Quantifying the Impacts of Landscape Disturbance on the Spatial Patterns of Grizzly Bear Habitat Use

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Abstract

Grizzly bear (*Ursus arctos*) habitat use is influenced by factors such as predatory-prey relationships, competition, and mating systems. As well, increased landscape disturbance affects the spatial structure of grizzly bear habitat use and exudes pressure on the population's viability. The purpose of our research is to quantify how individual grizzly bear habitat use is impacted by landscape disturbance from 1999 to 2003. The spatial-temporal changes in habitat use, as defined by the home range locations of ten adult female grizzly bears, will be related to landscape disturbance to determine how environmental disturbance is impacting bear habitat use.

Home ranges were delineated for each grizzly bear using kernel density estimations. The temporal changes in bear's home ranges will be quantified using STAMP (spatial-temporal analysis of moving polygons) to assess the type, size, and direction of change in annual home ranges. The changes identified by STAMP will be related to landscape change data to quantify the relationship between habitat change and adjustments in individual grizzly bear home range. Methods developed through this study will be transferable to other spatial-temporal analyses of animal home ranges and habitat connectivity.

Background and Relevance

The effect of humans on the spatial and temporal distribution and abundance of grizzly bears (*Ursus arctos*) in southern Canada is extensive (McLellan and Hovey 2001). Canada's Rocky Mountain grizzly bear population has felt the pressures of increased human presences causing competition for landscape resources through mining, recreation, forest harvesting and seismic oil and gas exploration (Linke et al. 2005). This is an issue of growing concern as these activities have the potential to change the nature of the landscape and impact the configuration and composition of grizzly bear habitat. A population's spatial structure directly impacts its dynamics, its resilience and, consequently, its viability (Apps et al. 2004). Due to their low population densities, high tropic level and low reproductive rates, large carnivores, such as grizzly bears, are especially susceptible to extirpation (Weaver et al. 1996, Nieslen et al. 2004). In order to successfully manage grizzly bear populations within resource-competitive environments, further knowledge about their habitat use within the landscape is necessary (Nieslen et al. 2004). As such, it is critical that the population's spatial temporal landscape patterning be understood to enable the establishment of long term conservation guidelines to be established.

Methods and Data

Spatial-temporal analysis of grizzly bear populations will be conducted by generating home ranges for individual bears through time. Habitat analysis will be confined to adult (≥ 5 years old) females, as male home ranges can differ substantially (Schwab 2003) and adult females are the foundational force shaping population growth and long-term viability (Pease and Mattson 1999, McLoughlin et al. 2003, Nielsen et al. 2004). Following other grizzly bear studies (e.g. Mace et al. 1996, Mace et al. 1999, Nielsen et al. 2004, Stenhouse et al. 2005, Munro et al. 2006), analysis will be conducted for three time periods in the foraging season (hypophagia, early hyperphagia and late hyperphagia), coincide with seasonal shifts in food habitats and resource selection patterns (Nielsen et al. 2003, Nielsen et al. 2004). Within our study area, the foraging seasons were previously defined by Nielsen et al. (2004), based on phenological changes in vegetation.

Grizzly bear location data collected with radio telemetry was used to delineate seasonal home range polygons using kernel density estimation approaches (Seaman and Powel 1996, Borger et al. 2006). Ten individual bears are investigated, and for each bear, between three and five years of data were collected over the period of 1999 to 2003. To detect change in home range locations through time, we will employ a newly developed approach for detecting temporal change on polygons. This method, spatial-temporal analysis of moving polygons – STAMP (Robertson et al. 2007), is an event based approach to quantifying polygon change. Using STAMP we will characterize how the home range changed through time by quantifying: the location and size of consistently used area, and the size and direction of areas where habitat use expanded or contracted, the movement of bears into new habitat, and the nature of fragmentation in habitat use.

Data on annual disturbance conditions, from 1999 to 2003, have been generated through a combination of remote sensing and utilities databases. Disturbance data includes clear cuts, roads, pipelines, mining wells, and railway lines. Changes in the bear’s home range, as quantified using STAMP, will be linked with landscape disturbance that is detected in each year. For instance, we will quantify if habitat associated with consistent use through time subject to less or different types of disturbance than habitats where use has expanded or contracted. This will allow for the quantitative comparison of the relationship between individual grizzly home range changes and landscape disturbances.

Results and Conclusions

Through spatial and temporal analysis of grizzly bear populations in Alberta, long-term conservation guidelines can be established. Spatially explicit knowledge of ecological phenomena allows for management and planning for minimal anthropogenic environmental effects. Also, methods developed through this study will be transferable to other spatial-temporal analyses of animal home ranges and habitat connectivity.

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