Percent Rare Ecosystem

This EnviroAtlas national map illustrates the percent of land within each subwatershed (12-digit HUC) that is comprised of relatively rare ecosystems. In EnviroAtlas, ecosystem rarity is evaluated based on the size, shape, and type of ecosystem. These data include natural lands indexed as greater than 75, on a relative rarity scale of 0 to 100.

Why are rare ecosystems important?

Ecosystems are interactive networks that include living organisms and the non-living environment (e.g. climate, soil). The natural processes that occur within ecosystems produce benefits that individuals, towns, and other ecological communities depend on (e.g. clean air and food). These benefits can be unique to processes occurring within each individual ecosystem. For example, wetlands provide different functions and benefits than forests, which differ from grasslands. Protecting a rare ecosystem may also preserve the services it provides, which may also be rare.

Traditionally, conservation efforts have largely focused on protecting vulnerable species. These measures, such as the U.S. Endangered Species Act (ESA), provide a mechanism to restore specific populations. Though this method has been successful in restoring and protecting certain populations, species-driven conservation may not account for the collective benefits and services that emerge from entire ecosystems.

There is growing recognition that ecosystem-based conservation is an effective approach to maintaining and protecting biodiversity. Protecting an entire ecosystem ensures the protection of both the living and non-living elements that comprise the system. By mapping and evaluating the existence of rare ecosystems, conservation efforts can effectively target and protect multiple species that comprise and/or depend on particular ecosystems.

In addition to the benefits to biodiversity conservation, rare ecosystems may also provide aesthetic, recreational, and cultural value to neighboring communities. For example, the Cascade Mountains in the Pacific Northwest include unique matrix forming and large patch type ecosystems. These unique features may provide rich recreation opportunities for residents and tourists, in addition to their striking beauty.

One challenge in an ecosystem-based conservation approach is defining "rare ecosystem". Rare ecosystems are often defined as ecosystems that occupy less than 30 percent of their original or pre-industrial range.[1] However, this definition is difficult to apply due to a lack of historical data.[2]

Photo: National Park Service, Pine Rocklands, Everglades

To address this gap in data, EPA has developed a metric of ecosystem rarity that can distinguish between ecosystems which are naturally small in extent (i.e. riparian or bog systems) from those that have limited area due to land conversion for other purposes.

How can I use this information?

The map, Percent Rare Ecosystem, and its underlying data can be used to identify where rare ecosystems may exist. Identifying the presence of rare ecosystems may help inform future conservation efforts and land use planning.

This map can be viewed in conjunction with both the Rare Ecosystems supplemental biophysical-raster map and the Land Protection Status layers in the EnviroAtlas interactive map. Together, these layers can show where rare ecosystems exist in relation to protected areas. This map can also be used with population data to provide insight into the overlap of people and rare ecosystems (ex. southern Florida and the Appalachian region).

In addition, EnviroAtlas also includes an Ecosystem Rarity ArcGIS toolbox that can be downloaded and used on national, local, or regional-scale analysis.

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How were the data for this map created?

These data are based on data generated by the U.S. Geological Survey (USGS) National Gap Analysis Program (GAP) landcover data. Open water and human use (ex. urban or agriculture) landcover types were removed. The systems were grouped into four spatial pattern types (i.e. matrix forming, linear, small patch and large patch), as defined by NatureServe. For example, riparian systems or shore lines tend to be linear and matrix forming ecosystems covering vast areas that provide critical habitat for large-area dependent fauna such as bison and prairie chickens.

The relative uniqueness of the ecosystems was determined by using the National Vegetation Classification (NVC) system, which acts as an ecological taxonomy. A relative rarity index ranging from 0 to 100 was then calculated for each ecosystem based on area, spatial pattern, and relative uniqueness. Rare ecosystem was then defined as land with an index value greater than 75. The percentage of total land within a subwatershed (12-digit HUC) that is covered by rare ecosystem was estimated and displayed in this map.

What are the limitations of these data?

The USGS GAP Version 2 Landcover data represents a hybrid dataset. It was composed by compiling regional GAP landcover datasets, classified by aerial imagery at 30-meter resolution, with data from the LANDFIRE project (USDA Forest Service and USDOI 2012) as well as data from NGOs, state and federal agencies.

The GAP landcover data maps individual ecological systems across the entire United States. These ecological systems are based upon the NatureServe ecological systems classification[3], yet they are not identical. The GAP labeling of the NatureServe ecosystems includes modifiers to the base NatureServe ecosystem labels.

All national data layers such as GAP are, by their nature, inherently imperfect; they are an estimation of the truth based on the best available science. Calculations based on these data are therefore also estimations. Accuracy information for the source data sets can be found on their respective web sites. For more information on the limitations these data, please see the metadata.

How can I access these data?

EnviroAtlas data can be viewed in the Interactive Map, accessed through web services, or downloaded. USGS GAP, NatureServe, and NVC data are available on their respective websites. The EnviroAtlas Ecosystem Rarity Toolbox is available on the EnviroAtlas Downloadable GIS Tools webpage.

Where can I get more information?

There are numerous resources on the classification of ecosystems, their value, and conservation; a selection of these resources is below. Organizations such as USGS, NatureServe, and the International Union for Conservation of Nature are a few groups that work on conservation and classification of ecosystems. For additional information on how the data were created or their limitations, access the metadata. To ask specific questions about these data, please contact the EnviroAtlas Development Team.

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Selected Publications

[1]Nicholson, E., D. A. Keith, and D. S. Wilcove. 2009. Assessing the Threat Status of Ecological Communities Conservation Biology 23:259-274.

[2]Rodríguez, J. P., K. M. Rodríguez-Clark, J. E. M. Baillie, N. Ash, J. Benson, T. Boucher, C. Brown, N. D. Burgess, B. E. N. Collen, M. Jennings, D. A. Keith, E. Nicholson, C. Revenga, B. Reyers, M. Rouget, T. Smith, M. Spalding, A. Taber, M. Walpole, I. Zager, and T. Zamin. 2011. Establishing IUCN Red List Criteria for Threatened Ecosystems. Conservation Biology 25:21-29.

[3]Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological systems of the United States: A working classification of U.S. terrestrial Systems. NatureServe, Arlington, VA.

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