RESOURCE SELECTION BY WHITE-TAILED DEER, MULE DEER, AND ELK IN NEBRASKA

By

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Under the Supervision of Professor Scott E. Hygnstrom

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David M. Baasch, Ph.D.

University of Nebraska, 2008

Advisor: Scott E. Hygnstrom

PREVIEW

Management of cervids in Nebraska is a growing concern due to population eruptions and declines, potential for inter-specific transmission of disease, and habitat depredation. We used resource selection functions to relate cervids to resources and develop locally adaptive plans for managing white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), and elk (*Cervus elaphus*) in Nebraska. We use simulation techniques to determine if discrete-choice, logistic-regression, and MAXENT-modeling could recover a known probability distribution. We evaluated influence of numbers of use and random locations and levels of selection and availability used in analyses of resource selection. Discrete-choice modeling consistently provided precise and accurate estimates of the known probability distribution when appropriate levels of selection and availability were chosen. Based on our results, we used discrete-choice modeling to assess influence of landscape characteristics on resource selection by white-tailed deer,

mule deer, and elk in Nebraska. Selection of resources by white-tailed deer at the DeSoto National Wildlife Refuge changed in response to conversions of cropland to grasslands. The conversion had the largest impact on cropland and wooded areas on the refuge. However, we could not consistently predict impacts of converting 5% of landcover from cropland to grassland, which indicated changes in selection of resources by white-tailed deer was nonlinear. White-tailed deer and mule deer in Morrill County selected agricultural crops juxtaposed with wooded cover, but mule deer selected resources at lower specificity. We determined >30% of landcover in Morrill County was selected by white-tailed deer and mule deer indicating an overlap in space-use. Selection of resources by female elk in the Pine Ridge was influenced by slope, aspect, and distance to road and forest edge. We used results to identify a potential elk redistribution area within the Pine Ridge to help managers minimize depredation complaints by landowners. My dissertation is an important contribution to resource selection modeling and cervid ecology in Nebraska. Our results will be used to direct management decisions and develop models for predicting the spread of infectious diseases.

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statistical and ecological knowledge and look forward to continuing our professional relationship.

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CHAPTER 1

An Evaluation of Three Resource Selection Modeling Techniques Using Simulated Presence-Absence Data

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ABSTRACT The performance of statistical methods for modeling resource selection is difficult to evaluate using field data because the true selection distribution is unknown. Simulated data based on a known probability distribution can be used as the "truth" to evaluate the performance of statistical methods. Models should be able to recover the true selection distribution if they are to be useful in analyzing field data. We used simulation techniques to evaluate the effectiveness of 3 statistical methods to recover a known probability distribution. We generated use locations at 4 sample sizes (250, 500,

1,000, and 2,000) and 4 levels of selection according to a known probability distribution across DeSoto National Wildlife Refuge (DNWR). We generated either 5 random locations per use location or 10,000 random locations (total) within a predetermined area around use locations to determine the influence of number of random locations on results. We analyzed simulated data with 2 popular methods for evaluating data for resource selection (discrete-choice and logistic regression) and compare the results with a maximum entropy method (MAXENT). We compared estimated coefficients of models to coefficients of the model used to develop the underlying probability distribution, compared estimated probability distributions to the known probability distribution, and used area under receiver operator characteristic curves (AUC) to evaluate performance of methods. Number of use and random locations use in analyses, level at which selection of resources occurred, and area considered available affected each statistical method differently. Discrete-choice produced more precise and accurate estimates of the true probability distribution when the area in which we selected use locations was larger than the area in which we selected random locations. Logistic regression produced good estimates of the true probability distribution when selection of use and random locations occurred at the study area level. All models were better than random in receiver operating characteristic (ROC) indicating better discrimination of selection than random chance. Results from ROC analyses however, often contradicted other methods used to evaluate model performance and we encourage caution when using AUC as a measure of performance for resource selection models. Discrete-choice modeling was best able to recover the known selection distribution in our study area, but we recommend further studies using simulated data over different landscapes to confirm our results.

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Key words: AUC, discrete-choice, logistic regression, MAXENT, resource selection, ROC, simulated data.

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INTRODUCTION

Resource selection is a valuable field of study in animal ecology. Conclusions drawn from resource selection studies have important implications because they serve as guidelines for habitat management plans and habitat suitability indices (Garshelis 2000). Effective management and conservation of species requires an understanding of habitat requirements, well-guided techniques for collecting data (use and random data), and an accurate method for analyzing data. Occasionally data on both use- and nonuse-locations are available for the development of resource selection models, for which general-purpose statistical methods can be used (i.e., at the population level: Design I in the terminology of Manly et al. 2002, MacKenzie 2006). However, in many cases absence data are not available. In particular, radio-telemetry studies only document where the animal was; this type of data is extremely common (Cooper and Millspaugh 1999, MacKenzie 2006).

Resource selection analysis usually involves the generation of random locations. Typically, random locations are generated by sampling cells within a region defined as available to the animal or by selecting a set number of points within each habitat class or region in the study area. A recurring problem that exists with presence-absence analyses is the determination of what is defined to be "available" to the animal. Several definitions of availability exist in literature, most of which are associated with the geographic range of the species, study area, home range, or localized areas around each

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