Maximum Total Vertebrate Species Richness: Southeast

This EnviroAtlas national map displays the maximum number of vertebrate species with potential habitat within each 12-digit hydrologic unit (HUC) in 9 southeastern states. These data are based on habitat models rather than wildlife counts. Potential habitat may be specific to wintering, breeding, or year-round activities depending on the species.

Why are vertebrate species important?

Total vertebrate species richness estimates the number of vertebrate species that may inhabit an area based on potential habitat. EnviroAtlas maps overlay the potential distribution of over 600 amphibian, reptile, bird, and mammal species. Species richness is frequently used as a surrogate for measuring biodiversity and as a measure of the relative conservation value of an area. Many scientists believe that biodiversity, because it represents all forms of life on earth, provides or supports the core benefits that humans derive from their environment and helps sustain human culture worldwide. Many organizations consider managing areas for biodiversity as one way to achieve an acceptable balance among competing demands for various ecosystem services.[1]

Each species plays an important role within its ecosystem, and ecosystems are highly interconnected. Each species depends on others for some aspect of its survival to provide food, habitat, decomposition, pollination, or control of pest species. The removal of even one species from an ecosystem can create a trophic cascade that can affect the entire food chain. For example, grazers and browsers directly modify the species composition, diversity, and condition of grassland and forest habitats. Top predators, by regulating herbivore numbers, indirectly influence habitat condition and diversity by reducing grazing pressure on plant production.[2] In the Southeast, the loss of a top predator like the red wolf removed population controls on white-tailed deer. Without predators, unchecked populations of white-tailed deer degraded forest understories, affecting other species' habitats. A predator-prey balance, now lost in many ecosystems in the Southeast, helped to maintain plant and wildlife species diversity.[2]

In addition to their roles within ecosystems, vertebrates are economically and culturally important. Watchable wildlife raises environmental awareness in the general public, attracting visitors to parks and other wildlife management areas. Hunting also has a long tradition in the U.S. Of the

Photo: Glossy Ibis, D. Daniels

606 southeastern vertebrate species represented, 78 species are considered harvestable for food or fur. The U.S. Fish and Wildlife Service estimated that hunters spent $33.7 billion in 2011, one-third of which went towards accommodations, transportation, and other tourism-related activities.[3] Revenue from hunting excise taxes and licenses is used to support land acquisition, conservation, and restoration.

How can I use this information?

The map, Maximum Total Vertebrate Species Richness: Southeast, is one of three EnviroAtlas maps that illustrate indicators of vertebrate species richness for the Southeast. Other EnviroAtlas maps show the mean total vertebrate species richness and a Normalized Index of Biodiversity (NIB) for each 12-digit HUC.[4] Used together or independently, these maps can help identify areas of potentially low or high vertebrate species richness to help inform decisions about resource restoration, use, and conservation. Knowing vertebrate species richness is one element of biodiversity conservation.

These maps can also be used in conjunction with other maps in EnviroAtlas such as protected areas (PADUS), connectivity, or GAP ecological systems to help identify areas with high ecological or recreational value for inclusion in conservation, recreation, or restoration planning. After learning the total vertebrate species richness values for a particular 12-digit HUC, users can investigate an area more intensively by using higher resolution individual species models available through the Southeast Regional Gap Analysis Project (SEGAP).

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How were the data for this map created?

This data layer is based on data generated by the U.S. Geological Survey (USGS) National Gap Analysis Program (GAP). The GAP program maps the distribution of natural vegetation communities and potential habitat for individual terrestrial vertebrate species. These models utilize predictive environmental variables (e.g., GAP land cover, elevation, distance to water) to derive deductive habitat models for each species.

Southeast GAP modeled habitat for 606 vertebrate species that reside, breed, or use the habitat within 9 southeastern states for a significant portion of their life history. Total vertebrate species richness was calculated by combining predicted habitat for all GAP individual vertebrate species by pixel across the 9 states. The number of vertebrate species in each pixel was summarized by 12-digit HUC and the maximum value noted for each HUC.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with these data. The data, based on models and large national geospatial databases, are estimations of reality that may overestimate actual vertebrate species presence. Modeled data are intended to complement rather than replace monitoring data. Habitat models do not predict the actual occurrence of species, but rather their potential occurrence based on their known associations with certain habitat types. Habitat is only one factor that determines the actual presence of a species. Other factors include habitat quality, predators, prey, competing species, and fine scale habitat features.

Other essential species information in addition to species richness includes the types of species and their functional groups, whether they are rare or common, native or non-native, tolerant or intolerant of disturbance. It is also important to consider that species numbers (at a landscape scale) tend to increase with moderate disturbance, meaning that moderately human-altered or disturbed habitats have higher numbers of species than either minimally disturbed or highly disturbed sites.[5]

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Metric values for individual pixels may be obtained from the New Mexico State University Center for Applied Spatial Ecology. Individual species data may be obtained from the SEGAP geo-data server.

Where can I get more information?

A selection of resources related to vertebrates and biodiversity is listed below. Information on the models and data used in the USGS GAP and SEGAP projects is available on their respective websites. For additional information on how the data were created, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgments

The data for Total Vertebrate Species Richness were created through a collaborative effort between the USGS GAP and EPA. Kenneth Boykin and graduate students from New Mexico State University generated the data. The data used to derive southeastern total vertebrate species richness came from SEGAP and the Biodiversity and Spatial Information Center (BaSIC) at North Carolina State University. The fact sheet was written by Kenneth Boykin, New Mexico State University, Anne Neale and William Kepner, EPA, Jessica Jahre, EPA Student Services Contractor, and Sandra Bryce, Innovate!, Inc.

Selected Publications

1. Boykin, K.G., W.G. Kepner, D.F. Bradford, R.K. Guy, D.A. Kopp, A. Leimer, E. Samson, F. East, A. Neale, and K. Gergely. 2013. A national approach for mapping and quantifying habitat-based biodiversity metrics across multiple spatial scales. *Ecological Indicators* 33:139–147.

2. Miller, B., B. Dugelby, D. Foreman, C. Martinez del Rio, R. Noss, M. Phillips, R. Reading, M. E. Soulé, J. Terborgh, and L. Wilcox. 2001. The importance of large carnivores to healthy ecosystems. *Endangered Species Update* 18(5):202–210.

3. U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2013. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, FHW/11-NAT (RV), Washington, D.C.

4. Kepner, W.G., K.G. Boykin, D.F. Bradford, A.C. Neale, A.K. Leimer, and K.J. Gergely. 2011. Biodiversity metrics fact sheet, EPA/600/F-11/006, U.S. Environmental Protection Agency, Washington, D.C.

5. Marzluff, J.M. 2008. Island biogeography for an urbanizing world: How extinction and colonization may determine biological diversity in human-dominated landscapes. *Urban Ecosystems* 8:155–177.

Maximum Total Vertebrate Species Richness: Southwest

This EnviroAtlas national map displays the maximum number of vertebrate species with potential habitat within each 12-digit hydrologic unit (HUC) in the southwestern United States (Arizona, Colorado, Nevada, New Mexico, and Utah). These data are based on habitat models rather than wildlife counts. Potential habitat may be specific to wintering, breeding, or year-round activities depending on the species.

Why are vertebrate species important?

Total vertebrate species richness estimates how many different vertebrate species may inhabit an area based on potential habitat. Species richness is frequently used as a measure of the relative conservation value of a particular area. It has been used as a surrogate for measuring biodiversity. Many scientists believe that biodiversity, because it represents all forms of life on earth, provides or supports the core benefits that humans derive from their environment. Thus, biodiversity helps sustain human culture throughout the world. Therefore, many organizations consider managing areas for biodiversity as a means to achieve an acceptable balance among competing demands for various ecosystem services. Total vertebrate species richness is one indicator of biodiversity within an area.

Each species plays an important role within its ecosystem. Ecosystems are highly interconnected, with numerous food chains that form a food web, where all species have a vital function. Each species depends on other species for some aspect of their survival, whether it is for habitat, food, decomposition, pollination, or pest control. The removal of even one species from an ecosystem could potentially have cascading effects throughout the system.

Vertebrate species richness can be indicative of recreational opportunities or aesthetic qualities. Vertebrate species such as big game and birds are often mentioned in tourist brochures to highlight the recreational opportunities available within an area. Vertebrate species richness has been used as an indicator of the biodiversity conservation potential of an area and is considered an important indicator of biodiversity hot spots.

There are some people who believe that humans have a self-sustaining reason to preserve biodiversity, while others believe we have a moral obligation. There are some characteristics of biodiversity that are valued by an even


Photo: Ryan Hagerty/USFWS

larger segment of the population, and thus they are important to include in any assessment that seeks to identify and quantify the value of ecosystems to humans. Some biodiversity metrics clearly reflect ecosystem services and their contribution to our quality of life and economy (e.g., abundance and diversity of game species), whereas others reflect indirect and difficult to quantify relationships to services (e.g., relevance of species diversity to ecosystem resilience, cultural value and aesthetic values).

How can I use this information?

The map, Maximum Total Vertebrate Species: Southwest, is one of three EnviroAtlas maps that illustrate indicators of vertebrate species richness for the Southwest. Additional EnviroAtlas maps show the mean total vertebrate species richness and a Normalized Index of Biodiversity (NIB) for each 12-digit HUC. Used together or independently, these maps can help identify areas of potentially low or high vertebrate species richness to help inform decisions about resource restoration, use, and conservation. Knowing vertebrate species richness provides one aspect necessary to conserve biodiversity.

These maps can also be used in conjunction with other maps in EnviroAtlas to help identify areas with high ecological or recreational value for inclusion in conservation or restoration planning or protection from further development for recreational or aesthetic reasons. This information can help identify areas that may be vulnerable to development. Connectivity planning and estimation of species' minimum

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area requirements are important considerations for mobile species with large territories.

After finding out the total vertebrate species richness values for a particular 12-digit HUC, an area can be more intensively investigated by using individual species models at a higher resolution. Individual species models are available through the Southwest Regional Gap Analysis Project (SWReGAP).

How were the data for this map created?

This data layer is based on data generated by the U.S. Geological Survey (USGS) National Gap Analysis Program (GAP). The GAP program maps the distribution of natural vegetation communities and potential habitat for individual terrestrial vertebrate species. These models utilize predictive environmental variables (e.g., GAP land cover, elevation, distance to water) to derive deductive habitat models for each species.

A component of GAP, SWReGAP modeled habitat for vertebrate species that reside, breed, or use the habitat within the 5-state Southwest study area for a significant portion of their life history. Vertebrate species richness was calculated by combining predicted habitat for all GAP individual vertebrate species by pixel across the southwestern United States. This map depicts the highest value found in each 12-digit HUC.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with the data. These data are based on models and large national geospatial databases. Calculations based on the data are estimations of the truth founded on the best available science. Modeled data can be complementary but the information is not meant to replace monitoring data. Habitat models do not predict the actual occurrence of species, but rather their predicted occurrence based on their known associations with certain habitat types. Habitat is only one factor that determines the actual presence of a species. Other factors include habitat quality, predators, prey, competing species, and fine scale habitat features such as woody debris.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Metric values for individual pixels may be obtained from the New Mexico State University Center for Applied Spatial Ecology. Accuracy information for the SWReGAP and GAP projects can be found on their respective web sites.

Where can I get more information?

There are numerous resources about the importance of vertebrate species and biodiversity; a selection of these resources is listed below. For additional information on how the data were created, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgments

EnviroAtlas is a collaborative effort led by EPA. The data for Total Vertebrate Species Richness were created through a collaborative effort between the USGS GAP Analysis Program and EPA. The data were generated by Kenneth Boykin and graduate students from New Mexico State University. The data used to derive Vertebrate Species Richness came from SWReGAP. The fact sheet was written by Kenneth Boykin, New Mexico State University, Anne Neale and William Kepner, EPA, and Jessica Jahre, EPA Student Services Contractor.

Selected Publications

Boykin, K.G., W.G. Kepner, D.F. Bradford, R.K. Guy, D.A. Kopp, A. Leimer, E. Samson, F. East, A. Neale, and K. Gergely. 2013. A national approach for mapping and quantifying habitat-based biodiversity metrics across multiple spatial scales. *Ecological Indicators* 33:139–147.

Boykin, K.G., B.C. Thompson and S. Propeck-Gray. 2010. Accuracy of gap analysis habitat models in predicting physical features for wildlife-habitat associations in the southwest U.S. *Ecological Modelling* 221:2769–2775.

Kepner, W. G., K. G. Boykin, D. F. Bradford, A. C. Neale, A. K. Leimer, and K. J. Gergely. 2011. Biodiversity Metrics Fact Sheet. U.S. Environmental Protection Agency, Washington, DC, EPA/600/F-11/006.

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Marzluff, J.M. 2008. Island biogeography for an urbanizing world: How extinction and colonization may determine biological diversity in human-dominated landscapes. *Urban Ecosystems* 8:155–177.