NIB Mammal Species Richness: Southeast

This EnviroAtlas national map displays the Normalized Index of Biodiversity (NIB) for mammal species richness based on 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 mammal species important?

Mammal species richness estimates the number of mammal species that may inhabit an area based on potential habitat. Species richness is frequently used as a surrogate for measuring biodiversity and as a measure of the relative conservation value of a particular 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.

Mammals are a diverse group of vertebrates that play important roles in ecosystems as herbivores, carnivores, insect and carrion feeders, plant pollinators, and seed dispersers. Mammals in these various roles affect their habitats by modifying vegetation composition, diversity, and condition. For example, grazers and browsers directly modify the species composition and condition of grassland and forest habitats. Top predators, by regulating herbivore numbers, indirectly influence habitat condition by reducing grazing pressure on plant production. A predator-prey balance, now lost in many ecosystems in the Southeast, helps to maintain vegetation and wildlife species diversity.[2]

Mammals are economically and culturally important. Many people enjoy simply viewing mammals and they seek them out in their natural habitats. For example, elk, recently re-introduced to Great Smoky Mountains National Park, attract


Photo: Steve Hillebrand, USFWS

visitors to the Cataloochee Valley, where they may also see white-tailed deer. Mammals are an important food source. Big game hunting has a long tradition in the U.S.; in 2011, about 85% of hunters pursued large mammals.[3] The presence of large mammals creates revenue from federal excise taxes and hunting licenses, which is used to support conservation efforts, land acquisition, and wildlife restoration projects.

How can I use this information?

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

These maps can 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. Connectivity planning is also important for mobile mammal species with large territories.

After learning the mammal species richness values for a particular 12-digit HUC, users can investigate an area more intensively by using higher resolution individual species

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models available through the Southeast Regional Gap Analysis Project (SEGAP).

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 97 terrestrial mammal species that reside, breed, or use the habitat within 9 southeastern states for a significant portion of their life history. Mammal species richness was calculated by combining predicted habitat for all GAP individual mammal species by pixel across the 9 states. The number of mammal species in each pixel was summarized by 12-digit HUC and the mean value calculated for each HUC. The NIB was calculated by dividing the mean species richness value by the maximum value 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. These data, based on models and large national geospatial databases, are estimations of reality that may overestimate actual mammal 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 mammals 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 Mammal 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 mammal 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, 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.

NIB Mammal Species Richness: Southwest

This EnviroAtlas national map displays the Normalized Index of Biodiversity (NIB), an index value for mammal species richness based on 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, not wildlife counts. Potential habitat may be specific to wintering, breeding, or year-round activities depending on the species.

Why are mammal species important?

Mammal species richness estimates how many different mammal species may inhabit an area, based on potential habitat. Species richness, or diversity, 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 biodiversity, as 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 a means to achieve an acceptable balance among competing demands for various ecosystem services. Mammal 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 to provide habitat, serve as food source, decompose matter, or control pest species. The removal of even one species from an ecosystem could potentially have cascading effects throughout the system.

Mammals are a diverse group of vertebrates that play important roles in ecosystems. Mammals can function as plant pollinators, seed dispersers, or even as keystone species in the environments that they inhabit.[1] For example, prairie dogs are often viewed as keystone species in prairies since their presence is known to influence vegetation structure, diversity of species, and the functioning of that ecosystem.[2]

In addition to the roles that mammals play in ecosystems, they are also an important food source and appreciated for the recreational opportunities and aesthetic value that they provide. Elk, bison, wolves and deer attract visitors to parks and other wildlife areas. Big game hunting, with a long tradition in the U.S., is the most popular type of hunting; in 2011, approximately 85% of hunters went hunting for large mammals.[3]


Photo: Ron Singer/USFWS

How can I use this information?

The map, NIB Mammal Species Richness: Southwest, is one of three EnviroAtlas maps that illustrate indicators of mammal species richness for the southwest. Additional EnviroAtlas maps show the maximum and mean mammal species richness for each 12-digit HUC. Used together or independently, these maps can help identify areas of potentially low or high mammal species richness to help inform decisions about resource restoration, use, and conservation. Knowing the mammal 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 and protection from further development for recreational or aesthetic reasons. This information can help identify areas that may be vulnerable to development.

After learning the mammal species richness values for a particular 12-digit HUC, a user can more intensively investigate an area by using individual species models at a higher resolution. Individual species models are available through the Southwest Regional Gap Analysis Project (SWReGAP).

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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.

A component of GAP, SWReGAP modeled habitat for 215 mammal species that reside, breed, or use the habitat within the 5-state Southwest study area for a significant portion of their life history. Mammal species richness was calculated by combining predicted habitat for all GAP individual mammal species by pixel across the Southwestern United States. The number of mammal species in each pixel was summarized by 12-digit HUC and the mean value calculated for each HUC. The NIB was calculated by dividing the mean value by the maximum value for each 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 they are 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. SWReGAP and GAP data and accuracy information can be accessed through their respective websites.

Where can I get more information?

There are numerous resources about the importance of mammal species richness and biodiversity in general; 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 Mammal Species Richness were created through a collaborative effort between the USGS GAP and EPA. The data were generated by Kenneth Boykin and graduate students from New Mexico State University. The data used to derive Mammal Species Richness came from SWReGAP. The fact sheet was written by Kenneth Boykin, New Mexico State University, and Anne Neale and William Kepner, EPA.

Selected Publications

1. Kremen, C. 2005. Managing ecosystem services: What do we need to know about their ecology? *Ecology Letters* 8:468–479.

2. Miller, B., R. Reading, J. Hoogland, T. Clark, G. Ceballos, R. List, S. Forrest, L. Hanebury, P. Manzano, J. Pacheco, and D. Uresk. 2000. The role of prairie dogs as a keystone species: Response to Stapp. *Conservation Biology* 14:318–321.

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.

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, EPA/600/F-11/006, U.S. Environmental Protection Agency, Washington, D.C.

Prior-Magee, J.S., K.G. Boykin, D.F. Bradford, W.G. Kepner, J.H. Lowry, D.L. Schrupp, K.A. Thomas, and B.C. Thompson, Editors. 2007. Southwest Regional Gap Analysis Project Final Report. U.S. Geological Survey, Gap Analysis Program, Moscow, Idaho.