CRITICAL LINKAGES II: ASSESSING REGIONAL SCALE LANDSCAPE CONNECTIVITY FOR TRANSPORTATION PLANNING IN MASSACHUSETTS

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ABSTRACT

The University of Massachusetts Amherst, working in partnership with The Nature Conservancy and state agencies completed a comprehensive analysis of areas in Massachusetts where connections must be protected and restored to support the Commonwealth's wildlife and biodiversity resources. The Critical Linkages project developed spatially explicit tools, including models, maps and scenario-testing software, for use in mitigating the impacts of roads and railroads on the environment. We employed a "coarse-filter" approach in our assessment of connectivity; i.e., one that did not involve any particular focal species but instead holistically considered ecological systems. Because we were dealing with biodiversity in its broadest sense we distinguished two important scales for assessing connectivity, which we refer to as local and regional scales. Local connectivity refers to the spatial scale at which the dominant organisms interact directly with the landscape via demographic processes such as dispersal and home range movements. This is the landscape context that an individual organism might experience during their lifetime. Regional connectivity refers to the spatial scale exceeding that in which organisms directly interact with the landscape. This is the scale at which long-term ecological processes such as range expansion/contraction and gene flow occur. At this scale, individuals generally do not interact with the landscape, but their offspring or their genes might over multiple generations. Phase I of the Critical Linkages project (reported at ICOET 2011) focused on an analysis of local scale connectivity. In Phase II of the project we utilized a hybrid of the resistant kernel estimator approach (used at the local scale) and a graph theoretic approach to assess connectivity at a regional scale. We created a hybrid system that maintains the spatial realism of the resistant kernel estimator approach and capitalized on the computational efficiencies of the graph matrix representation. Resistant kernels combine two familiar methods: 1) standard kernel density estimation, and 2) least cost path analysis based on resistant surfaces, into a hybrid approach that allows for nonlinear ecological distance relationships and accounts for connectivity between every location to every other location (as opposed to between a single designated source and destination location). The project builds on the existing Conservation Assessment and Prioritization System (CAPS), a computer model developed by UMass that incorporates biophysical and anthropogenic data to develop an index of ecological integrity.