Pygmy Rabbit Populations: estimating abundance and effects of burrow occupancy on vegetation.

Project Progress Report

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Acknowledgments

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Introduction

Abundance and distribution of animal populations is a critical yet challenging component of wildlife science. Accurate estimates are essential to understand the current status of species and population trends over time (Rosenberg et al 1995). For many mammalian species however, populations are either too rare or their behavior too secretive to make traditional abundance estimation techniques feasible for the managers in charge of monitoring them (Engeman 2005). Therefore, indirect abundance techniques are important to gathering baseline data needed to understand population trends and behavior.

The pygmy rabbit (*Brachylagus idahoensis*) is one species for which neither distribution nor abundance is completely known. As dietary and habitat specialists, the pygmy rabbit lives in close association with tall dense stands of big sagebrush (*Artemisia tridentata*). The pygmy rabbit is also one of only 2 rabbits known to dig their own burrows (Green and Flinders 1980). Pygmy rabbits are also considered central-place foragers, employing feeding strategy that maximizes their rate of energy delivery and reducing their risk of predation, by consuming vegetation closest to a central refuge of their burrow (Rosenberg and McKelvey 1999).

The current geographic range of pygmy rabbits includes most of the Great Basin and surrounding intermountain areas. However, the animals are distributed patchily within their sagebrush habitats, and there is mounted concern about their status throughout their range. Recently, the Columbia Basin pygmy rabbit was listed as an endangered distinct population segment under the Endangered Species Act (Federal Register 2003), however, a petition to list all remaining populations as threatened or endangered was denied in May 2005, citing insufficient information to warrant listing (Federal Register 2005). Concern about their status in Idaho has been reflected by its ranking as Species of Greatest Conservation Need (IDFG), Range wide/Globally Imperiled Species (BLM), and Sensitive Species (USFS Region 4). Insufficient species distribution, population abundance, and population trend data are available to asses their true conservation status at range and region-wide scales. Without this knowledge little can be done to use existing data to understand, manage, and conserve the smallest of North Americas' rabbits

Rejection of the petition to list pygmy rabbits under the Endangered Species Act has lead researchers to place high priority on developing a consistent method to survey the species across is range (Ulmschneider 2003). A calibrated index of burrow density and activity has been proposed to be used as a consistent, time and money efficient method to acquire baseline estimates of pygmy rabbit distribution and abundance. Ultimately, the goal is to use this index as a tool for monitoring long term population trends and responses to management activities.

The purpose of this research is to develop a standardized method to monitor abundance of pygmy rabbits and to gain an understanding of how pygmy rabbits affect their habitat. Specific objectives are to:

1) Calibrate an index of abundance based on burrow systems by correlating the index with estimates of population density;
2) Design standardized protocols for monitoring abundance, and;
3) Evaluate the effect of pygmy rabbits on vegetation around burrow systems

Study Area

Research was conducted this past fall in the Lemhi Valley and Idaho National Laboratory (INL). Research sites in the Lemhi Valley are near the town of Leadore, which is located in east-central Idaho, near the Montana border. The Lemhi Range runs along the western edge of the Valley and the Beaverhead Mountains run along the eastern edge. Average annual precipitation is approximately 20 cm (Western Regional Climate Center 2007). Elevation in the valley ranges from 1600-2400 m (Roberts 2001). The Valley is characterized by sage-steppe vegetation, and owned by both private landowners, as well as the Bureau of Land Management (BLM). The dominant shrub cover on the study area includes Wyoming big sagebrush (*A. tridentata wyomingensis*), mountain big sage (*A. vaseyana*), three-tipped sage (*A. tripartata*), black sage (*A. nova*), and green rabbit brush (*Chrysothamnus nauseousus*). Two sites were delineated in the Lemhi Valley along the base of Beaverhead Mountains. Cedar Gulch (89.39-ha) is characterized by very patchily distributed vegetation that occurs on mima-mounds. Rocky Canyon (103.01-ha) is characterized by less patchily distributed vegetation, mima-mounds with taller sagebrush, and more continuous sage between mounds.

I also conducted work on the Idaho National Laboratory (INL) located in the southeastern region of the state, west of Idaho Falls. This is a federally restricted-access area operated by the Department of Energy (DOE). The INL encompasses approximately 231,500 ha of upper Snake River Plain sage-steppe habitat, and is adjacent to the southeastern foothills of the Lost River, Lemhi, and Bitterroot mountain ranges. Mean annual precipitation is 24 cm (Western Regional Climate Data Center 2007). The predominant shrub is big sagebrush, and primary understory vegetation includes bottlebrush squirrel tail (*Sitanion hystrix*), wheatgrass (*Agropyron spp*.), and common winterfat (*Eurata lanata*), as well as invasive species including cheat grass *(Bromus tectorum)*. A study area just north of Atomic City (105.72-ha) was delineated and is categorized by fairly continuous big sagebrush and loose soils. Sagebrush height tends to be higher than in the Lemhi Valley. I also conducted work on 2 smaller 16-ha study sites. These sites were chosen from recent occupancy survey work conducted by the Wildlife Conservation Society (WCS). Plot 67 is located 3.01 km west of NRF, and is comprised of patchy sage in non-descript mounds. Plot 28 is located 4.28 km north of Highway 20, and consists of undulating topography with fairly continuous tall sage.

Methods

Mark-resight surveys and burrow censuses were completed this past fall in the Lemhi Valley and on the INL. A third method snow track surveys will be completed in the following months as snow permits. Censuses of burrow systems will allow estimates of relative population abundance and mark-resight studies and snow track surveys will allow absolute abundance estimates to be compiled. Mark-resight and snow-tracking techniques will be used to calibrate the index based on burrow systems.

Burrow entrance counts are commonly used to estimate population abundance for semi-fossorial mammals. A complete census of burrow systems was conducted at sites in the Lemhi Valley (Cedar Gulch and Rocky Canyon) and on the INL (Atomic City, Plot 28, and Plot 67). For each burrow system, GPS locations and the number of burrow entrances was recorded, pellets

collected at a random selection of active burrow systems, and each system classified based on sign/activity as described by Roberts (2001). This classification system ranks burrows into four classes of activity status; active, recently active, old, very old (Table 1). A map of burrow systems was then compiled using ArcGIS 9.

Next, trapping was conducted from 4-14 days at Cedar Gulch, Rocky Canyon, and Atomic City. No trapping was conducted at the 16-ha plots on the INL. At sites in the Lemhi Valley a visual search and chase technique was the sole method used to capture animals, however due to low success of this technique on the INL other methods were employed. Additional techniques used were: drift fences, spotlighting, and placing traps in active locations during daylight hours. Captured animals were fitted with 4.2 g radio transmitters (Holohil Inc., Toronto), PIT tags implanted, and standard mammalian measurements taken.

Upon completion of trapping events, mark-resight surveys commenced. Mark-resight techniques are an alternative method to estimate absolute abundance of species that persist at low densities, are patchily distributed, or difficult to trap/ observe such as the pygmy rabbit. Resight techniques are an extension of traditional closed mark-recapture methods and therefore, have the same basic assumptions. Animals were resighted by using maps and GPS to navigate to all active and recently active burrow systems as determined form the previous burrow censuses. Using this technique allowed us to maximize resight probabilities of all animals. When an animal was sighted, we recorded: 1) the presence of a mark (collar); 2) relative location of the rabbit (at a burrow system, under sagebrush, etc); 3) GPS location of sighted rabbit; and 4) confirmed survival. A portable receiver with 3-elemant yagi antennae was used to identify whether a rabbit is collared and to record which rabbit (if collared) had been located. Other measurements were taken at each resighting occasion from approximately the center of the study site and included weather (categories: rain, snow, sunny, overcast), temperature, snow cover (4 cover classes), wind (categorized into 4 classes), and date/time. Upon completion of the resight occasion all collared animals not detected were located to determine if they were onsite for survey. In the Lemhi Valley resight occasions were rotated every other day between Rocky Canyon and Cedar Gulch, for 5 resight days on Rocky Canyon and 6 resight days on Cedar Gulch. On the INL resight events were conducted every day for 5 resight occasions.

Snow track surveys were not completed at this time due to absence of snow events. They will be conducted in the next few months, as snow allows. Research has shown that complex movements of rabbits among burrow systems can be readily observed by the presence of snow cover current occupancy can be approximated with surveys conducted immediately after a fresh snowfall, but before rabbits begin moving actively between burrow complexes. This “snow tracking” technique proved to be a practical method for estimating abundance during a pilot study in the Lemhi Valley in 2003 at the Cedar Gulch study site (Rachlow and Witham 2004). To conduct snow tracking, site maps of burrow systems and GPS locations of active and recently active burrows (as determined during earlier burrow censuses) will be compiled. Observers will use GPS units to navigate to all mapped burrow systems in the “active” and “recently active” categories. Rabbit occupancy will be determined by presence of rabbits, tracks, and/or evidence of digging at burrow entrances within 1 day after snowfall. Study sites for snow tracking also will contain the radio-collared rabbits trapped during the mark-resight survey from earlier in the season. During visits to active and recently active burrows, frequencies of radio-collared rabbits

will be scanned to determine if burrows are occupied by collared animals. Immediately after the survey any collared rabbit not detected will be located by homing to determine if it is alive and present on the site. Collared animals also will allow estimation of the percent of rabbits present, but not associated with active or recently active burrows, and percent of occupied burrows where a rabbit was present, but no digging activity was detected by the observer. Snow tracking will be conducted ≥ 3 times at each site, time and weather permitting. This method will then be used as a second population estimate for comparison with mark-resight estimates, and both will be used to calibrate the index based on burrow systems. Survival of radio-collared rabbits will be estimated and used to account for mortality occurring between the mark-resight and the snow tracking population estimates. On the INL, snow tracking will be the sole method used to estimate abundance of pygmy rabbits on a random selection of 16 ha grids.

Current Results and Accomplishments

On September 11, 2007, I formally presented my proposed work to an audience of my peers and submitted the final draft of my proposal to my graduate committee. I then began my first field season on September 15, 2007.

As expected, systematic censuses in the Lemhi Valley and on the INL indicate a difference in the number of burrow systems in each activity class (Table 2) and the density of burrow systems on each of the 3 study areas. Cedar Gulch had the lowest total number of burrow systems (131) and the lowest density of burrow systems, while Rocky Canyon had the largest number of burrow systems (505) and the highest density burrow systems. Atomic city fell in the middle with 449 total burrow systems. Atomic City also falls in the middle when density of burrow systems is considered, however active burrow density is only slightly higher than active burrow density of Cedar Gulch, but when all burrows are considered the burrow density is closer to the burrow density of all burrows for Rocky Canyon (Figure 1).

Trapping in the Lemhi Valley commenced for approximately 12 days between the two study areas. On Cedar Gulch 13 animals were fitted with radio-collars (5 males, 8 females) and on Rocky Canyon 14 animals were collared (6 males, 8 females). No mortalities occurred from trapping but 2 fatalities of unknown origin occurred between the first and second resight occasions on Cedar Gulch (1 female, 1 male). The day after capture we located rabbits to visually check collar fit. It was observed that several animals made large movements (several 100 meters) after capture then returned to an area close to their capture within a few days. For this reason, resight events were 2 days after the last trapping event.

Trapping effort at Atomic City yielded only one animal captured. The visual technique used in the Lemhi Valley proved to be inefficient, therefore other techniques were attempted. We set 30 Tomahawk traps and 30 Havahart 2 door traps at sites of active sign. Traps were set at sunrise and baited with apples, carrots or green beans, then checked at sunset. After several days of no success we constructed 4 drift fences (Burak 2006, Faulhaber et al 2005) and placed them in areas where we had spotted rabbits previously. Traps were placed along the fences and also set at sunrise and checked at sundown. Bungee cords were used to hold traps in open overnight allowing animal passage through the area. Drift fences proved to be unsuccessful, but with some improvement might be a useful method in the future. The one rabbit that was successfully

trapped (male) was caught by the visual technique, and remained in the same complex of burrows it was captured.

Mark-resight surveys in the Lemhi Valley yielded 25 collared and 44 uncollared rabbit sightings on Cedar Gulch over 6 days, and 25 collared, 22 uncollared rabbits on Rocky Canyon over 5 days. On several occasions 1 or 2 rabbits were documented offsite at both Rocky Canyon and Cedar Gulch (Table 3), thus not available for resight. Of the rabbits sighted on Cedar Gulch 89.9% were located at active burrow systems, 5.8% at recently active, and 4.3% at other burrows. At Rocky Canyon 74.5% were sighted at active, 23.4% at recently active, and 2.1% at other systems (Table 4).

Mark-resight surveys at Atomic City yielded 10 sightings of rabbits over 5 occasions. The collared rabbit was spotted 3 out of 5 occasions and a total of 7 uncollared rabbits were spotted (Table 3). Location of rabbit sightings differed from that of Cedar Gulch and Rocky Canyon with only 20% of rabbits located at active burrows, and 70% at recently active burrows. Preliminary observations from this site suggest that densities of rabbits is much lower at than in the Lemhi Valley, and that rabbits may be using more burrow systems per rabbit. Sanchez and Rachlow (in review) found that the number of burrows used per rabbit was higher on Rocky Canyon (7.7) where sage and grasses are more continuous, than on Cedar Gulch (4.9). The observations at Atomic City suggest that a relationship of number of rabbits per burrow system may be related to shrub density. Thus more burrow systems are used per rabbit at Atomic City where sage appears much more continuous than Rocky Canyon.

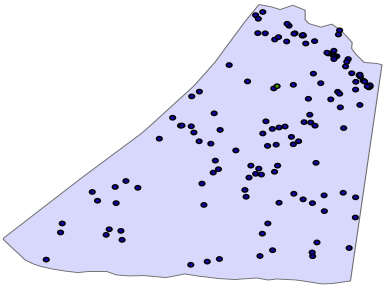
Schedule of Activities

Preliminary data has been compiled for my first field season, with the exception of snow track surveys. Over the next few months I will be analyzing this data and testing hypothesis related to the objectives of my research. A complete schedule of activities is as follows:

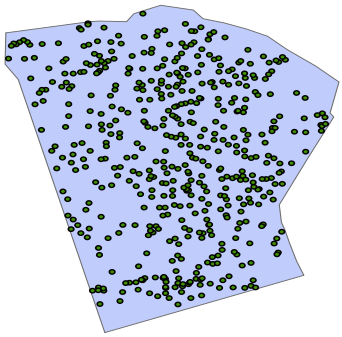
January - February 2008	Conduct snow-track surveys
January - May 2008	Classes, analyze first year data, plan protocol for vegetation/browsing analysis
June – August 2008	Vegetation sampling, further data analysis
September – November 2008	Second fall field season (burrow surveys and mark-resight on 4-6 new sites)
November - February 2009	Snow-track surveys
January - May 2009	Classes, data analysis
June - August 2009	Vegetation sampling, further data analysis
September – December 2009	Remaining class credits, data analysis, thesis writing
December 2009 *	Defend thesis and graduate

Tables and Figures

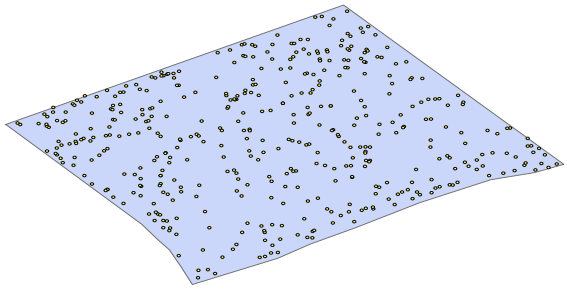
Figure 1. Maps of all burrow systems at each study site conducted September - November 2007. Density of all burrow systems and of active burrow systems was highest at Rocky Canyon and lowest at Cedar Gulch.



Cedar Gulch
Area: 89.392 ha
Density Active Burrows: 0.671 bs/ha
Density All Burrows: 1.029 bs/ha



Rocky Canyon
Area: 103.013 ha
Density Active Burrows: 1.019 bs/ha
Density All Burrows: 2.281 bs/ha



Atomic City
Area: 105.715 ha
Density Active Burrows: 0.776 bs/ha
Density All Burrows: 2.176 bs/ha

Table 1. Criteria used to assess activity status of pygmy rabbit burrows (adapted from Roberts 2001). This system has been used at the Lemhi Valley study sites since 2002.

Criteria	#1 (Active)	#2 (Recently Active)	#3 (Old)	#4 (Very Old)
Burrow Entrances:				
intact/open	X	X	X	
intact/debris			X	
collapsed				X
Fecal Pellets:				
fresh	X			
old/weathered		X		
absent			X	X
Digging/Tracks:				
fresh/abundant	X			
absent/old/few		X	X	X

Table 2. Number and proportion of burrow systems at each study site categorized by activity status during censuses in September – November 2007.

Study Site	Area (ha)	#1 (Active)	#2 (Recent)	#3 (Old)	#4 (Very Old)	Total
Cedar Gulch	89.392	60 (46%)	32 (24%)	14 (11%)	25 (19%)	131
Rocky Canyon	103.013	105 (21%)	130 (26%)	151 (30%)	119 (24%)	505
Atomic City	105.715	82 (18%)	148 (33%)	105 (23%)	114 (25%)	449

Table 3. Results of mark-resight surveys on study sites. Cedar Gulch (CG) had the largest number of resights, followed by Rocky Canyon (RC), then Atomic City (AT).

Date	Study Area	# collared	# uncollared	# offsite	# Collared On-site	Total resights
4-Oct	CG	5	7	2	11	12
6-Oct	CG	4	9	1, 2 dead	10	13
8-Oct	CG	3	4	1	10	7
10-Oct	CG	4	8	2	9	12
12-Oct	CG	5	9	0	11	14
14-Oct	CG	4	7	1	10	11
					TOTAL =	**69**
5-Oct	RC	3	4	1	13	7
7-Oct	RC	5	4	0	14	9
9-Oct	RC	4	3	1	13	7
11-Oct	RC	8	5	0	14	13
13-Oct	RC	5	6	1	13	11
					TOTAL =	**47**
12-Nov	AT	0	1	0	1	1
14-Nov	AT	1	3	0	1	4
15-Nov	AT	1	1	0	1	2
16-Nov	AT	0	1	0	1	1
17-Nov	AT	1	1	0	1	2
					TOTAL =	**10**

Table 4. Number and proportion of rabbits sighted which where located at burrow systems categorized as active, recently active, and other older burrow systems or no located at a burrow system (other).

Site	Burrow Status	# Collared	# Uncollared	Total	Percent of Total
Cedar Gulch	Active	22	40	62	89.9
Cedar Gulch	Recently active	0	4	4	5.8
Cedar Gulch	Other	3	0	3	4.3
Rocky Canyon	Active	21	14	35	74.5
Rocky Canyon	Recently active	3	8	11	23.4
Rocky Canyon	Other	1	0	1	2.1
Atomic City	Active	0	2	2	20.0
Atomic City	Recently active	3	4	7	70.0
Atomic City	Other	0	1	1	10.0

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