CHAPTER 10

RESOURCE SELECTION BY FEMALE GRIZZLY BEARS
10.1 CONTEXT TO RESOURCE SELECTION MODELS FOR FEMALE GRIZZLY BEARS IN THE EASTERN SLOPES BASED ON COARSE-FILTER AND FINE-FILTER APPROACHES

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INTRODUCTION
Understanding resource selection by animals is of considerable interest among ecologists, conservationists, and land managers because it can facilitate the conservation of resources and habitats used by a species, and thereby increase the likelihood of population persistence. For grizzly bears, survival and productivity of adult females are critical to population viability (Knight and Eberhardt 1985, Garshelis et al. In Press). Accordingly, detailed knowledge of the specific resource requirements of female grizzly bears is important for the management and conservation of the grizzly bear population in the eastern slopes of the Canadian Rocky Mountains in Alberta.

During the past decade advances have been made in statistics and geographic information systems (GIS) that have allowed the development of several techniques to describe resource selection. In the Alberta portion of the Central Rockies Ecosystem, resource selection by female grizzly bears has been investigated in 2 studies (Stevens 2002, Theberge 2002), each involving different methodological and management approaches. These studies respectively represent a coarse-filter and fine-filter approach to understanding adult female grizzly bear habitat selection. The different approaches lead to management implications at different scales.

This chapter provides an introductory context for the research conducted by Stevens and Theberge. The results of these studies are presented in the next 2 chapters. Details can be found in the original thesis (Stevens 2002) and dissertation (Theberge 2002). The final chapter of the Resource Selection Section of the Report highlights the major differences in the approaches and results of the two studies.

STUDY AREA
Both Theberge and Stevens studied the same 20,000 km² area east of the Continental Divide, focusing on bear home ranges in the Bow River watershed, an 11,400 km² area east of the Continental Divide (Figure 1). Stevens addressed an additional 5,000 km² area on the west side of the Continental Divide.

Home ranges were delineated for female grizzly bears, and resource selection functions (RSFs) were derived. Theberge used the software package KERNELHR to define home ranges at the 95% isopleth. Stevens used a 95% fixed kernel technique with a smoothing parameter using the Animal Movements extension in Arc View.

COARSE AND FINE APPROACHES
Selection refers to the disproportionate use of a resource compared to the availability of the resource (Manly et al. 1993). In Stevens (2002) and Theberge (2002), selection of resource features was determined by observing the ratio of features used by bears to their availability in the landscape. The statistical modeling of these ratios, or resource selection functions (Manly et al. 1993), identifies the combination of characteristics that provide the greatest likelihood of locating female grizzly bears.

Stevens (2002) investigated the correlation of female grizzly bear locations during the berry (summer/fall) season with the variables: greenness, and distance to greenness. She also investigated correlations of locations with density of high greenness, elevation and human access density in a 1.5-km radius moving window.
Theberge (2002) investigated the correlation of female bears with resource characteristics, during 2 seasons (spring through fall), and at several scales. At the 300-m diameter scale, she investigated vegetation type, proximity to vegetation edge, proximity to water, elevation, slope, and aspect. Also investigated were heterogeneous landscape patterns at the 300-m, 1.5-km, and 3.0-km diameter scales, specifically: vegetation diversity, vegetation dominance, terrain ruggedness, density of motorized access, and density of non-motorized access.

Human access density was incorporated differently in the 2 studies. Stevens investigated all human access in a 3.0-km diameter window. Theberge split this variable into non-motorized and motorized categories, measuring within 1.5-km and 3.0-km diameter windows.

Stevens’ approach to RSF modeling addressed coarse scales and is useful for identifying broad landscape changes for management. Theberge’s approach addressed multiple scales and is useful for identifying some habitat attributes that can be managed to enhance grizzly bear conservation.

LITERATURE CITED
10.2 GREENNESS AND SECURITY FOR FEMALE GRIZZLY BEARS: A COARSE-FILTER APPROACH TO MAPPING AND MANAGING BEAR HABITAT

Saundi Stevens

For more detailed information, please refer to the thesis “Landsat TM-based Greenness as Surrogate for Grizzly Bear Habitat Quality in the Central Rockies Ecosystem” at www.canadianrockies.net/Grizzly.

Maps depicting grizzly bear habitat quality are required to enable managers to efficiently identify important locations for bears. Because in some areas grizzly bears move among several jurisdictions that have inconsistent ecological mapping methods, generating a unified map has been problematic. Prior to this research, a validated habitat map for grizzly bears did not exist for the Central Canadian Rocky Mountains. “Greenness” is one variable biologists have identified from tassel-capped transformations of satellite images that has contributed to producing a GIS based cross-jurisdictional habitat map. The objective of my research was to determine the relationship between greenness values (a surrogate for habitat) and grizzly bear locations, then to develop a predictive habitat quality map, for the Central Canadian Rockies Ecosystem (CRE), according to empirically determined preferences for high greenness values. I then used the habitat quality map in conjunction with the security model to identify areas of high quality habitat that are, or could be managed for grizzly bear security. I identified the percent of available land base that is secure high habitat quality at various landscape levels and concluded that the percentage of land base in secure high quality habitat is small across the CRE; currently no jurisdiction, BMU or female grizzly bear home range meets USDA Forest Service targets for providing habitat security for long term grizzly bear conservation. I identified specific applications of the secure habitat quality model in grizzly bear conservation and management strategies. The predictive models of habitat quality and security areas in the CRE are necessary tools to assist managers in cross-jurisdictional planning and demarcation of important sites for grizzly bears.

I incorporated data from the Eastern Slopes Grizzly Bear Project and the Upper Columbia Bear Research Project; each encompasses separate, biologically distinct study areas within the CRE. I used a seamless vegetation greenness map generated by Wierzchowski (2000) for the CRE. Seasonal analysis for selection of greenness by grizzly bears was not possible because of limited availability of cloud-free satellite images during springtime (June – mid July). Greenness modeling depends upon good quality cloud free Landsat satellite images. Complete data were available for the berry season (mid July – end of October) and therefore my analyses were restricted to that period.

As a surrogate for land cover type (habitat), I analyzed greenness scores and two variables derived from the greenness model; distance to high greenness and density of high greenness. I also included the variables elevation and human access density to develop a probability of occurrence model and habitat quality map for grizzly bears. I identified differences in use of pseudo-habitat variables between male and female, wary and habituated grizzly bears in both study areas. Adult female grizzly bears were the focus of my habitat modeling as they are the reproductive engines of a population and their success is fundamental to sustaining populations for the long term (Mattson 1993, Mace et al. 1999, Gibeau 2000).

I used resource selection analysis that compares ‘used’ versus ‘available’ (random) points to determine probabilities of resource selection based on what is available (Manly et al. 1993, Garshelis 2000). I evaluated 2nd order resource selection for female grizzly bears in each study area, defined by the outermost boundary of the compilation of all female home ranges. I developed a set of candidate models, per study area, of all likely variable combinations that may influence the probability of occurrence of female grizzly bears. I used logistic regression to estimate parameter coefficients and likelihood values for each candidate model and compared them using the Akaike Information Criteria (AIC) (Burnham and Anderson 1998). In both study areas, density of high greenness and distance to high greenness were the most important and strong predictors for female grizzly bear occurrence.
I used coefficients from the top AIC model in both study areas to generate a map of relative probability of female grizzly bear occurrence throughout the CRE, then categorized the probability values into 3 equal intervals to delineate low, moderate or high habitat quality (Figure 1).

![Map of relative probability of female grizzly bear occurrence throughout the Central Rockies Ecosystem, categorized by 3 equal intervals of low, moderate or high habitat quality.](image)

I updated the secure area model developed by Gibeau et al. (2001) for female grizzly bears using the most recent and accurate spatial data for motorized and non-motorized access across all jurisdictions in the CRE (Figure 2). I then combined the security area analysis with the habitat quality map and identified areas of secure high quality habitat (Figure 3). I defined the percent of available land base that is secure and of high habitat quality across 4 major jurisdictions within the CRE, across individual BMU’s within National Parks and Kananaskis Country, Alberta and within individual female grizzly bear home ranges. My results (Stevens 2002) indicate no jurisdictions in the CRE meet the USDA Forest Service target level of 68% secure habitat (IGBC 1998). A small proportion of each jurisdiction encompasses secure high quality habitat. British Columbia provincial lands have the largest percentage (13%) of their available land base in secure high quality habitat. The National Parks have the least amount of available land base in secure high quality habitat (5%).
There is strong support for preserving areas where grizzly bears will be secure from encounters with humans as these would foster the wary behavior in bears that most managers consider to be desirable (Mattson 1993, Mace and Waller 1997, Gibeau et al. 2001). These secure areas are also expected to provide enough forage so bears can meet their energetic requirements, while at the same time choosing to avoid people (Mattson 1993). Combining the security area model with knowledge of habitat quality is essential to highlight areas most productive for grizzly bears. Secure high quality habitat will most reliably maintain fitness or survival of individual grizzly bears and it will foster reproductive potential of adult females, important to the viability of the population.

The secure habitat quality map offers recent scientific data on habitat (established by the probability of bear occurrence based on greenness) and human activities influencing grizzly bears. It can help identify specific areas within the CRE that should receive special management attention specifically during the summer and fall season and is a tool that may contribute significantly to various cross-jurisdictional management and conservation initiatives.
The strength in this model is that variables derived from greenness are strong predictors of grizzly bear occurrence. Satellite images are attainable for any region or landscape and with professional GIS technical support are easily transformed into greenness bands. Some management applications may experience a limitation to using greenness as a pseudo-habitat variable because the relationships between greenness values and vegetative community types are yet unknown. Vegetation type is undeterminable from the model and therefore managing for certain habitat enhancement projects, for example, cannot be done without more site-specific investigation.

Because greenness is relatively easy to measure, this analysis provides a good coarse-filter tool for management to assess changes in grizzly bear habitat across time and over large landscapes, particularly during the summer/fall season. If, over time, it appears that greenness levels are changing, especially within secure areas, then management action may be necessary to avoid a decline in habitat effectiveness, such as enhancing habitat attributes delineated in a fine-filter approach (see next chapter). This map will not only help management and conservation programs in the CRE to prevent further loss of existing secure high quality habitats, but also to guide them in identifying areas for enhancing bear habitat quality and increasing habitat effectiveness through restoration of secure areas.
LITERATURE CITED