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Multi-Scale Spatio-Temporal Analysis of Brown Bear Habitat in Northern Iberia: A Large Landscape Conservation Planning Perspective

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ABSTRACT

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Problem Statement

The distributions of brown bears in northern Iberia are mainly found in protected areas but they also extend beyond protected boundaries. Since brown bears need large continuous areas of habitat with sufficient availability of preferred foods, escape cover and den sites; it's important to map brown bear habitats at a landscape level to further examine their connectivity and fragmented habitats. The major problems for brown bear recovery and management in the northern Iberian Peninsula is the lack of identified linkages (one means of achieving connectivity) between subpopulations, and barriers (fragmentation-natural or anthropogenic) that divide them. Brown bear habitats in northern Iberia are highly fragmented as a result of previous and ongoing developments and land-use land cover changes. Improvement of connectivity and prevention of more habitat destruction is vital to recovering the species in this region. To help understand the spatial and temporal variations of brown bear habitat connectivity and fragmentation, there is a need for maps which both accurately represent the condition of habitat and comparable at multiple scales (Soulé and Terborgh 1999 & FOP 2014).

Brown bears in the study area are endangered in large part due to a loss of connectivity in their habitat. Planning must be sustainable in order to maintain ecosystems in which brown bear habitats reside. In addition, these ecosystems provide clean water, air, and genetic resources-the basic resources people need to survive (Servheen et al. 1999).

The essential goal of maintaining connectivity in large landscape conservation is addressed via the spatial configuration of habitat that is important to satisfy the demands of the species. This research will quantify change of brown bear habitat fragmentation by applying post-classification change mapping techniques to remote sensing-derived, multi-temporal land cover maps. Spatio-temporal change analyses will be conducted to evaluate brown bear habitat fragmentation identified by the Morphological Spatial Pattern Analysis (MSPA) and potential connectivity using Circuit Theory (Circuitscape). In terms of analyzing connectivity, geographic extent and scale are important; therefore, broader landscapes should be considered for effective bear management conservation planning (Hilty et al. 2006).

The questions driving my research are:

1. What are the net changes of brown bear habitat fragmentation at multiple scales for 1990, 2000, and 2006?
2. What is the degree of brown bear habitat connectivity at multiple scales in 2006?
3. When did brown bear conservation policies take effect and should large landscape conservation planning be implemented?

Study Area & Methods

The research setting for this study is located in a mountain range in northern Spain, the Cantabrian Cordillera. The Cantabrian Cordillera has three geographic distinct regions: Western (the Asturian Massif in Galicia, Asturias, Leon, and Cantabria); Central (the Cantabrian Massif, in Cantabria); and the Eastern (Monte Vascos or Basque Mountains in the Basque Country).

MSPA will map land cover maps that will be reclassified into binary classes of foreground (habitat: core and links) and background (non-habitat). MSPA will utilize the binary map and convert the foreground (area of interest) into seven spatial pattern elements: core, islet, bridge, loop, branch, edge, and perforation. MSPA maps will be compared to evaluate changes in brown bear habitat structure for 1990, 2000, & 2006. IDRISI Selva provides an excellent tool for comparing categorical maps based on cross-tabulation at the pixel level. The Land Change Modeler (LCM) will evaluate gains/losses and net change of brown bear habitat fragmentation using MSPA categories. Circuitscape (an open-source program that uses circuit theory) will help to predict potential connectivity of brown bear habitats within and between subpopulations in northern Spain. A raster habitat map will be coded for resistances (high values denote greater resistance to movement) or conductances (reciprocal of resistance; higher values indicate greater ease of movement).

The purpose of this research is to use MSPA and Circuit Theory to map and understand the spatial relationships among habitat, potential linkages and barriers, and to identify gaps in managed habitats to assist with restoring connectivity.

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