

Effects of habitat quality on Utah prairie dog
(*Cynomys parvidens*) reproduction and survival

Research Proposal

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Introduction

A recent analysis of Utah prairie dog (*Cynomys parvidens*) population trends since 1976 revealed large fluctuations and frequent “crashes” at local complexes (groups of prairie dogs more than 3 km from others). Local population fluctuations appear to be asynchronous and density dependent rather than the result of random environmental stochasticity. These characteristics suggest Utah prairie dogs exist as a natural metapopulation, or a series of isolated local populations linked by occasional dispersal (Ritchie 1996). The key to persistence of a metapopulation species is the proper balance between local population crashes and recolonizations across the species’ range (Wiens 1996). A key step in enhancing the persistence of a metapopulation is understanding the factors that influence local population dynamics of the species.

The distribution of the Utah prairie dog is limited to the semi-arid grasslands of southwestern Utah. Introduction of domestic livestock into Southwest Utah in the mid 1800’s greatly altered habitat conditions across much of the range of the Utah prairie dog (Crocker-Bedford 1975). In the 1960’s, large expanses of rangeland/prairie dog habitat were converted from native grassland to crested wheatgrass (*Agropyron desertorum*) monoculture to improve range conditions for livestock (McDonald 1993). In addition, heavy grazing by cattle, combined with active fire suppression, has been implicated in the conversion of grasslands to shrublands. The effects of these habitat changes on Utah prairie dog colony persistence have yet to be thoroughly analyzed. At the local level, we need to know how grazing use and vegetation factors affect prairie dog success (reproduction, survival, weight gain). At the metapopulation level we need to evaluate the implications of habitat quality for Utah prairie dog persistence. Are current grazing practices and habitat conditions influencing success of local prairie dog colonies? If so, how might that affect the rate of crashes of local complexes?

Understanding the effects of habitat quality on existing Utah prairie dog colonies is the first step in fulfilling a major short-term goal identified in the UPD Interim Conservation Strategy (UPD Recovery Implementation Team 1997). Previous results suggest that grazing season, plant diversity, vegetation dominance by native vs. introduced plant species, and thermal environment all appear to influence prairie dog activity, foraging rates, and weight gain. Thus, these variables may be important in choosing appropriate habitat improvement strategies for existing Utah prairie dog complexes and in selecting suitable sites for prairie dog translocations. The question we seek to answer is whether or not revegetation (greater plant species diversity, less shrubs) and/or grazing schemes can improve success of existing and future prairie dog colonies. To answer this question we will examine success of individual prairie dogs across colonies that differ in current grazing use and vegetation to answer the following questions:

- 1) How much do colonies differ in mean individual foraging rates, weight gain, litter size, and overwinter survival?
- 2) Is prairie dog success related to grazing use and/or vegetation?
- 3) How is prairie dog success related to the long-term persistence and frequency of crashes of a complex?

Objectives

This study will examine effects of habitat condition on the success of individual prairie dog colonies and its implications for metapopulation persistence. We will examine success across 12 colonies that vary in grazing use and vegetation. To determine if results are consistent across an elevation gradient, we will choose four colonies from each of three recovery areas (West Desert, Paunsaugunt, and Awapa Plateau) differing in elevation. Our objectives are to:

- 1) relate grazing use and vegetation at a colony to individual prairie dog success (foraging rates, weight gain, reproduction, survival),
- 2) relate thermal conditions at different colonies to prairie dog activity level, and
- 3) relate measures of individual prairie dog success to the average annual count, frequency of population crashes, and other measures of the persistence of prairie dog complexes from the long-term UDWR annual count data.

Background

Our 1998 study of habitat effects on individual prairie dog success revealed differential mean success among colonies with different cattle grazing seasons and vegetation treatments (native vs. non-native), but was unable to conclusively separate the effects of each factor. Research also suggested that thermal conditions (elevation) might be an important factor for prairie dog success. Results showed juvenile:adult ratios were greatest in Summer and Fall/Winter cattle grazed sites. Forage rate and weight gain were also highest in Summer grazed colonies. Surprisingly, Fall/Winter grazed sites had the lowest foraging rates and weight gains. This may be related to thermal conditions at these sites. The two colonies in this category occurred at low elevation (< 2000 m). Hot mid-day temperatures may have restricted foraging activity to early morning and late afternoon, as evidenced by the significantly shorter daily activity times for colonies in this grazing category.

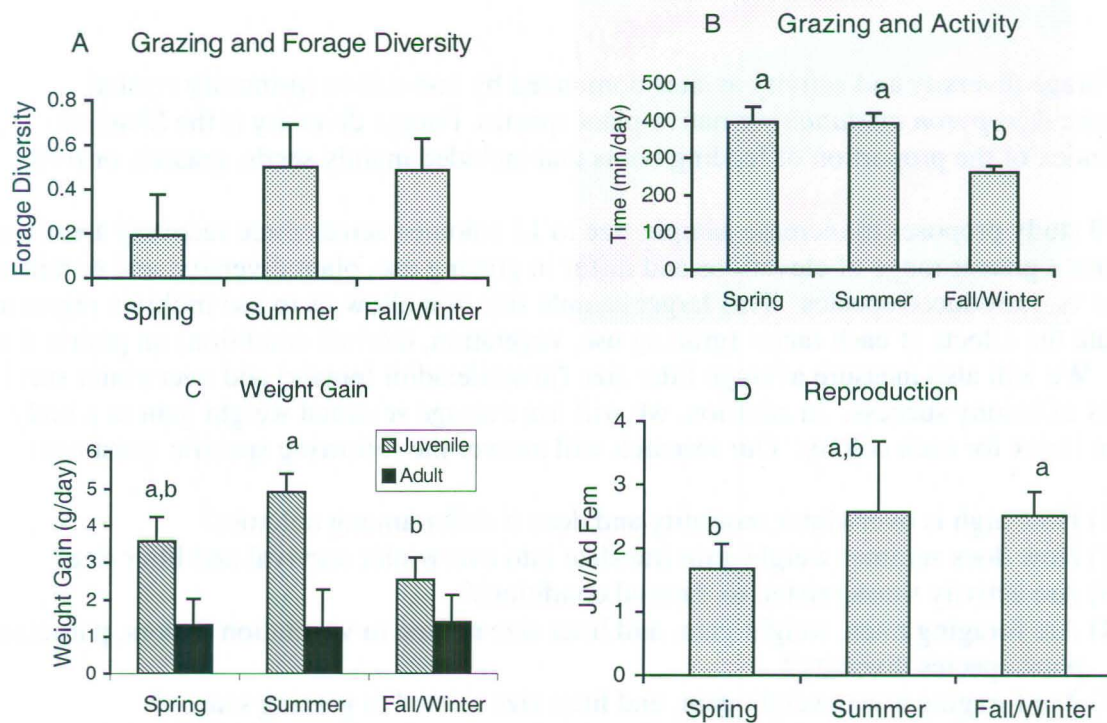


Fig. 1. Indicators of potential success of individual prairie dogs at West Desert colonies in 1998 at colonies with different seasons of grazing (Spring (1 April- 15 June), Summer (15 June – 1 September), or Fall/Winter (1 September – 1 April)). A. Shannon-Wiener diversity index of the proportion of feeding bouts that included mainly seeds, grasses or forbs. B. Activity time per day. C. Daily weight gain over a 5-week period July – late August. D. Ratio of juveniles to adult females in July. Differences in lowercase letters indicate significant differences ($P < 0.05$, ANOVA).

We also looked at effects of vegetation on colony persistence and prairie dog success. The frequency of “crashes” (annual spring count < 5) declined dramatically as local plant diversity increased (Ritchie 1998). In our 1998 study we categorized colonies according to whether they were dominated by native (high species diversity) or non-native (crested wheatgrass monoculture) vegetation and compared prairie dog success between the two categories. Native-dominated sites had greater plant species diversity and prairie dogs consumed a greater diversity of forage types. However, the two native sites in our study were also low elevation Fall/Winter grazed sites. Therefore, although results showed clear differences in prairie dog success (weight gain) among colonies, it was difficult to separate the effects of grazing use, vegetation, and thermal condition with our sample size of colonies.

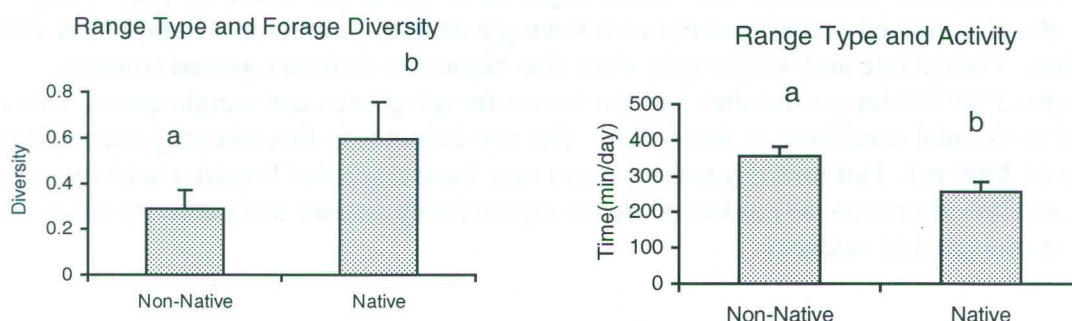


Fig. 2. Forage diversity and activity at sites dominated by non-native (primarily crested wheatgrass, *Agropyron cristatum*) or native plant species. Forage diversity is the Shannon-Wiener index of the proportion of feeding bouts that included mainly seeds, grasses, or forbs.

Our 1999 study proposes to increase sample size to 12 colonies across three recovery areas that encompass a greater range of elevations and differ in grazing use, plant diversity, and dominance by native vs. introduced species. This larger sample size will allow us to use multiple regression to separate the effects of each factor (grazing use, vegetation, thermal condition) on prairie dog success. We will also measure average litter size (juvenile:adult female) and overwinter survival as indices of colony success. In addition, we will use average seasonal weight gain as a body condition index for each colony. Our research will answer the following specific questions:

- 1) How high is overwinter mortality and does it differ among colonies?
- 2) How does summer weight gain translate into overwinter survival and litter size?
- 3) Are activity times related to thermal conditions?
- 4) Are foraging rates, weight gain, and litter size related to vegetation factors, particularly plant species diversity?
- 5) Are foraging rates, weight gain, and litter size related to grazing season?
- 6) Are population growth and colony extinction rate related to individual weight gain and litter size?

Proposed work

We will conduct our research at 12 prairie dog colonies differing in cattle grazing season (Spring, Summer, or Fall/Winter), vegetation, and elevation. Fall/Winter grazed sites are essentially control sites from a grazing point of view because prairie dogs are largely inactive during the season of grazing. In addition, annual plant growth and seed production are least

likely to be affected by cattle grazing during these periods of plant senescence and dormancy. Research will be performed in two rounds, with each colony visited by one person for one week per round. Round one will run from mid-May to end of June. Round two will run from beginning of August to mid-September. These dates correspond with prairie dog active season from juvenile emergence (mid-May) to adult hibernation (end of September).

Vegetation analysis

Vegetation characteristics (plant species richness, herbaceous cover, and shrub cover) will be measured at each of the 12 study colonies during Round Two to be consistent with vegetation measurements taken in previous years (Ritchie 1998). At each colony we will place three sets of four parallel 50 m toe-point transects at least 200 m apart near active burrow mounds. Pairs of transects (5 m apart) will be 5 m to either side of a marking stake, whose location will be chosen at random within the most representative vegetation associated with Utah prairie dogs at the colony. Toe-point hits will be classified as bare ground, pavement, rock, litter, or live plant, with live plants classified to species. Annual plants will be considered live whether green or dried. Toe-point hits overlaid by shrub canopy will be noted, as will local plant species not hit on transects. These techniques follow established BLM methods and allow comparison with vegetation characteristics measured during BLM range inventories in previous years.

In addition to general vegetation characteristics, we will obtain direct, quantitative measurements of forage quality (total digestibility, digestible N, and caloric content) at each of the 12 study colonies. Bite samples collected from focal animal sampling (see section below on *Foraging rates*) will be dried at 45°C for three days. Samples will be sorted by presence/absence of secondary compounds (palatability) and functional group, then weighed to the nearest 0.01 g. We will obtain three measures of forage quality for each functional group of palatable vegetation per colony. Total digestibility will be determined by acid-pepsin digestion of samples. Percent digestible nitrogen will be analyzed with a Carlo-Erby apparatus, available from USU Soils Lab. Caloric content of samples will be measured by bomb calorimetry. Together with measurements of general vegetation characteristics, these tests should provide a comprehensive assessment of forage quality and availability (digestibility) for cross-colony comparisons.

Thermal conditions and activity times

We will conduct scan counts of active prairie dogs every 15 minutes from 0630 - 2000 hrs. Each colony will have at least two days of scan counts per round. Only active (foraging and/or off the mound) prairie dogs in the designated focal area will be counted. Focal area size will be limited by confidence in our ability to account for all active dogs. For example, in colonies with high shrub density, focal area will be restricted to a portion of the colony that can provide a relatively unobstructed view of the dogs. Activity time for a colony will be calculated relative to maximum count of dogs during any 15 min. period of the day. Therefore, size of focal area should not bias calculations. Prior to each scan we will record ambient air temperature and wind speed at 10 cm above ground (the height of a prairie dog on all fours). This will allow us to relate thermal conditions to activity level.

Litter size, weight gain, and overwinter survival

Prairie dogs will be intensively trapped at each colony for at least four days per round. All captured dogs will be aged (juvenile or adult), sexed, weighed, and marked with numbered Monel #1 ear tags. Average litter size for a colony will be estimated as juvenile:adult female ratio of dogs trapped during Round One. Juvenile mortality is believed to be high in the first several weeks after emergence (McDonald 1993). Because we cannot trap at all colonies simultaneously, we will compensate for juvenile mortality by adjusting litter size estimations for

time since juvenile emergence. Weight gain will be estimated from individuals captured in both rounds. We will analyze adult weight gain and juvenile weight gain separately and calculate a colony average for each. To estimate overwinter survival, we will trap at each colony soon after prairie dog emergence in early Spring 2000. Survival will be calculated from percent recapture of dogs tagged and alive in August/September 1999.

Foraging rates

Foraging rate for an individual will be estimated as the product of average colony activity time, individual biting rate, and individual bite size (Ritchie 1988). Biting rates will be measured by selecting individuals within the focal area within 50 m of the observer and measuring the time needed for an individual to take ten bites using a spotting scope. A maximum of five counts will be taken per individual and as many different individuals will be selected as possible. Bite size will be estimated by observing a foraging individual closely and, after the individual leaves an area, finding the particular plants on which it fed. Uncropped adjacent plant parts (e.g. grass blades, seed heads, forb leaves) will be matched with the remaining stubs of plant parts fed upon by prairie dogs and then collected. These bite samples will be dried at 45°C for three days and weighed to the nearest 0.01 g. Bite samples (each representing multiple bites) will be collected separately for at least ten adults and ten juveniles at each colony for each round. Overall average bite size for each age class will be used to calculate individual foraging rates since it is impossible to estimate this reliably for each individual.

Research coordination

Our proposed work will be conducted in coordination with studies of Utah prairie dog dispersal from both existing colonies and new transplant sites. This coordination will involve discussion of methods and results at frequent meetings during the field season and at meetings of the Utah Prairie Dog Interim Recovery Team.

Deliverables

Upon completion of this study, we will provide the following:

- 1) Progress report submitted to funding agencies
- 2) Data file submitted to funding agencies
- 3) M.S. thesis
- 4) Research papers submitted for publication in scientific journals

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