Pre-Assessment of Wildlife Movement Patterns in a Forested Habitat Prior to Highway Development: Prioritizing Methods for Data Collection to Couple Local and Landscape Information for the Development of Statistical Models

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Abstract

In 2004 the Federal Highway Administration, Western Federal Lands Highway Division, presented a proposal to improve the roadway along the Thompson River in west central Montana connecting state Highway 200 east of the town of Thompson Falls and Highway 2 west of the town of Kalispell. As currently exists here, two gravel roads run, north-to-south, over a 40-mile length. This corridor supports denning wolves, has legal status as a grizzly bear corridor, has habitat which may be used by lynx, wolverine, and fisher, has large populations of elk, white-tailed and mule deer, moose, and bighorn sheep, and the river itself is a bull trout spawning tributary. Because of this, the Thompson River drainage was identified as such a significant wildlife corridor that a consortium of organizations (USDA Forest Legacy Program, USFWS Habitat Conservation Land Acquisition Program, Montana Fish, Wildlife & Parks, and Bonneville Power Administration) allocated $34 million to place a conservation easement on this region.

Initial plans were to pave this roadway to permit year-round travel and to reduce siltation of the Thompson River. Our research focus was to characterize the terrestrial wildlife populations along this corridor, to determine the most significant locations across which animal crossings occur and characterize these by local and landscape attributes, and to develop mitigation plans to deal with significant wildlife issues if improvements were to proceed. One of our primary purposes was to develop a model approach predicting wildlife activity to such studies for the FHA which could be employed in the future at other locations.

Wildlife distributions were determined through the use of remote cameras (n = 583 sites monitored with replicates; >7,600 animals detected), permanent snow-track transects (n = 52; >18,000 tracks identified), and GPS radiotelemetry (specifically bighorn sheep; n = 9; average of > 4,600 locations determined/animal). Movement patterns were further studied by identifying roadway crossing locations ("hotspots" – n = 650), backtracking a subset of these and creating GPS layers, and identifying all locations at which road mortalities (n = 33) occurred. Local (25 m radius) vegetation analyses and habitat characteristics were collected in the field at 316 locations along the roadways associated with each of these survey parameters, and various landscape level attributes within a 1 km radius of each camera location were then derived using ArcGIS 9.0 from GIS layers supplied from the USFS Northern Region Vegetation Mapping Project and Lolo National Forest coverages. These include actual surface area estimates of dominant vegetation and lifeform type, vegetation size, canopy cover, ownership, and road and stream density. A 10-meter digital elevation model (DEM) and MODIS satellite data of the study area were used to generate topographic attributes of slope and aspect and estimates of forest cover for analysis.

Using ESRI's ModelBuilder geoprocessing environment, spatial data from individual camera locations served as inputs for a data model developed for landscape-level data extraction from GIS layers and subsequent coupling of local and landscape variables. One kilometer buffer zones created around each camera location were used to intersect with GIS layers. Summary tables of model variables were generated in a geodatabase, exported to a Microsoft Access database and merged with local variables where further derivation and calculation of predictor information could be accomplished. Once complete, a final table containing both response and local and landscape predictor variables was created and exported to SPSS/S-PLUS for statistical analysis.

Three distinct regions along the 43-mile corridor were identified for separate model development. The southernmost region is largely characterized by steep, forested canyon topography; the central region consists of a broader, open, forested river valley, while the northernmost region is predominantly private agricultural land. As our primary response variable measuring animal activity along the proposed highway, we calculated the number of animal sightings recorded by each camera per 100 hours of camera time for each location (called Occurrence Index) and the number of tracks (by species) per 100 meter interval over each 1 km snow transect. Several regression modeling approaches are currently being explored including logistic, Poisson, and Ordinary Least Squares, depending on response variable distribution model fit and other procedural assumptions. Spatial correlation will also be evaluated using either ESRI's Geostatistical Analyst or S-PLUS. Models will be generated for each region and their final selection will be determined using both cross-validation and various model fit criteria. Beyond their current application in this study, it is our further goal that these models representing contrasting landscapes will have a broader inter/intra-regional application for other similar studies in the future.