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Report on Research for: **Seasonal Variation in Wildlife Community Dynamics in Relation to Urbanization and Human Activities on the Front Range**

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Introduction

We present a report that updates the progress of our research supported through Boulder County Parks and Open Space (BCPOS). Without the support from the BCPOS grants program we would not have been able to accomplish our field efforts over the last 6 months and greatly appreciate your interest in our research.

The overall objective of our research is to understand how urbanization and human activities influence the composition of the wildlife community and interactions among species adjacent to the urban-wildlife interface. Our work is focused on the interactions among bobcats, mountain lions, and domestic cats, as well as understanding the interactions of these focal

species in the context of a much broader relationship with the wildlife community and landscape characteristics.

Our specific objectives include:

1. Understand which wildlife species are present along the Front Range and evaluate how urbanization and human activities influence the composition of the animal community.
2. Evaluate activity patterns of wildlife in relation to urbanization and human activity patterns.
3. Evaluate interactions of wildlife in relation to urbanization and other landscape characteristics.
4. Estimate the population size of bobcats in relation to urbanization.
5. Evaluate the seasonal variation (during fall, winter, spring, and summer) of species composition, activity patterns, interactions, and population density.

To accomplish the above objectives we have maintained a broad-scale grid of 40 Cuddeback motion-activated digital cameras, spaced approximately 2-km apart, across 2 areas that are characterized by varying degrees of urbanization (Figure 1). Our urban study area occurs west of Boulder (dimensions approximately 6 x 14 km) and our non-urban study area occurs to the northwest of Boulder (dimensions 8 x 10 km; Figure 1). Our cameras operated across several BCPOS properties, including Heil Valley Ranch, Hall Ranch, Anne U White, Walker Ranch, and Betasso Preserve.

Below we describe our research progress to date that was aided through BCPOS and explain our plans for the upcoming year.

Progress to Date

From September 2010 to November 2011, we maintained 40 motion-activated cameras as described above. All 40 cameras operated simultaneously and were checked every 2 – 4 weeks to replace batteries and memory cards. Cameras were placed within each grid cell by scouting each 2 x 2 km² area and selecting a site that was predicted to maximize the probability of documenting wild felids based on the presence of carnivore sign, such as scrapes and scats along trails. The camera surveys were originally intended to be conducted for less than 6 months. However, money awarded through BCPOS enabled us to extend the duration of our camera surveys for the past 6 months and allowed us to collect data from the cameras over the course of an entire year. Due to weather conditions in the field over this period of time, several cameras malfunctioned and were not consistently operating. With funds provided through BCPOS, we replaced or repaired these cameras to address this issue. In addition, 4 cameras were stolen in the field and needed to be replaced to maintain our entire grid of cameras. Funds through BCPOS were used to replace stolen cameras and associated security boxes and memory cards. Due to the volume of photos collected from cameras, new memory cards were used on all cameras. Additional memory cards were purchased through funds provided by BCPOS. Cameras operated for 2 - 4 weeks on a set of 4 D-cell batteries depending on the volume of photos and batteries were replaced during maintenance of cameras every 2 – 4 weeks. During the spring and early summer 2011, we hired a technician to assist with camera maintenance in the field. In September 2011, we hired a student at Colorado State University to assist in sorting the data collected from our cameras. She will continue to work on data sorting through December 2011 and is sorting photos from people trails. In addition, an undergraduate student enrolled in the Honors Undergraduate Research Scholars (HURS) Program at CSU began

working on our project and will also assist in sorting photos through spring 2012. We are in the process of developing a research question for this HURS student and are considering a project that evaluates how dogs on and off leash influence the wildlife community.

Between mid-October and mid-November 2011, all motion-activated cameras were removed from the field. Over the past year, we have collected tens of thousands of photographs from our cameras. During this period of time, we obtained approximately 600 bobcat and 450 mountain lion photos. We obtained thousands of photographs of other wildlife species as well (see Appendix I for some wildlife photos obtained on BCPOS properties) and this data will be summarized in more detail shortly. Table 1 presents a summary of species detected on our grid of cameras.

Additionally, we obtained tens of thousands of photographs of human recreational activities. As an example of how these data have been utilized, as part of an undergraduate senior thesis project, Nicole McDaniel assisted with summarizing camera data from January to May 2010 for 4 camera sites along City of Boulder OSMP managed trails. From 25,859 photos of human activity over 4.5 months, we obtained 4,272 images of dogs off leash, 1,204 images of dogs on leash, 366 images of dogs of undetermined leash status, and the remaining photos were of hikers. This information will be summarized further to evaluate activity patterns of different recreation types and the potential impacts on wildlife along these trails. Similar data summary and analysis will be conducted for all 40 camera sites across the entire year. This type of analyses will provide Boulder County Parks and Open Space with a detailed inventory of the mammalian species using their properties, as well as allow for an understanding of how the characteristics of the wildlife community may be altered by human activities.

Plans for 2012

Beginning in January 2012, the next phase of the project will focus on data analysis to answer our research objectives outlined above. Photos will continue to be summarized through the winter of 2012. During this time, we will also begin data analysis to evaluate density of bobcat and mountain lion populations on the Front Range, interactions among species, and activity patterns of animals across seasons in relation to urbanization and human activities. To estimate density of bobcats we will use mark-resight techniques as described by McClintock et al. (2009) where artificial marking (i.e., collar and eartags) in conjunction with natural pelage marking are used to identify unique individuals. In collaboration with Dr. Mat Alldredge with Colorado Parks and Wildlife, we will use similar techniques to also estimate the density of mountain lions. Occupancy modeling (MacKenzie et al. 2004) will be used with the camera data to evaluate species interactions by estimating whether the presence of one species influences spatial or temporal avoidance of an area by another species, such as whether the presence of mountain lions causes bobcats to avoid an area either spatially or temporally. In addition to data collected through motion-activated cameras, we also have collected fine-scale movement information from 20 bobcats fitted with GPS collars on the Front Range. This information will be used to estimate the amount of time that bobcats spent on our camera grids to assist in estimating population density of bobcats. A similar approach will be conducted for mountain lions in collaboration with Dr. Mat Alldredge. The bobcat GPS data will also be used in collaboration with Dr. Mat Alldredge to evaluate inter-specific interactions with GPS collared mountain lions. We plan to collaborate with Ashley Gramza (CSU graduate student with Dr. Kevin Crooks) to evaluate interactions between wild felids and domestic cats fitted with GPS

collars. Habitat selection of bobcats will be estimated using both GPS data and motion-activated cameras.

Our work will continue through 2012 and be completed by 2013, at which point our results will be presented in several publications in peer-reviewed journals.

References

- MacKenzie, D. L., L. L. Bailey, and J. D. Nichols. 2004. Investigating species co-occurrence patterns when species are detected imperfectly. *Journal of Applied Ecology* 73: 546-555.
- McClintock, B. T., G. C. White, M. F. Antolin, and D. W. Tripp. 2009. Estimating abundance using mark-resight when sampling is with replacement or the number of marked individuals is unknown. *Biometrics* 65: 237-246.

Table 1. List of animals detected on our grid of motion-activated cameras along the Front Range from 2010 – 2011.

Bobcat
Mountain lion
Domestic cat
Black bear
Coyote
Gray fox
Red fox
Striped skunk
Spotted skunk
Mule deer
Elk
Moose
Bighorn sheep
Aberts squirrel
Rock squirrel
Pine squirrel
Chipmunk
Song birds (various)
Poorwill
Magpie
Raven
Great-horned owl
Mallard duck
Cottontail rabbit
Woodrat
Humans
Domestic dog
Horse
Cattle

FRONT RANGE STUDY AREA

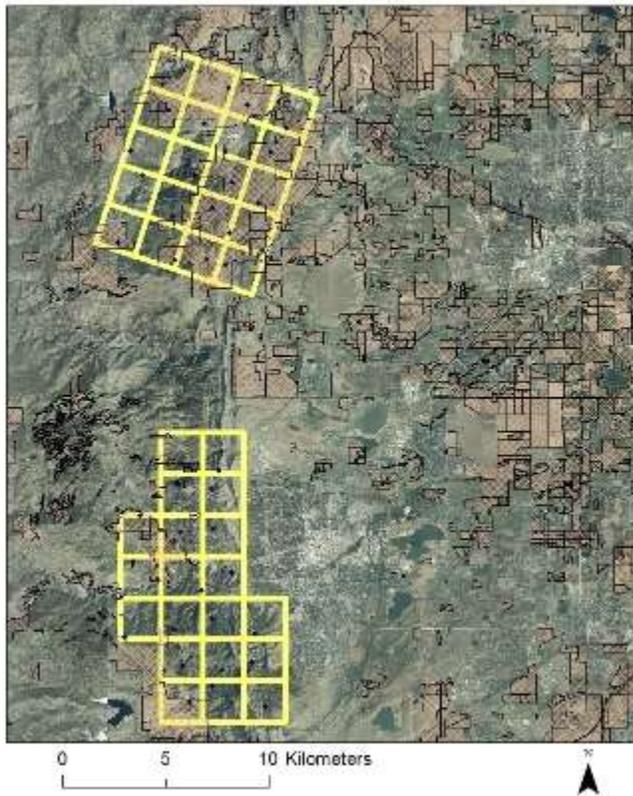


Figure 1. Study area on the Front Range where 40 motion-activated cameras were maintained across 2 study grids near Boulder, CO.

APPENDIX I: Wildlife photos obtained on BCPOS properties from August to September 2011.



Photo 1: Elk at Red Hill, Heil Valley Ranch



Photo 2: Black bear in Marietta Canyon, Heil Valley Ranch



Photo 3: Mountain lion in Arkansas Gulch at Betasso Preserve



Photo 4: Bobcat at Walker Ranch



Photo 5: Domestic cat along Picture Rock Trail, Heil Valley Ranch