



Total Vertebrate Species Richness

These EnviroAtlas national maps display the total number of vertebrate species based on potential habitat within each 12-digit hydrologic unit (HUC) in the conterminous United States. These data are based on habitat models rather than wildlife counts.

Why are vertebrate species important?

The metric, Total Vertebrate Species Richness, estimates the number of vertebrate species that may inhabit an area based on potential habitat. Species richness is one measure of [biodiversity](#) that can represent 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 to sustain society, economy, health, and well-being. Managing for biodiversity is one way to balance competing demands for 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 For example, the loss of top predators has removed population controls on white-tailed deer. Without predators, unchecked populations of white-tailed deer have degraded forest understories, affecting other species' habitats. A predator-prey balance, now lost in many ecosystems, helped to maintain plant and wildlife species diversity.²

In addition to their roles within ecosystems, vertebrates are economically and culturally important. Watchable wildlife opportunities raise environmental awareness in the general public, attracting visitors to parks and other wildlife management areas. Vertebrate species richness can also be indicative of recreational opportunities or aesthetic qualities. Vertebrate species such as big game animals and birds are often featured in tourist brochures to highlight the recreational opportunities available within an area. Vertebrate species richness has been used as an indicator of the biodiversity



Photo: Ryan Hagerty/USFWS

conservation potential of an area and it is considered an important indicator of biodiversity hot spots.

Hunting has a long tradition in the U.S. The total economic impact of terrestrial wildlife for 2015 was \$346 billion with hunting providing \$78 billion and wildlife watching providing \$166 billion. Hunting and wildlife watching expenditures were \$89 billion for that same time period. The U.S. Fish and Wildlife Service estimated that one-third of what hunters spent in 2011 went towards accommodations, transportation, and other tourism-related activities.³ Revenue from federal excise taxes and hunting licenses is used to support community and regional conservation efforts, land acquisition, and wildlife restoration projects.

Characteristics of biodiversity are valued in a variety of ways 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 amenities).

How can I use this information?

Three EnviroAtlas maps, Mean, Maximum, and Normalized Index of Biodiversity (NIB), illustrate Total Vertebrate Species Richness within each 12-digit HUC in the conterminous United States. Used together or independently,

these maps can help identify areas of potentially low or high total vertebrate species richness to help inform decisions about resource restoration, use, and conservation. Mean richness is a commonly used and understood value for comparison. NIB provides an index to compare a metric with other metrics across multiple project scales simultaneously. Maximum richness identifies areas that are species rich but may not occupy large areas (e.g. linear riparian areas).

These maps can be used in conjunction with other EnviroAtlas maps such as ecoregions, the U.S. Geological Survey (USGS) protected areas database ([PAD-US](#)), or the USGS Gap Analysis Project ([GAP](#)) ecological systems to identify areas with high ecological or recreational value for 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 individual species models available from the GAP Project.

How were the data for this map created?

The USGS GAP project maps the distribution of natural vegetation communities and potential habitat for individual terrestrial vertebrate species. These models use environmental variables (e.g., land cover, elevation, and distance to water) to predict habitat for each species. GAP modeled habitat for 1,590 terrestrial vertebrate species that reside, breed, or use the habitat within the conterminous U.S. for a significant portion of their life history. The mean and maximum numbers of terrestrial vertebrate species in each 30-meter pixel were calculated for each 12-digit HUC. The mean species richness value by HUC was divided by the maximum mean value within all HUCs to calculate the NIB.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with the data. These data, based on models and large national geospatial databases of predicted habitat, are estimations of reality that may overestimate actual species richness. 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 finer 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.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Individual 30-meter pixel data may be downloaded from the New Mexico State University Center for Applied Spatial Ecology.

Where can I get more information?

A selection of resources related to terrestrial vertebrates and biodiversity is listed below. Information on the models and data used in the USGS Core Science Analytics, Synthesis & Library's [GAP](#) project is available on their website. For additional information on how the data were created, access the [metadata](#) for the data layer from the layer list drop down menu. To ask specific questions about this data layer, please contact the [EnviroAtlas Team](#).

Acknowledgments

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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.
- Kepner, W.G., K.G. Boykin, D.F. Bradford, A.C. Neale, A.K. Leimer, and K.J. Gergely. 2013. [Biodiversity metrics fact sheet](#). EPA/600/F-11/006, U.S. Environmental Protection Agency, Washington, D.C. (Fact sheet for the original regional habitat models for southeastern and southwestern U.S.)
- Pearce, D., and D. Moran. 1994. *The economic value of biodiversity*. International Union for Conservation of Nature, Taylor and Francis, New York, New York. 104 p.