Progress Report to

National Park Service, Fossil Butte National Monument

Understanding the impact of fire on pygmy rabbit distribution, abundance, and movement

Rocky Mountain Cooperative Ecosystem Studies Unit

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Background

Extinction risk is affected by a number of traits, such as ecological specialization, body size, dispersal ability, and abundance (McKinney 1997, Collen et al. 2006). Additionally, the combination of two or more extinction-promoting characteristics can increase extinction risk in a synergetic non-additive manner (Davies et al. 2004, Henle et al. 2004, Olden et al. 2008). Habitat loss and fragmentation are widely accepted as the primary threats to biodiversity (Fischer and Lindenmayer 2007, Stutchbury 2007) and as such, traits affecting the persistence of a species are increasingly considered in a geographical context (Henle et al. 2004).

Due to the patchiness of their resources, the persistence of a specialist species depends on habitat distribution and vagility (Swihart et al. 2003). The matrix is perceived as more hostile by specialist than by a generalist species (Swihart et al. 2003, Henle et al. 2004), and can prevent movement between habitat patches, affecting the connectivity of populations. Theory suggests that specialist species, evolving in naturally patchy habitat, should be less sensitive to fragmentation (Henle et al. 2004) than suggested by empirical evidence (Davies et al. 2004, Devictor et al. 2008). A possible source for this disparity is that while the degree of habitat suitability for a species naturally varies across the landscape, fragmentation does not mimic natural patchiness. Fragmentation results in patches that are smaller, have an increased proportion of edge, and experience greater isolation than would be found in an undisturbed landscape (Fletcher et al. 2007).

Pygmy rabbit

The pygmy rabbit (*Brachylagus idahoensis*) is the smallest North American leporid species, weighing 246 - 462 g (Green and Flinders 1980) and is one of two North American leporid species to dig their own burrows (Keinath and McGee 2004). Its range extends over the Great Basin, with a genetically distinct population in the Columbia Basin of Washington State (Warheit 2001). In Wyoming, the pygmy rabbit occurs in the southeastern corner of the state, as far north as Pinedale and as far east as Rawlins (Figure 1) (Purcell 2006). While not dietary obligates, pygmy rabbits depend on the structural features of mature big sagebrush (*Artemisia tridentata*). They require loose deep soils to construct burrows, along with vertically complex shrubs to provide cover from predators, especially raptors (Katzner and Parker 1997, Gabler et al. 2001, Himes and Drohan 2007). By using the pygmy rabbit as the study species, I hope to further the understanding of metapopulation dynamics and individual behaviors of specialist species that are adapted to a naturally patchy landscape, but whose habitat is also experiencing fragmentation.

Pygmy rabbit populations are believed to be declining due to habitat destruction (Federal Register 2008). In Wyoming, much sagebrush habitat is converted through agriculture and development. In addition, drought, grazing, and invasive species degrade the sagebrush ecosystem by changing the physical structure, successional trajectory, and fire regime of sagebrush stands (Wyoming Interagency Vegetation Committee 2002). In Wyoming, sagebrush communities > 50 years old are alleged by some to be even-aged stands having low forb and grass cover, which can be detrimental to wildlife and

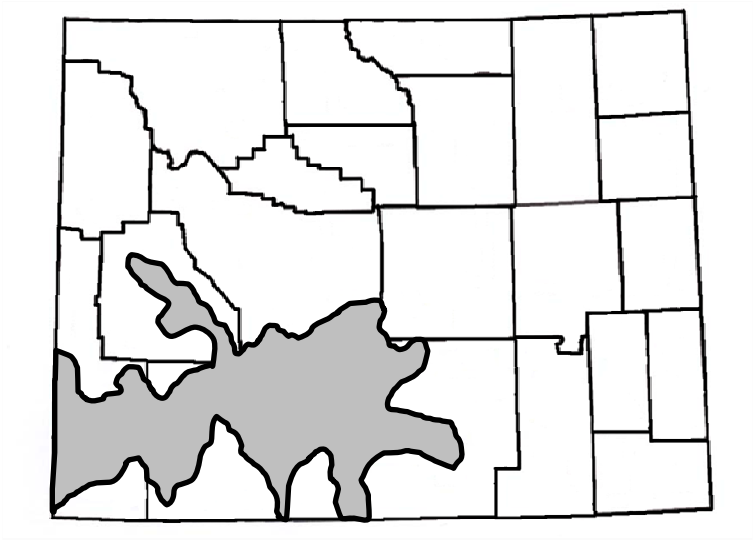

Figure 1. Pygmy rabbit distribution in Wyoming adapted from Purcell (2006).

livestock. In such sagebrush ecosystems, prescribed fire is used as a habitat management tool to increase the productivity and diversity of the plant community (Wyoming Interagency Vegetation Committee 2002). However, the natural fire frequencies in sagebrush are uncertain, with estimates of fire return intervals ranging from 10 to 250 years (Wyoming Interagency Vegetation Committee 2002, Baker 2006). Although a history of fire within the last 13 years has been found to be a negative predictor of pygmy rabbit occurrence (Rachlow and Svancara 2006), little is known about how habitat use, site occupancy, and movement are affected by prescribed fire.

Monitoring pygmy rabbit populations

Current monitoring procedures for pygmy rabbits include searching for burrows and pellets in targeted habitats (Ulmschneider 2004). Over the entire pygmy rabbit range, *Sylvilagus* spp. are sympatric (Zeveloff 1988). Juvenile *Sylvilagus* spp. pellets overlap in size with pygmy rabbit pellets (4 – 6 mm) and pregnant pygmy rabbit pellets overlap in size with full grown *Sylvilagus* spp. pellets (6 – 10 mm) (Ulmschneider 2004), creating uncertainty when carrying out pygmy rabbit surveys. While pellet size is an inexpensive survey method, supplemental methods of species identification are needed to accommodate the seasonal species overlap in pellet size. DNA techniques can be used for confirming the identification of pygmy rabbit pellets (Ulmschneider 2004), but requires fresh pellets, as high temperatures and moisture degrade DNA (Kovach et al. 2003, Luikart et al. 2008). In addition, the quality of DNA extracted from pellets can vary seasonally, because characteristics of winter forage cause greater epithelial cell shedding in feces (Kovach et al. 2003, Luikart et al. 2008). Stable isotopic analysis of pellets could prove to be a beneficial tool for species identification. The higher percentage of sagebrush in the diet of pygmy rabbit compared to *Sylvilagus* spp. (Shipley et al. 2006) suggests that the isotopic signature of big sagebrush in rabbit pellets as a possible alternative to pellet size and DNA analysis for species identification.

Objective 1

We will determine whether the burn mosaic contains patches of unburned big sagebrush that are able to support pygmy rabbits and if habitat use differs in burned areas. Vegetation and soil characteristics will also be measured in burned and unburned areas to

assess whether suitable pygmy rabbit habitat remains in the burn mosaic. Through radio telemetry, we will monitor movements in order to understand the capacity of pygmy rabbits to use and move through the burn mosaic and to compare habitat use of rabbits within the burned area to that in unburned areas. Vegetation, soil and rabbit presence data will be used to create GIS layers depicting pygmy rabbit habitat in and around Fossil Butte National Monument.

Study Area and Methods

Study Area

Figure 2. Two study sites located in Fossil Butte National Monument that underwent prescribed burning in 2005. The black areas denote patches of unburned vegetation within each burn area (data provided by FBNM).

The study area will be located in the Kemmerer area and include portions of Fossil Butte National Monument. Two study sites will be located in each of two prescribed burns that occurred in either 1995 or 2005 (Figure 2). Additionally, we will select an area with no recent history of fire (>36 years).

Habitat Measurements

We will continue to sample patches at each of the study sites until we have collected vegetation measurements and patch sizes that span a range appropriate to fit a logistic regression model of presence-absence of pygmy rabbits. Vegetation patches will be determined to be burned or unburned, then searched for current sign of pygmy rabbits. Using a Trimble Pathfinder ProXRS GPS receiver, we will map each sampled patch, using GIS methods to measure the patch area, patch perimeter, and distance to the next closest patch. Although we will attempt to sample across the whole burned landscape, actual sample locations will be governed by the presence of unburned big sagebrush patches. Shrub patches will be characterized using vegetation and soil attributes. To classify the burned portion of the matrix, vegetation and soil measurements will also be made in randomly placed sham patches that are similar in shape and size to actual unburned patches. We will determine the sampling effort needed to accurately describe vegetation and soil parameters in patches of varying size at the beginning of the field season.

Using a line-intercept method, we will quantify percent shrub cover, percent sagebrush cover, and percent dead

sagebrush canopy (Barbour et al. 1999). We will run a base transect along the longest axis of the patch and place secondary transects perpendicular to the base transect. The total length of secondary transects in each patch will be in proportion to the area of the patch. We will describe the vertical structure of the shrub component at systematic intervals along the transects. A pole with 10-cm marked increments will be placed next to the shrub and the number of hits on each 10-cm interval will be recorded (Katzner 1994). Additionally, we will place Daubenmire quadrats at systematic intervals along the transects to determine the percentage of grasses, forbs, and bare ground in each patch (Daubenmire 1959).

Soil hardness will be assessed through measurements of penetration resistance and soil texture. Soil samples will be collected from the same locations as the Daubenmire quadrants. We will use a penetrometer to measure penetration resistance and will use a wet sieve method to determine the proportion of sand (> 60 µm) in the soil (Rowell 1994).

Pygmy rabbit absence/presence

We will use burrows, signs of fresh digging, pellets, and sightings as predictors of pygmy rabbit presence. Following the classification of burrow systems by Ulmschneider (2004), we will locate all burrows in a patch and categorize them as follows: 1) Active burrow (entrance free of debris), fresh pellets (green, brown, black); 2) Unused burrow (debris in entrance), fresh pellets; 3) Burrow, old pellets; 4) Burrow, no pellets; 5) Collapsed burrow, no pellets; 6) Pellets only; 7) Fresh digging at burrow, no pellets; 8) Possible burrow, no pellets. We will assess patch occupancy twice, once in the summer and again in the winter. To insure that burrows and fresh pellets are visible, we will wait at least two days after a snow fall to conduct surveys.

Habitat use and Movement Through the Burn Mosaic

In patches with recent pygmy rabbit sign, we will place Tomahawk box traps, wrapped in burlap, over burrow entrances and runways. To limit thermal stress, we will set traps in the evening and check them in the morning. Captured rabbits will be weighed and sexed. When a rabbit is captured, we will fit a subset of them with radio collars. Radio-collared rabbits will be located in the morning and evening. We will fit radio collars on 10 rabbits in burned areas and 10 rabbits in unburned areas (n = 5 for each habitat in both 2008 and 2009). We will focus my trapping effort on the smallest patches with current pygmy rabbit sign, as animals occupying the smallest patches are most likely to utilize multiple patches. Trapping and handling procedures were approved by the Institutional Animal Care and Use Committee at the University of Wyoming.

Data Analysis

We will use the habitat variables to create a binary logistic regression model with pygmy rabbit presence-absence as the response variable. After we determine the habitat variables

that best predict pygmy rabbit presence, we will perform additional analyses to examine how prescribed burning affects the habitat predictors of pygmy rabbit presence.

Progress during the reporting period

In January, we explored whether pygmy rabbit presence could be determined with greater accuracy during the winter months. We found that snow cover removes much of the ambiguity that arises when pygmy rabbit presence is assessed using sign during other times of the year; pellets and burrows found on snow can be assumed to be current.

In May, Amanda presented our study plan during a Kemmerer Rotary Club meeting, at the invitation of Dave McGinnis, in order to inform the community about research occurring at Fossil Butte National Monument. Also, we mapped unburned vegetation patches within the 2005 prescribed burn boundary at Fossil Butte National Monument in order to create a suitable GIS layer. We have received the original GIS layer denoting burned areas, unburned inclusions, and pygmy rabbit burrows. Additionally, preliminary pygmy rabbit surveys in the unburned patches indicated that there are no rabbits within the burn boundary,. The vegetation that remained unburned within the burn boundary does not appear to suitable for pygmy rabbits, and no reliable sign has been found, although we need to clarify that via winter surveys. Further vegetation analysis during the summer will allow us to quantify and describe the unburned vegetation. We are also searching areas adjacent to the burns for pygmy rabbit sign. If pygmy rabbit presence is confirmed in these adjacent areas, vegetation characteristics will be measured for comparison to the unburned vegetation in the burned area and pygmy rabbits will be trapped and fitted with radio collars.

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