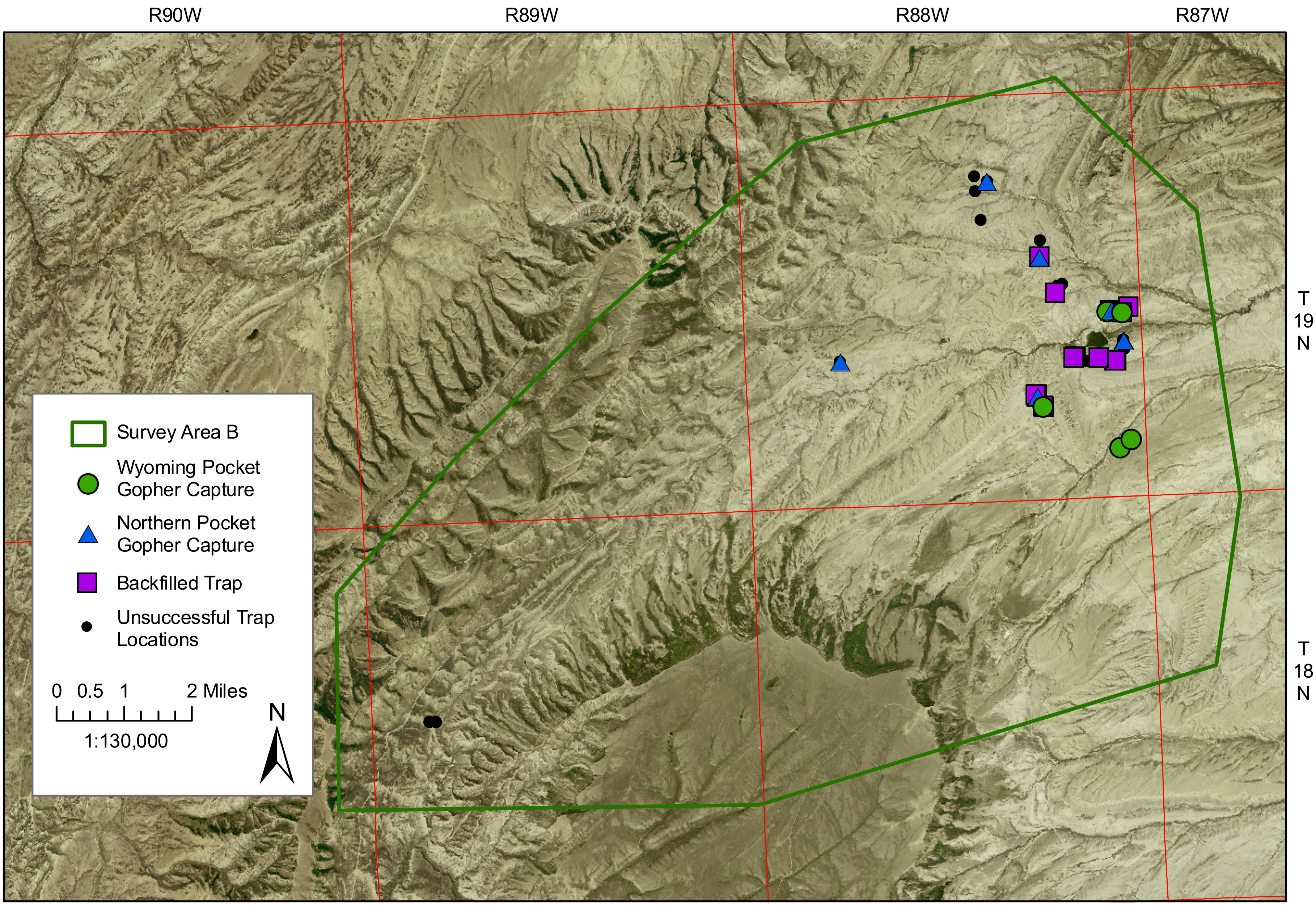

Figure 3. Wyoming pocket gopher capture locations, northern pocket gopher capture locations, backfilled trap locations, and unsuccessful trap locations in Survey Area B.

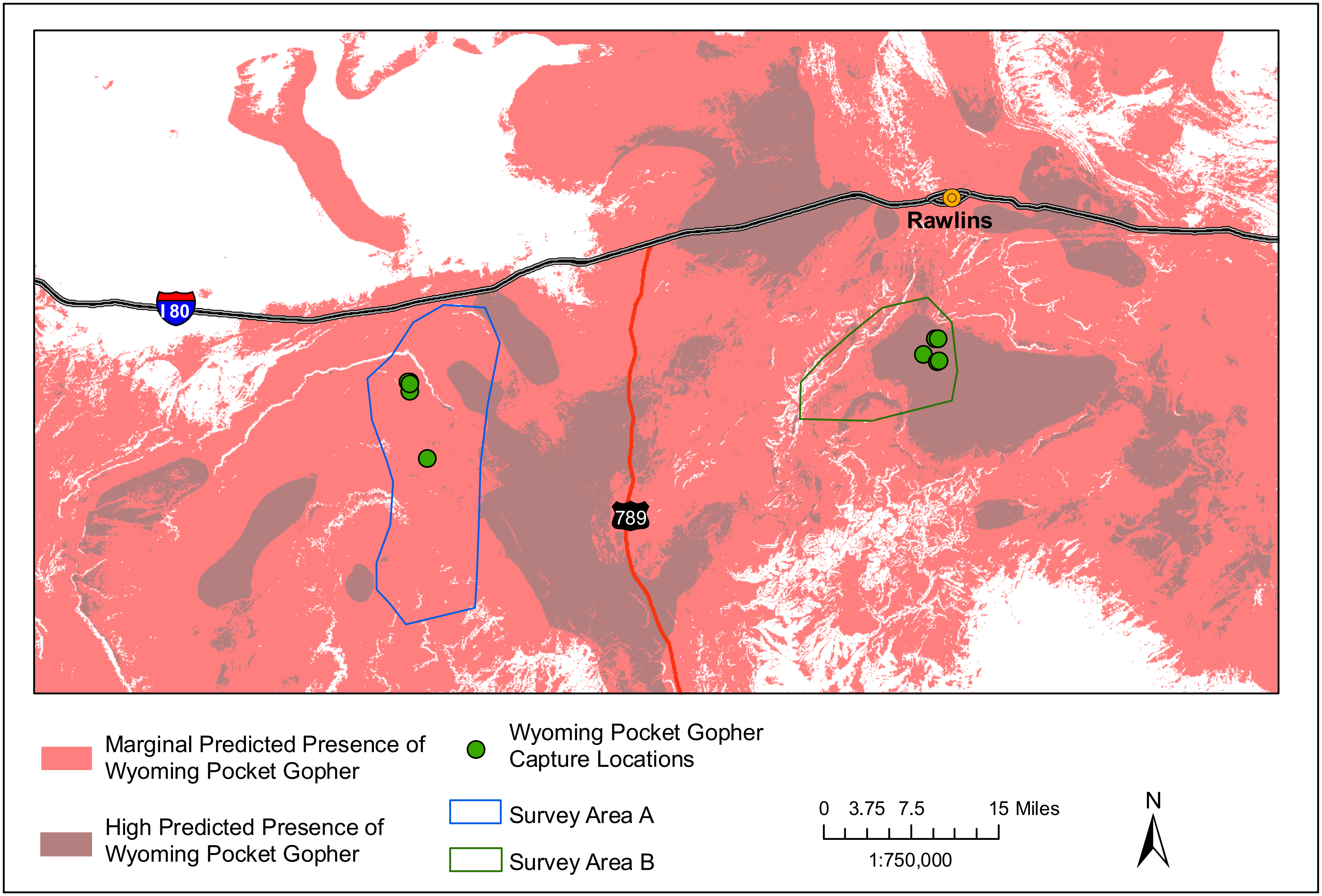

Figure 4. Capture locations in relation to the predicted distribution for Wyoming pocket gophers. Predicted distribution model developed by WYNDD.