MSPA Connectivity: Water as Foreground, 30 Meter Edge Width

This EnviroAtlas map for connectivity in the conterminous U.S. depicts core areas of natural landcover (NLCD 2011), core fragmentation, and patterns of connectivity among core patches. In the water as foreground data layer, waterbodies are classified with core natural areas and included in the analysis with the natural landcover classes.

Why is connectivity important?

Connectivity describes the ways in which a landscape promotes or impedes the movement of organisms among core areas of potential habitat or cover.[1, 2] Landscapes with high connectivity allow species to move freely among core areas, whereas landscapes with low connectivity tend to isolate species within scattered patches.[1] The EnviroAtlas connectivity framework may be considered a structural (rather than functional) framework because its connectivity patterns are independent of species' habitat requirements.[2]

Connectivity is an important element in the concept of green infrastructure, which is used in both land and water quality management. Green infrastructure represents a network of interconnected natural areas that integrate natural systems with urban communities to increase community health and well-being.[3] Connectivity data are useful for applications in land-use planning, habitat conservation, restoration prioritization, and habitat suitability studies. Maintaining and creating connections among core areas with natural corridors is critical for retaining biodiversity. Planners can identify the most vulnerable local corridors and evaluate how they connect to broader scale habitat networks. Producing a comprehensive, proactive strategy of connectivity is preferable to piecemeal local reactions to individual development projects.[1]

Pixel-level classification of connectivity allows the mapping of pattern changes from local to national scales. In addition, it allows the monitoring of connectivity changes over time with each periodic National Land Cover Data (NLCD) update.[3] Continuous data permits management of the whole landscape; this approach is particularly useful for mobile species or species that are tolerant enough of regional land uses to cross unsuitable habitat. A different approach and additional information (e.g., specific habitat and life history information) may be needed to plan functional connectivity networks for specific species or species that have difficulty moving among isolated patches of habitat.[1,4] Such functional connectivity studies will have

even more importance to plan for adaptive movements of wildlife to refugia in higher elevations or temperate microhabitats in reaction to climate change.

How can I use this information?

These data are useful for any scale connectivity study, from local to national. For example, an important role of local land use planning in urban areas is to conserve surrounding green spaces through land trust purchase or conservation easement. Connectivity information helps to identify remaining natural parcels to maintain upland-lowland or riparian connections through and around communities. For wildlife conservation on a broader scale, connectivity data may be compared with species distributions, habitat needs, and EnviroAtlas data layers such as ecoregions, GAP Ecological Systems, or protected areas (PADUS, enter layer names in the search box in the EnviroAtlas navigation panel) to assess the adequacy of reserves, remaining habitat core areas, and movement corridors for wildlife. Using these data, planners may be able to identify the most vulnerable corridors to target for conservation or to locate habitat areas that may be restored to increase connectivity within a network.

How were the data for this map created?

Connectivity data were derived using the GUIDOS 1.3 raster image processing toolbox, which includes the Morphological Spatial Pattern Analysis tool (MSPA). National Land Cover Data (2011 30-meter resolution NLCD) was reclassified into predetermined foreground and

background classes in preparation for applying MSPA—using natural landcover classes (31, 41, 42, 43, 52, 71, 90 and 95) and water classes (11, open water, and 12, ice and snow) as foreground and developed classes (21, 22, 23, 24, 81 and 82) as background. Edge width was one pixel (30 meters) and foreground connectivity was assessed using all eight neighboring pixels. MSPA creates feature classes shown in the legend (such as core, edge, perforation, branch, and islet) that describe the pattern of fragmentation and connectivity in the image. Detailed descriptions of these feature classes are available on the GUIDOS website.

Foreground and background assignments vary according to study objectives and targets of interest. In EnviroAtlas, three separate connectivity data layers treat water differently: 1) water ignored; 2) water as background; and 3) water as foreground. In water as foreground, waterbodies are classified with the core natural areas feature class (green areas in image). River and riparian patches (image, center) consolidate into larger core patches surrounded by black edge and connected by blue bridges (corridors). Treating waterbodies as core elements may be useful when considering the movements of aquatic and semiaquatic species. For example, in this scenario, a reservoir surrounded by development appears as a green (core) island on a gray (development) background; depending on reservoir size and development intensity, the waterbody may provide useful habitat for waterfowl.

What are the limitations of these data?
The landcover classes found in NLCD are created through the classification of satellite imagery. Human classification of landcover types that have a similar spectral signature can result in classification errors. As a result, NLCD is a best estimate of actual landcover.

The resolution of the final MSPA classes can be no finer than the resolution of the NLCD classes. That is, development and fragmentation occurring at a finer scale than NLCD (for example, forest fragmentation created by logging) will not be captured by this model. In addition, this connectivity framework will vary in relevance for various wildlife species, depending on their mobility and tolerance for development. Finally, the term "natural" core area does not take into account habitat quality or condition.

How can I access these data?
EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded.

Where can I get more information?
A selection of resources related to connectivity is listed below. For additional information on data creation, access the metadata found in the drop-down menu for each map layer listed in the EnviroAtlas table of contents and click again on metadata at the bottom of the metadata summary page for more details. The GUIDOS website has an MSPA guide and a user manual that describe the process and output elements. For details on connectivity results using water ignored and water as background see those individual fact sheets. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

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Selected Publications

1. Bennett, A.F. 2003. Linkages in the landscape: The role of corridors and connectivity in wildlife conservation. International Union for Conservation of Nature, Gland, Switzerland and Cambridge, United Kingdom. 254 p.

2. Tischendorf, L., and L. Fahrig. 2000. On the usage and measurement of landscape connectivity. *Oikos* 90:7–19.

3 Wickham, J.D., T.G. Wade, K.H. Riitters, and P. Vogt. 2010. A national assessment of green infrastructure and change for the conterminous United States using morphological image processing. *Landscape and Urban Planning* 94:186–195.

4. Vogt, P. J.R. Ferrari, T.R. Lookingbill, R.H. Gardner, K.H. Riitters, and K. Ostapowicz. 2009. Mapping functional connectivity. *Ecological Indicators* 9:64–71.

Bélisle, M. 2005. Measuring landscape connectivity: The challenge of behavioral landscape ecology. *Ecology* 86(8):1988–1995.

Hess, G.R., and R.A. Fischer. 2001. Communicating clearly about conservation corridors. *Landscape and Urban Planning* 55:195–208.