Maximum Bat Species Richness: Southwest

This EnviroAtlas national map displays the maximum number of bat 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, not wildlife counts. Potential habitat may be specific to wintering, breeding, or year-round activities depending on the species.

Why are bat species important?

Bat species richness estimates how many different bat 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. Bat species richness is one indicator of biodiversity within an area.

Each species, regardless of type or size, 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, to serve as food source, to decompose matter or control pest species. Thus, the removal of even one species from an ecosystem could potentially have cascading effects throughout the system.

Bats are nocturnal mammals that feed mainly on insects and pests, such as mosquitoes and insects that may damage crops. By consuming agricultural pests, bats reduce the need for the use of pesticides, some of which can have harmful effects on human health and the environment.[1] A recent study estimated that the cost-savings from insect-suppression by bats is worth $22.9 billion dollars annually to the U.S. agricultural industry.[2]

Bats are also important pollinators and seed dispersers for a variety of wild and cultivated plants worldwide. Several species of bats in the southwestern United States are pollinators of columnar cacti and agave plants.[3]

Photo: Nick Hristov, NPS

There are 45 bat species that inhabit the United States, 7 of which are currently listed as endangered or threatened. Populations of several bat species are rapidly declining as a result of the emergence of White-nose syndrome.[4]

How can I use this information?

The map, Maximum Bat Species Richness: Southwest, is one of three EnviroAtlas maps that illustrate indicators of bat species richness for the Southwest. Additional EnviroAtlas maps show the mean species richness and an index of bat species richness for each 12-digit HUC. Used together or independently, these maps can help identify areas of potentially low or high bat species richness to help inform decisions about resource restoration, use, and conservation. Knowing the bat 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 finding out the bat 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).

CONTINUED ON BACK ▶

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 30 bat species that reside, breed, or use the habitat within the 5-state Southwest study area for a significant portion of their life history. Bat species richness was calculated by combining predicted habitat for all GAP individual bat species by pixel across the southwestern United States. The number of bat species in each pixel was then summarized by 12-digit HUC and the maximum value for each HUC was noted.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with these data. These data are based on models and large national geospatial databases. Calculations based on these data are estimations of the truth founded on the best available science. Modeled data can be complementary but 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 bats and on biodiversity in general; a selection of these resources is listed below. Additional information on the models and data used in the USGS GAP and SWReGAP projects are 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

EnviroAtlas is a collaborative effort led by EPA. The data for Bat 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 Bat Species Richness came from SWReGAP. The fact sheet was written by Kenneth Boykin, New Mexico State University, Anne Neale and William Kepner, EPA, and Patrick Johnson, EPA Student Services Contractor.

Selected Publications

1. Kunz, T.H., E. Braun de Torrez, D. Bauer, T. Lobova, and T.H. Fleming. 2011. Ecosystem services provided by bats. *Annals of the New York Academy of Sciences* 1223(1):1–38.

2. Boyles, J.G., P.M. Cryan, G.F. McCracken, and T.H. Kunz. 2011. Economic importance of bats in agriculture. *Science* 332:41–42.

3. Fleming, T.H., T. Tibbitts, Y. Petryszyn, and V. Dalton. 2003. Current status of pollinating bats in southwestern North America. Pages 63–68 *in* O'Shea, T.J., and M.A. Bogan (eds.), Monitoring trends in bat populations of the United States and territories: Problems and prospects: U.S. Geological Survey, Information and Technology Report USGS/BRD/ITR–2003-0003, U.S. Geological Survey, Reston, Virginia. 274 p.

4. Frick, W.F., J.F. Pollock, A.C. Hicks, K.E. Langwig, D.S. Reynolds, G.G. Turner, C.M. Butchkoski, and T.H. Kunz. 2010. An emerging disease causes regional population collapse of a common North American bat species. *Science* 329: 679–682.

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, (Eds.). 2007. Southwest Regional Gap Analysis Project Final Report. U.S. Geological Survey, Gap Analysis Program, Moscow, ID.