Biodiversity and Energy Online Mapping

About the layers

Layer: Matrix Forest Block Linkages and Linkage Zones
Date of this document: 29 November, 2012
Layer developed by: New York Natural Heritage Program

Short Description:
Forest Block Linkages:
This layer depicts the Least Cost Paths (LCP) among forest blocks; one model of the best way to maintain connectivity for the populations of plants and animals of these forests. A least cost path balances travel distance and ease of travel -- here designated as the amount of natural land within 1 kilometer. The goal is to describe the most permeable part of the landscape between a pair of forest blocks. LCPs may help identify habitat stepping stones, riparian zones, or even wide swaths of natural land and thus should be viewed within the context of the landscape, not simply as a line on the ground.

Linkage Zones:
This layer depicts the Conditional Minimum Transit Cost linkage zones among forest blocks. A zone between two forest blocks depicts the area around all the paths represented by the cost of the single LCP plus 20%. The goal is to describe the most permeable part of the landscape between a pair of forest blocks. The LCP and the associated linkage zone may help identify habitat stepping stones, riparian zones, or even wide swaths of natural land and thus should be viewed within the context of the landscape.

Why these layers matter:
To best maintain viable populations within matrix forest blocks there needs to be a minimal amount of movement and genetic exchange among blocks. Understanding where successful movement is most likely to occur helps us prioritize for landscape permeability and barrier mitigation.

Source: These layers are modeled by the New York Natural Heritage Program based on work developed through funding from NYSERDA and NYSDEC. The LCP is based on a surface depicting the amount of natural land in the landscape, which is derived from the NOAA C-CAP Land Cover data set MRLC Land Use/Land Cover dataset (30 meter raster data) (http://www.csc.noaa.gov/digitalcoast/).

Processing Overview:
1. To create a generalized representation of natural land for the study area, we extracted all natural land categories: Grassland/Herbaceous (8), Deciduous Forest (9), Evergreen Forest (10), Mixed Forest (11), Scrub/Shrub (12), Palustrine Forested Wetland (13), Palustrine Scrub/Shrub Wetland (14), Palustrine Emergent Wetland (15), Estuarine Forested Wetland (16), Estuarine Scrub/Shrub Wetland (17), and Estuarine Emergent Wetland (18).

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2. We then conducted a roving-window (focal statistics) analysis on this extracted layer, using a circle of radius 1000 meters, to create a surface depicting the proportion of natural land within 1000 meters.
3. We then reduced the resolution of the raster data set from 30-m cells to 330-m cells using the Aggregate tool (cell factor of 11) in ArcGIS with the output cell representing the mean of the cells aggregated. This layer was used to represent the resistance surface.
4. Each matrix forest block occurring at least partially within New York State was evaluated as a patch. Least Cost Paths (LCP) were evaluated from and to every patch.
5. A single LCP is derived as a balance of straight distance and "cost" to travel, which comes from the surface of proportion natural land. A key assumption is that forest species see the natural landscape as easier to travel through than the developed landscape and thus areas with a higher proportion of natural land are more permeable to our species of interest. The formula describing the balance between distance and cost used in this assessment is:

   $$\text{Cost for traveling one step} = \text{distance} * \text{average cost between points}^{1.5}$$

   Points are represented by single nodes along the path, and vary in their distance depending on the homogeneity of the cost surface. The total cost of the LCP is the sum of all the step to step costs.

6. The linkage zone is then an aggregation of all the paths between two patches with a total cost less than the LCP plus 20%.

For more details about the approach used here to develop these linkages, see: Howard, T., and M. Schlesinger. 2012. PATHWAYS: Wildlife Habitat Connectivity in the Changing Climate of the Hudson Valley. New York Natural Heritage Program, Albany, NY. 143 pages. (available here: http://nynhp.org/pathways)

The approach for developing linkage zones follows the theory developed in Pinto, N., and T. H. Keitt. 2009. Beyond the least-cost path: evaluating corridor redundancy using a graph-theoretic approach. Landscape Ecology 24:253–266.

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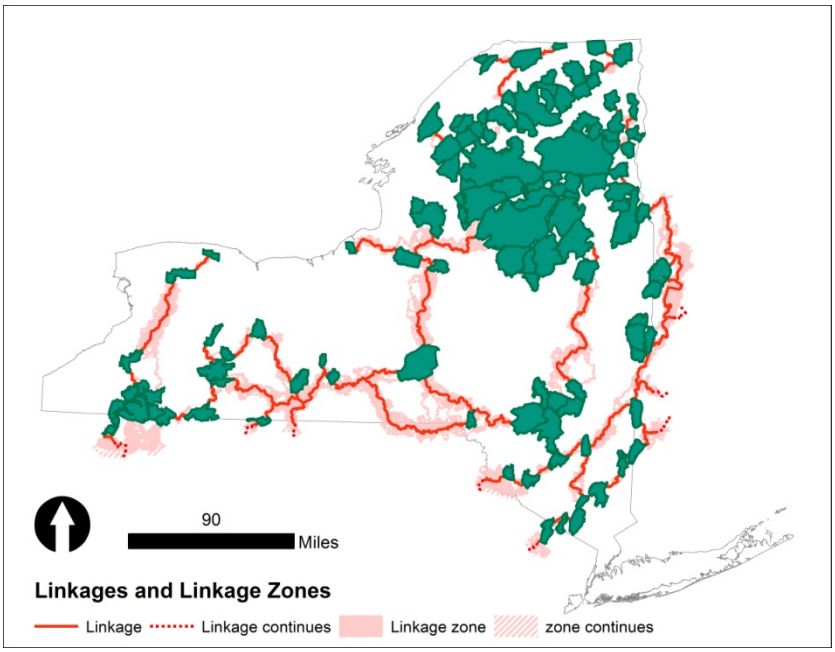

Linkages and linkage zones among matrix forest blocks in New York State

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