Candidate Ecological Restoration Areas per Square Kilometer

This EnviroAtlas national map depicts the number of Candidate Ecological Restoration Areas (CERA) per square kilometer within each 12-digit hydrologic unit (HUC) across the U.S. Candidate ecological restoration areas are close but disjunct patches of land that could be restored to improve connectivity between naturally vegetated patches.

Why are candidate ecological restoration areas important?

Ecological restoration is projected to become a prominent means of environmental conservation in the coming decades, and landscape context (i.e., the pattern of neighboring land cover and land uses) has emerged as an important principle for identifying locations for restoration.[1,2] For this metric, land cover was used as input into morphological spatial pattern analysis (MSPA) to identify close but geographically disjunct vegetated regions.[3,4] These vegetated regions were used to identify candidate ecological restoration areas.

Candidate ecological restoration areas relate to three EnviroAtlas benefit categories: 1) biodiversity conservation, 2) clean and plentiful water, and 3) recreation, culture and aesthetics. Because of the way in which the land cover was processed with the MSPA software, agriculture and urban land cover classes represented the predominant land uses in the candidate ecological restoration areas. Restoration (i.e., revegetation) of candidate sites tends to create corridors connecting nearby vegetated regions in developed areas. Corridors have been shown to have positive benefits for biodiversity conservation because they preserve native vegetation, provide habitat for terrestrial and aquatic plant and animal species, and provide cover for wildlife species' movement or migration through developed land.[5,6] The creation of corridors connecting larger vegetated regions may also promote increased recreational use. Restoration of riparian candidate sites may improve and maintain the provision of clean and plentiful water because the potential natural streamside vegetation (forest, wetland, grassland and shrubland) improves and maintains water quality by filtering significant quantities of sediment, nutrients, and pollutants and recharging groundwater aquifers.[7]

Seventeen attributes were added to the candidate ecological restoration areas to inform site content and site context. Examples of site content include, road length, stream length, impaired stream length, soil productivity, and the proportion of a site amenable to wetland restoration. Examples of site context include the number of vegetated regions that could be connected, the total size of vegetated regions that could be connected through restoration, and the size of the two largest surrounding vegetated regions that could be connected. Another example of site context is the proportion that the second largest vegetation region contributes to the combined size of the two largest vegetated regions. The largest and second largest vegetated regions are approximately equal in size when the proportion approaches 0.5 (50%). Restoration practitioners may want to focus on restoration sites where this value is close to 0.5 when biodiversity and habitat restoration are important objectives.


Photo: Small patch natural cover, Iowa, T. McCabe, NRCS

How can I use this information?

The map, Candidate Ecological Restoration Areas per Square Kilometer summarized by 12-digit HUC, is one of two EnviroAtlas maps that examine restoration through the aggregation of patches of natural vegetation. The companion map, Candidate Ecological Restoration Areas, displays CERA polygons across the U.S. The primary intended use of candidate ecological restoration areas is as a screening tool. The attributes in the database can be used to guide selection of candidate areas that meet specified goals. For example, a user could identify roadless candidate sites where the size of the two largest surrounding vegetated regions is greater than or equal to their respective national medians. Such a map might be a starting point for ecological restoration for the promotion of biodiversity conservation, wildlife habitat, and movement corridors. The map can help with similar queries for the promotion of clean and plentiful water and recreation.

CONTINUED ON BACK ▶

Ecological restoration can be expensive.[8] Because of potential expense, this metric is conservative in defining "close but geographically disjunct" patches, and the candidate restoration areas tend to be small. The areas were intentionally kept small because many of the EnviroAtlas stakeholders may lack the financial resources to undertake large-scale projects.

How were the data for this map created?

The 2011 National Land Cover Data (NLCD) land cover map was reclassed into foreground and background for MSPA processing. NLCD 2011 classes for forest, wetland, shrubland and grassland were re-coded as foreground, and water, urban, barren, and agriculture were re-coded as background. MSPA classified foreground into core (interior), edge, bridge (corridor), loop, branch ("dead end" corridor), perforation (hole), and islet (patch) and then regionalized.[9] The MSPA branch was extracted, expanded by two pixels, and regionalized. The regionalized and expanded branched- and regionalized-MSPA were overlaid, and candidate restoration areas were identified as expanded and regionalized branches that overlaid $\geq$ 2 regionalized MSPA regions. The output was converted to vector format, and common GIS overlay routines were used to develop the attribute database. The CERA polygons are typically aggregations of 1 to 3 close but geographically disjunct patches of natural vegetation. This metric depicts the number of candidate restoration areas per square kilometer summarized by 12-digit HUC for the conterminous U.S.

What are the limitations of these data?

No data are free from measurement and other sources of error. NLCD 2006 accuracies were 88%–91% and NLCD 2011 accuracies were expected to be similar. Misclassification of NLCD land cover could lead to errors in the identification of candidate restoration sites. Misclassification of NLCD may also affect the identification of potentially restorable wetlands. In addition, the National Hydrography Dataset (NHD) 1:100,000-scale data has a tendency to omit ephemeral streams.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. NLCD, MSPA, and NHD data downloads are available at their respective websites.

Where can I get more information?

A selection of resources related to the importance of ecological restoration and corridors is listed below. For additional information on how the data were created, access the metadata for the data layer. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgments

The candidate ecological restoration areas data were created James Wickham, EPA. The fact sheet was written by James Wickham.

Selected Publications

1. Holl, K.D., E.E. Crone, and C.B. Schultz. 2003. Landscape restoration: Moving from generalities to methodologies. *BioScience* 53:491–502.

2. Shackelford, N., R.J. Hobbs, J.M. Burger, T.E. Erickson, J.B. Fontaine, E. Laliberté, C.E. Ramalho, M.P. Perring, and R.J. Standish. 2013. Primed for change: Developing ecological restoration for the 21st century. *Restoration Ecology* 21:297–304.

3. Homer, C., J. Dewitz, L. Yang, S. Jin, P. Danielson, G. Xian, J. Coulston, N. Herold, J. Wickham, and K. Megown. 2015. Completion of the 2011 national land cover database for the conterminous United States: Representing a decade of land cover change information. *Photogrammetric Engineering and Remote Sensing* 81:345–354.

4. Soille, P., and P. Vogt. 2009. Morphological segmentation of binary patterns. *Pattern Recognition Letters* 30:456–459.

5. Gilbert-Norton, L., R. Wilson, J.R. Stevens, and K.H. Beard. 2010. A meta-analytic review of corridor effectiveness. *Conservation Biology* 24:660–668.

6. Haddad, N.M., L.A. Brudvig, E.I. Damschen, D.M. Evans, B.L. Johnson, D.J. Levey, J.L. Orrock, J. Resasco, L.I. Sullivan, J.J. Tewksbury, S.A. Wagner, and A.J. Weldon. 2014. Potential negative effects of corridors. *Conservation Biology* 28:1178–1187.

7. Sweeney, B.W., T.L. Bott, J.K. Jackson, L.A. Kaplan, J.D. Newbold, L.J. Standley, W.C. Hession, and R.J. Horwitz. 2004. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. *Proceedings of the National Academy of Sciences, USA* 101:14132–14137.

8. De Groot, R.S., J. Blignaut, S. Van Der Ploeg, J. Aronson, T. Elmqvist, and J. Farley. 2013. Benefits of investing in ecosystem restoration. *Conservation Biology* 27:1286–1293.

9. Wickham, J., K.H. Riitters, T.G. Wade, 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.