The impact of landscape disturbance on grizzly bear habitat use in the Foothills Model Forest, Alberta, Canada

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Abstract

The goal of this paper is to quantify the impact of habitat disturbance on the spatial-temporal trends in grizzly bear habitat use in the foothills of the Rocky Mountains in Alberta, Canada using telemetry data. To meet this goal we delineate grizzly bear home ranges in three foraging seasons (hypophagia, early hyperphagia, and late hyperphagia) annually from 1999 to 2003. We then quantify and map temporal patterns in the annual persistence of home ranges over the study area. The spatial-temporal patterns of habitat use are related to annual landscape disturbance in order to determine if the probability of future use differs between disturbed and undisturbed locations.

Background and Relevance

Activities that lead to habitat loss may threaten the persistent of wildlife. Conservation and management planning require an understanding of how wildlife use habitat, in space and time, and how habitat use changes in response to landscape disturbances. The Rocky Mountains in Alberta, Canada are subject to the influences of human activities, such as mining, oil and gas exploration, logging and recreation (Linke et al. 2005). As this area also provides vital habitat for grizzly bears (Ursus arctos L.) and other wildlife, it is a valuable region for understanding the interaction between disturbance and wildlife habitat use (Nielsen et al. 2004, Linke et al. 2005). Grizzly bears are an important keystone species and their populations have declined substantially in the last 100 years (Nielsen et al. 2006).

The goal of this paper is to quantify the impact of habitat disturbance on the spatial-temporal trends in grizzly bear habitat use in the foothills of the Rocky Mountains in Alberta, Canada using telemetry data. To meet this goal we delineate grizzly bear home ranges in three foraging seasons (hypophagia, early hyperphagia, and late hyperphagia) annually from 1999 to 2003. We then quantify and map temporal patterns in the annual persistence of home ranges over the study area. The spatial-temporal patterns of habitat use are related to annual landscape disturbance in order to determine if the probability of future use differs between disturbed and undisturbed locations.

Methods and Data

Study Area

The study was carried out in the Rocky Mountains foothills portion of the Foothills Model Forest (FMF) Grizzly Bear Project (Linke et al. 2005). Jasper National Park contains the western portion of the FMF Grizzly Bear Project, and no anthropogenic activities related to resource extraction occur in this area. Outside of the protected areas, human disturbances of varying intensities exist throughout the study area (Linke et al. 2005). These activities include forestry, mining, oil and gas exploration and development, trapping, hunting and recreation (Stenhouse et al. 2005).

Methods

From 1999 to 2003, 34 grizzly bears were captured and collared within the forestry study area using aerial darting and leg snaring. GPS radio collars were programmed to collect 6 locations per day at 4-hour intervals (Schwab 2003). The seasonal home ranges for female grizzly bears within the study area for each year were identified with a fixed kernel density estimator. The 95th percentile of the kernel density surface for each season in each year was used to identify the grizzly bear home ranges, as has been the precedent in previous studies (e.g., Kernohan et al. 1998, e.g., Borger et al. 2006, Gitzen et al. 2006).

The temporal patterns of home range at each location within our study area were quantified by the temporal sequence of home range presence and absence. In each year, locations within a seasonal home range were assigned a value of 1 while all other locations were assigned a value of 0. Combining the 0's and 1's for all years, a one-dimensional binary string was used to characterize the temporal sequence of the presence or absence of the annual home range at fixed locations. Properties of the binary string, such as the number of home range years and modal state, were used to summarize temporal trends.

Landscape disturbances were identified using a combination of remotely sensed imagery and utilities information provided by both logging companies and the government. Annual LANDSAT images were used to confirm the creation of cutblocks and the construction of roads, pipelines, powerlines, and wellsites.

To quantify if and how habitat disturbance impacts the future use of a location by grizzly bears, we determined if the proportion of locations with future use differed between disturbed and undisturbed locations. For each foraging season and year, maps of the temporal trends in home ranges were categorized as intersecting disturbance undisturbed locations.

The proportion of locations where future use was dominant, i.e., use was more common than non-use, were compared for data partitioned on disturbance (disturbed vs. undisturbed). The statistical difference in proportion parameters

was tested using a Pearson's chi-squared statistic to assess whether two samples have the same proportion parameter. Statistical significance was assessed using a $\alpha \leq 0.05$.

Results

We found that in the foothills of Alberta, grizzly bears are not avoiding disturbed locations, and that they preferentially use previously disturbed areas during some foraging seasons. Particularly in the phase following den emergence, hypophagia, bears are consistent in a greater proportional future use of disturbed areas, relative to undisturbed locations. During the early hyperphagia season, future use of habitat is typically proportionally greater at undisturbed locations. In the final foraging season, late hyperphagia, the dominant trend is for future use of disturbed areas to be proportionally greater during the first years of the study, but as the study progresses in time, the trend switches and future use in undisturbed areas dominates.

Conclusions

This study will provide an opportunity to examine the temporal changes in grizzly bear home ranges in the Rocky Mountain foothills at a population level. Analyses such as this are important and the results may be invaluable for wildlife managers and conservationists. Using a sequence of presence and absence of home ranges to investigate habitat use in response to habitat change is easily transferable to other projects with a variety of target species and in many different environments.

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