6-2010

EVALUATING THE IMPACTS OF BLACK-TAILED PRAIRIE DOGS ON VEGETATION IN TRADITIONAL AND NON-TRADITIONAL HABITATS

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EVALUATING THE IMPACTS OF BLACK-TAILED PRAIRIE DOGS ON VEGETATION IN TRADITIONAL AND NON-TRADITIONAL HABITATS—The wildland-urban interface (WUI), defined as areas where human development meets undeveloped wildland (Radeloff et al. 2005), is a focal area for human-wildlife interactions in many communities of the western United States, particularly in those areas that have experienced rapid and expansive human population growth. Since 1960, conversion of rural to urban land has more than doubled in the United States (Theobald 2001). The eastern front range of the Rocky Mountains has experienced one of the most rapid urban expansions in the country, with approximately 110,000 hectares of undeveloped rural land being converted to human-developed land every year between 1992 and 1997 (Obermann et al. 2000, Maestas et al. 2001). In grassland remnants within the WUI, many native wildlife species, including black-tailed prairie dogs (*Cynomys ludovicanus)*, persist and land managers are faced with decisions about how to manage these wildlife populations.

Black-tailed prairie dogs are colonial, semi-fossorial rodents that thrive in a multitude of urban landscapes (e.g., vacant lots, prairie and agricultural remnants, road medians; Hoogland 1995, Johnson and Collinge 2003, Magle and Crooks 2008). Although this species can survive in non-traditional habitats, wildlife management plans strive to contain or relocate prairie dog populations to traditional prairie habitats (e.g., Fort Collins Natural Resources Division 1998, Boulder County Grassland Ecosystem Management Plan 1999). Allowing prairie dogs to persist in non-traditional habitats is contentious because their populations can spread to undesired locations (e.g., golf courses, private lawns), they increase removal of vegetation, and may facilitate invasion by exotic plant species (O'Melia et al. 1982, Zinn and Andelt 1999). However, despite these common perceptions, the impact that black-tailed prairie dogs have on vegetation structures of urban landscapes has not been extensively studied.

Because urbanization is touted as a major cause of the drastic decline of black-tailed prairie dog populations over the past 100 years (Van Pelt 1999, Van Puten and Miller 1999, Antolin et al. 2002), additional research comparing habitat characteristics of black-tailed prairie dogs in traditional grassland habitats to their counterparts in non-traditional urban habitats is warranted. Thus, the objectives of this study were to compare plant cover, species diversity and the abundance of native and non-native plant species between prairie dog occupied and unoccupied areas in both traditional and non-traditional urban habitats.

With the assistance of City of Boulder County Open Space and Mountain Parks (BOSMP) personnel, we selected 8 prairie dog occupied sites and 8 prairie dog unoccupied sites on public lands administered by BOSMP in Boulder County, Colorado, USA. At the time of the study, each of the sites was an open-space park (i.e., undeveloped natural parcel of land) designated for wildlife habitat, native plant habitat and / or passive, low impact recreational activities (e.g., hiking, wildlife viewing, horseback riding, mountain biking and other non-motorized recreational use). All of the study sites occurred within a 20 km radius and were not physically connected. Land use histories of the sites were varied. Because the study areas were of varying size (ranging from less than 5 ha to over 50 ha), we randomly selected a 1-hectare area for intensive survey within each site. Of the 8 prairie dog occupied sites, 4 were located in traditional prairie habitats and 4 were located in disturbed areas that had been used previously for farming or mining (i.e., "non-traditional' habitats). Traditional habitats were defined as those included in Boulder County black-tailed prairie dog Habitat Conservation Areas (HCAs), which were selected based on their ecological suitability for this species (i.e., preferred soil type, low slope angles, availability of grassland forage species; see Boulder County Grassland Management Plan 1999 for additional description). Non-traditional habitats outside of prairie dog HCAs had been designated as inhospitable or of low suitability for black-tailed prairie dogs by BOSMP because of unfavorable soil texture or depth, higher slope angles, and low availability of grassland forage species. Thus, our study represented a 4 × 4 unpaired randomized design with 4 sites designated as each of the following: prairie dog occupied / traditional habitat, prairie dog unoccupied / traditional habitat, prairie dog occupied / non-traditional habitat, and prairie dog unoccupied / non-traditional habitat. We conducted field evaluations in October 2007.

We estimated percent plant cover by species, bare ground, rock and litter cover at 20 random locations (0.25 × 0.5 m sampling frames) within each site (Lehmer et al. 2006). Plant species that could not be identified because of senescence were classified as "unknown". We calculated percent cover of native and non-native graminoids, native and non-native forbs, shrubs, bare ground, and litter. Also, we calculated Shannon diversity of native and non-native graminoids, native and non-native forbs, and shrubs (Gurevitch 2002). Determination of plants as native or non-native to Colorado was based on the U.S. Department of Agriculture Plants Database (2007). Because plant sampling was conducted late in the growing season, spring annuals and C3 species are likely underrepresented. We used Analysis of Variance (ANOVA) to measure differences among site types (occupied / unoccupied, traditional / non-traditional and their interaction terms) with respect to dependent variables of vegetation cover, species diversity, and abundance of native and non-native species ($\alpha = 0.05$). Site designations were treated as independent, categorical variables. We estimated pairwise differences between site types using least squares means comparisons and Tukey-Kramer adjustments for multiple comparisons.

Of sites surveyed, vegetative communities ranged from diverse shortgrass prairies with complex native vegetation structures to monocultures of invasive weed species with

little biodiversity. There were no differences among sites with respect to forb coverage ($F_{3,12} = 2.18$, $P = 0.14$), shrub coverage ($F_{3,12} = 2.46$, $P = 0.10$), or rock coverage ($F_{3,12} = 0.57$, $P = 0.64$). Graminoid coverage differed among sites ($F_{3,12} = 10.25$, $P < 0.01$) and was greater on unoccupied sites (48.46, SE = 23.02) than on sites occupied by prairie dogs (7.87, SE = 1.76; $P < 0.01$). Litter coverage differed among sites ($F_{3,12} = 3.43$, $P = 0.04$) with non-traditional, unoccupied sites having lower litter cover than other site types ($P = 0.05$). Bare ground differed among sites ($F_{3,12} = 8.32$, $P < 0.01$) and was greater on occupied (37.47, SE = 12.98) than unoccupied sites (10.28, SE = 2.01; $P = 0.01$). Interactions between prairie dog occupancy and habitat type were similar for all coverage classes (forbs $P = 0.13$; shrubs $P = 0.14$; rock $P = 0.73$; graminoid $P = 0.08$; litter $P = 0.11$). Cover of native plant species differed across site types ($F_{3,12} = 3.77$, $P = 0.04$), with occupied sites (5.38, SE = 4.33) having lower cover of native species than unoccupied sites (13.63, SE = 5.09; $P = 0.03$). Cover of non-native species did not differ across site types ($F_{3,12} = 1.79$, $P = 0.20$). Shannon diversity (H') differed across site types ($F_{3,12} = 4.68$, $P = 0.02$) with sites occupied by prairie dogs having lower diversity (185.40, SE = 63.13) than unoccupied sites (299.84, SE = 63.05; $P = 0.03$).

Collectively, our results indicate that prairie dogs impose substantial changes in vegetation structure upon the landscape; however, these changes do not seem disproportionate in areas that occur outside of their traditional habitats. Thus, although prairie dogs significantly alter vegetation structure, they do not necessarily convert suitable habitat patches into unsuitable patches. Also, our results support previous studies conducted in native prairie (e.g. Uresk 1985, Archer et al. 1987, Whicker and Detling 1988, Hartley et al. 2009) and urban areas (Magle and Crooks 2008) demonstrating that, compared to unoccupied sites, sites occupied by prairie dogs had lower graminoid cover and greater bare ground. There is an assumption among many land managers that prairie dogs facilitate encroachment of exotic species on a site. Likewise, previous studies have shown that prairie dog occupied sites have greater forb coverage compared to unoccupied sites (Day and Detling 1994, Detling 1998) and because forbs include a number of exotic species (e.g., *Convolvulus arvensis*), this has prompted some researchers to suggest that prairie dogs may facilitate colonization of exotics on a site (Magle and Crooks 2008). However, we detected no significant differences in forb coverage between occupied and unoccupied sites, and the abundance of non-native plant species did not appear to be impacted by prairie dog occupation on sites located in either traditional or non-traditional habitat. Our results provide preliminary evidence that black-tailed prairie dogs may not necessarily exacerbate encroachment of exotic species on a site, particularly in areas that are of similar habitat type (i.e., traditional or non-traditional). We believe that propagule pressure, or the composite measure of the number of individuals released into an area where they are not native and the number of discrete release events (Lockwood et al. 2005) may be a more important cause of increases in exotic plant species in urban areas than is disturbance by prairie dogs. Importantly, previous studies had larger sample sizes and more comprehensive sampling designs than our coarse-scale study. Furthermore, our work was conducted later in the growing season after early annual plants had likely senesced or been consumed by prairie dogs. A more comprehensive look at forb cover and species diversity across the growing season and over a range of years in urban areas is warranted.

Soil loss through wind erosion is an important and often overlooked process that can have major effects on biogeochemical and ecological systems (Field et al. 2009). Erosion of soil from prairie dog colonies is becoming an increasingly prevalent problem on the Front Range of Colorado because blowing soil is considered a nuisance to urban dwellers and soil loss can lead to desertification (Seastedt 2009). We observed significantly more bare ground on occupied compared to unoccupied sites, which could contribute to soil erosion, especially in winter when annual plants have senesced and wind storms are common. More quantitative information about the effects of prairie dogs on bare ground cover, soil erosion, and soil nutrient status is needed.

Considered together, our results underscore the ability of black-tailed prairie dogs to persist in a variety of habitat types. Although our study is inherently limited by its coarse-scale design and lack of statistical power, we provide several preliminary lines of evidence demonstrating that black-tailed prairie dogs do not necessarily have a disproportionate negative effect on non-traditional habitats compared to traditional habitats within urban landscapes. Hence, we propose the emphasis that past urban prairie dog management plans have placed on traditional habitat structure be re-evaluated. A number of previous studies have assessed the value of this species in urban ecosystems based upon whether they fulfill a keystone role in affecting biodiversity of vertebrates or on their positive and negative contributions to vegetation structure (Lomolino and Smith 2003, Magle et al. 2007, Magle and Crooks 2008). While we recognize that management of prairie dogs in urban settings requires inherent consideration of many societal and ecological factors, we suggest the importance of prairie dogs not be evaluated entirely on their positive and negative contributions to habitat structure and biodiversity. Rather, we suggest the potential role of urban prairie dog populations in future conservation of this species be considered of high value. In light of the declines that black-tailed prairie dogs have experienced in the past century, placing a higher value on prairie dog populations in non-traditional habitats may be imperative in the event of further decline of this species.

Support for this research was provided by Fort Lewis College and the Barrett Foundation. Special thanks to L. Sterling-Krank, D. Butler, B. Ayers, K. Nulty, K. Sotosky

and J. Sanders. Earlier drafts were greatly improved by the comments of two anonymous reviewers and the Associate Editor.—*Erin M. Lehmer[1], Laurel Hartley[2], Jesse Lanci[1] and Charlie Kolb[1]. [1]Department of Biology, Fort Lewis College, Durango, CO 81301, USA. [2]Department of Biology, University of Colorado, Denver, CO 80217, USA. Corresponding author email address: lehmer_e@fortlewis.edu.*

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Submitted 19 November 2009. Accepted 17 April 2010. Associate Editor was Christopher S. DePerno.