A GPS-collared cougar in west-central Alberta

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PREVIEW

University of Alberta

Conserving Cougars in a Rural Landscape: Habitat Requirements and Local Tolerance in West-Central Alberta

by

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in partial fulfillment of the requirements for the degree of

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in
Ecology

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ABSTRACT

Maintaining large carnivores in human-dominated landscapes poses a significant conservation challenge. Extirpation is common because of habitat loss or direct persecution. I studied cougar habitat selection and human perception of cougars in west-central Alberta to better understand human-cougar coexistence. Cougars that were exposed to higher levels of development at the home-range scale exhibited less avoidance of anthropogenic features and altered habitat use temporally to accommodate variation in human activity, indicating behavioral resilience to development. Survey results showed that cougars were valued and tolerated by people, provided cougars did not occur near residences. Where human densities are increasing in moderately developed landscapes in west-central Alberta, therefore, human tolerance may currently be more important than habitat change for conserving cougar populations. Tolerance was negatively affected primarily by the risk (real and perceived) cougars pose to people, livestock, and game. Public education to counteract overestimation of risk may increase tolerance.

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CHAPTER 1
GENERAL INTRODUCTION

Will large carnivores be relegated to dwindling reserves of pristine wilderness or can they persist in human-dominated landscapes? The answer to this question depends on two factors: (1) the resilience of large carnivores to anthropogenic landscape change (Weaver et al. 1996), and (2) whether human populations are willing to coexist with predators that sometimes threaten their lives and livelihoods (Woodroffe et al. 2005). Providing data to answer these questions and developing management prescriptions with that knowledge in hand is an important component of large-carnivore conservation in an increasingly anthropogenic world.

Throughout this thesis, resilience is defined as the ability of a species to withstand or adapt to anthropogenic disturbance (i.e., landscape change or increasing human presence; Weaver et al. 1996). Species with low resilience will be unable to persist in modified landscapes, while those with high resilience may thrive. Large carnivores are frequently described as having low resilience (Weaver et al. 1996, Woodroffe 2000), but this is a broad generalization and variation among species appears to be high (Cardillo et al. 2004). Effective management and conservation of a particular species may therefore depend on understanding the degree to which that species is resilient to anthropogenic landscape change. Understanding the habitat requirements of carnivores will be critical for linking habitat patches (Chetkiewicz and Boyce 2009), planning development (Beier et al. 2006), and mitigating conflict (Treves et al. 2004).

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For species that are resilient to anthropogenic habitat modification, the willingness of human populations to coexist with large carnivores (i.e., tolerance) may be the central factor influencing conservation prospects. Low tolerance in western societies has led to widespread extirpation of large carnivores in the past, but tolerance has increased in recent decades (Kellert et al 1996, Williams et al. 2002). In North America, for instance, wolves (*Canis lupus*), grizzly bears (*Ursus arctos*), and cougars (*Puma concolor*) are valued as much for their aesthetic beauty as their ecosystem function, and images of carnivores are frequently used by conservation organizations to drum up romantic support for conservation of wildlife and wilderness. Positive perceptions of large carnivores, however, are not shared by all. Rural communities often harbor deep-seeded resentment toward carnivores (Breitenmoser 1998) and are unwilling to support resurgence of previously extirpated populations.

In North America, cougars present an ideal species to explore the importance of habitat loss and human tolerance for conservation. Although they suffered dramatic range constrictions and population reduction following European settlement, cougar populations stabilized where they persisted in western North America with the refinement of management practices in the 1960's and 1970's. Today, breeding populations in the Cypress Hills of Alberta and Black Hills of South Dakota indicate that the species is repopulating portions of its former range (Anderson et al. 2009). Concurrent with increasing cougar populations has been a rise in the number of people and anthropogenic land use in western North America. Thus, cougars and people are increasingly using the

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same space. Habitat loss has been identified as the top threat to cougar conservation (Logan and Sweanor 2001), but the ability of cougars to persist in anthropogenic landscapes is poorly understood. Moreover, populations in some western states may be decreasing, not because of insufficient habitat but because of management actions taken in response to low tolerance for coexistence (Lambert et al. 2006).

Understanding both cougar habitat requirements in anthropogenic landscapes and the factors that will promote local human populations to tolerate cougars in their midst will therefore be critical to the conservation of the species. It is these two aspects of cougar conservation that I attempt to address in this thesis. To accomplish this goal, I studied a population of cougars in west-central Alberta inhabiting the Clearwater County, an area with a gradient of development ranging from wilderness parks to rural farmland, towns and acreages. I present my findings in this thesis in the form of two independent but interrelated papers. In addition to this introductory chapter and a summary chapter, the thesis contains two data chapters, which address the two key aspects of cougar conservation outlined above (i.e., habitat loss and tolerance).

In Chapter 2, I used location data collected from 41 GPS-collared cougars to investigate cougar habitat selection patterns. To determine how cougars might adapt to anthropogenic development, I modeled selection at the individual level and looked for the occurrence of functional responses in selection as development increased across the landscape as well as a temporal response of cougars to human activity. In Chapter 3, I used opinion data collected from a questionnaire

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delivered to residents of Clearwater County, Alberta to investigate what factors (i.e. value for cougars, risk perception, socio-economic information, proximity to cougars) influenced tolerance for cougars amongst a rural population that is currently coexisting with the large carnivore. Taken together these chapters aim to evaluate possibilities for cougar conservation and human-cougar coexistence as Alberta's population grows and its landscapes are increasingly affected by anthropogenic development, and I summarize these possibilities in Chapter 4.

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CHAPTER 2

COUGAR HABITAT SELECTION IN A RAPIDLY DEVELOPING LANDSCAPE

INTRODUCTION

Anthropogenic habitat modification and increased human presence on landscapes can negatively affect conservation prospects for a variety of species by altering habitat selection (Gill et al. 1996), creating ecological traps (Delibes et al. 2001), degrading habitat quality (Saunders et al. 1991), and reducing landscape level connectivity (Chetkiewicz et al. 2006). Populations of large terrestrial carnivores are thought to be especially susceptible to local and regional extirpation either directly when they are removed due to conflict (Woodroffe and Ginsberg 1998, Woodroffe 2000) or indirectly when habitats are altered and prey populations reduced (Noss et al. 1996, Fuller and Sievert 2001, Sunquist and Sunquist 2001, Karanth et al. 2004). Human populations continue to grow rapidly, and anthropogenic habitat change is occurring at an unprecedented pace and scale on global landscapes (Vitousek et al. 1997); thus effective large carnivore conservation may depend on landscape-level strategies capable of preserving sufficient habitat in the face of increasing demands by people for resources and space (Beier et al. 2006, Kareiva et al. 2007).

A fundamental step toward developing landscape-level conservation strategies for large carnivores is to understand what constitutes sufficient habitat in modified landscapes, but critical information is often lacking. In North America, for example, cougar (*Puma concolor*) populations are recovering and

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expanding their range after centuries of persecution (Anderson et al. 2009, Knopff 2010). However, core cougar range in the west is being transformed from lightly developed wilderness and rangelands to more intensively used rural and exurban landscapes (Logan and Sweanor 2001, Cougar Management Guidelines Working Group 2005, Sweanor and Logan 2009). Although habitat alteration has been identified as the single greatest threat to cougar conservation (Logan and Sweanor 2001), the extent to which cougars can use modified landscapes remains unclear. Cougar persistence in modified landscapes will depend on their resilience, i.e., their ability to withstand or adapt to disturbance (Weaver et al. 1996).

Behavioural flexibility, particularly the ability to alter habitat-use patterns, is a key attribute of resilient species (Woodroffe 2000, Boydston et al. 2003), and species that exhibit such flexibility have much better conservation prospects than those that do not (Weaver et al. 1996). Animals exhibit behavioural flexibility with respect to habitat in two primary ways: 1) temporal changes in habitat-use patterns, and 2) functional responses in habitat selection. Animals capable of modifying habitat selection temporally may be able to continue using anthropogenic landscapes by accessing them nocturnally, when humans are less active (Boydson et al. 2003, Hebblewhite and Merrill 2008). Functional responses in habitat selection occur when selection patterns change with changing availability (Mysterud and Ims 1998). Although rarely applied in the context of anthropogenic landscape modification, functional responses could have profound implications for conservation planning. Species that avoid disturbance less as it

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becomes increasingly abundant exhibit resilience, whereas species that avoid disturbance more as landscapes are developed are more vulnerable to extirpation.

To gain a better understanding of cougar resilience to anthropogenic landscape modification, I explored cougar habitat selection in a rapidly developing landscape in west-central Alberta, Canada. My objectives were to 1) develop a cougar habitat-selection model with a specific focus on determining the importance of anthropogenic features as drivers of habitat selection, 2) examine spatio-temporal changes in habitat selection and assess the degree of flexibility in cougar habitat selection, and 3) investigate cougar habitat selection across a gradient of anthropogenic disturbance to assess functional responses in habitat selection.

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METHODS

Study area

I studied cougar habitat selection in a 16,900 km^2 study area located in the boreal foothills and mountains of west-central Alberta. The study area was selected because it contained a gradient of development and human use, providing the foundation for a natural experiment to assess cougar habitat selection with respect to anthropogenic landscape modification. Intensity of human development was highest in the eastern portion of the study area, which consisted almost entirely of private lands and included the towns of Rocky Mountain House (population 7,231) and Caroline (population 515), as well as rural farmland and small acreages. The human population has increased steadily in the eastern

portion of the study area (2.79% annually during 2001-2006; Statistics Canada 2006). Road and building density on private land in the eastern portion of the study area (average density roads: 0.79km/km^2, buildings: 3.09/km^2) was substantially higher than on public land in the west (average density roads: 0.34km/km^2, buildings: 0.24/km^2; Figure 2.1). Industrial activity, primarily forestry and natural gas extraction, was common throughout much of the study area and contributed to an extensive network of roads, seismic lines, and pipelines. All forms of anthropogenic development decreased across an east-west gradient, reaching nil in portions of the Bighorn Backcountry, which abuts Banff and Jasper National Parks at the western edge of the study area (Figure 2.1).

The cougar population in the region is supported primarily by white-tailed deer (*Odocoileus virginianus*), but cougars also consumed mule deer (*O. hemionus*), elk (*Cervus elaphus*), moose (*Alces alces*), feral horses (*Equus caballus*), bighorn sheep (*Ovis canadensis*) and a variety of non-ungulate prey (Knopff et al. 2010b). Cougar numbers increased by at least 250% in my study area between 1991 and 2006 (Knopff 2010), although a combination of shooting and incidental snaring at wolf bait stations might have been sufficient to arrest or reverse this trend during 2006-2008 (Knopff et al. 2010a). Cougars were hunted on a quota basis (Ross et al. 1996), could be shot on sight on private land, and were occasionally killed or translocated as problem wildlife by Fish and Wildlife agency personnel. For information on the biophysical attributes of the study area see Knopff et al. 2009.

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GPS telemetry data

I obtained information on cougar use of the landscape from global positioning system (GPS) telemetry collars deployed on cougars throughout the study area. A total of 41 cougars outfitted with Lotek 4400S GPS radiocollars (Lotek Engineering, Newmarket, Ontario, Canada) programmed to collect location data every 3 hours were used. All capture and handling procedures were approved by the University of Alberta Animal Care Committee Protocol No. 479505 and Province of Alberta Collection and Research Permit 19872 CN (see Knopff et al. 2009 for additional detail on captures). While collars were active, field crews attempted to locate each cougar once per week and download GPS data fortnightly. Cougars were monitored between 24 and 650 days ($\bar{x}$ = 192). Monitoring durations of less than one year occurred because of collar failure (n = 7 confirmed failures), cougar mortality (n = 17), or dispersal outside the study area (n = 1).

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GIS layers

I classified habitats using the 25m-resolution Canadian Forest Service Earth Observation for Sustainable Development of Forest (EOSD; Natural Resources Canada 2009), updated annually for the study area with cut-block information (provided by Sundre Forest Products). I grouped habitat information into eight habitat types: open (i.e., grassland and non-vegetated habitat), shrub, wetland (i.e., wetland treed, wetland shrub, and wetland grassland), closed conifer, open conifer, deciduous forest, and mixed forest. Forest edge is