NIB Waterfowl Species Richness: Southeast

This EnviroAtlas national map displays the Normalized Index of Biodiversity (NIB) for waterfowl species richness based on potential habitat within each 12-digit hydrologic unit (HUC) in 9 southeastern states. These data depend on habitat models rather than wildlife counts. Potential habitat may be specific to wintering, breeding, or year-round activities depending on the species. Waterfowl species richness is based on wintering habitat.

Why are waterfowl species important?

Waterfowl are defined as a group of swimming birds from the family Anatidae, including ducks, geese, and swans. Waterfowl species richness estimates the number of different waterfowl species that may inhabit an area based on their range and 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 for biodiversity as one way to achieve an acceptable balance among competing demands for various ecosystem services.[1]

Each species plays an important role in its ecosystem. Within a food chain, waterfowl serve as a food source for other wildlife and function as primary and secondary consumers, with various species feeding on plant material, invertebrates, fish, and aquatic and terrestrial insects. Waterfowl disperse aquatic and terrestrial plant seeds, which can influence the distribution of (both native and non-native) plant species locally or over longer distances.[2]

Waterfowl also influence ecosystems by moving nutrients between wetland and terrestrial habitats. Studies have shown that waterfowl can deposit 40% of the nitrogen and 75% of the phosphorus entering a wetland.[2] In the Southeast, nutrients deposited in waterbodies by waterfowl accumulate mostly during wintering, when bird densities increase over smaller areas. According to Ducks Unlimited, two-thirds of North America's waterfowl winter in the southern states, meaning that maintaining quality waterfowl habitat in the Southeast is critical to the health of the North American population. Private landowners can play an important role in providing winter waterfowl habitat by flooding their fields.

Photo: Hooded Merganser, Tim McCabe, USFWS

In addition to the important roles that waterfowl play in our ecosystems, they are also a popular food source. Waterfowl hunting has a long tradition in the U.S. A recent national survey found that ducks were the most sought after group of migratory birds hunted in the U.S. In 2011, hunters spent 23 million days hunting birds such as waterfowl and other game birds, which generated $1.8 billion for the U.S. economy.[3] Waterfowl are also appreciated by wildlife-watchers for their aesthetic beauty and the recreational opportunities they provide. There are an estimated 46.7 million birdwatchers in the U.S. and waterfowl are the most highly-viewed group of birds. In total, wildlife viewing contributed almost $55 billion to the U.S. economy in 2011.[3]

How can I use this information?

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

These maps can also be used in conjunction with other maps in EnviroAtlas such as protected areas (PADUS) or GAP ecological systems to help identify areas with high ecological or recreational value for inclusion in conservation, recreation, or restoration planning.

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After learning the waterfowl 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).

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,) to derive deductive habitat models for each species. Southeast GAP modeled habitat for 28 waterfowl species that reside, breed, or use the habitat within the 9 southeastern states for a significant portion of their life history. Waterfowl species richness was calculated by combining predicted habitat for all GAP individual waterfowl species by pixel across the 9 states. The number of waterfowl species in each pixel was summarized by 12-digit HUC and the mean species richness value calculated for each HUC. The mean species richness value was divided by the maximum value to calculate the Normalized Index of Biointegrity (NIB).

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 of predicted habitat, are estimations of reality that may overestimate actual waterfowl 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 biodiversity and waterfowl 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 Waterfowl 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 waterfowl 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, Patrick Johnson, 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. Sekercioglu, C.H. 2006. Increasing awareness of avian ecological function. *Trends in Ecology and Evolution* 21(8):464–471.

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 Waterfowl Species Richness: Southwest

This EnviroAtlas national map displays the Normalized Index of Biodiversity (NIB), an index value for waterfowl 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). Waterfowl refers to any type of goose, duck, or swan. 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 waterfowl species important?

Waterfowl species richness estimates how many different waterfowl 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 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 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. Waterfowl species richness is one indicator of biodiversity within an area.

Each species plays an important role within its ecosystem and the food web. Within the food chain, waterfowl function as primary and secondary consumers and as a food source for other wildlife. They can play a role in dispersing aquatic and terrestrial plant seeds, which can influence the distribution of plant species in the environment. Moreover, waterfowl can influence ecosystems by moving nutrients across habitats and the landscape.[1]

In addition to the important roles that waterfowl play in our ecosystems, they are also a popular harvestable species and an important food source. Waterfowl hunting has a long tradition in the U.S. and continues to be a popular activity today. According to the U.S. Fish and Wildlife Service, ducks were the most sought after group of migratory birds hunted in the U.S. in 2011; hunters spent 23 million days hunting birds such as waterfowl and doves, which generated $1.8 billion for the U.S. economy.

Waterfowl are also appreciated by wildlife-watchers for their aesthetic beauty and the recreational opportunities they provide. There are an estimated 46.7 million birdwatchers in the U.S. and waterfowl are the most highly viewed group of birds. In total, wildlife viewing contributed almost $55 billion to the U.S. economy in 2011.[2] Waterfowl provide recreation, cultural, and aesthetic value to wetlands and water features.

Photo: George Gentry/USFWS

How can I use this information?

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

After finding out the waterfowl 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).

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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 25 waterfowl species that reside, breed, or use the habitat within the 5-state Southwest study area for a significant portion of their life history. Waterfowl species richness was calculated by combining predicted habitat for all GAP individual waterfowl species by pixel across the Southwestern United States. The number of waterfowl species in each pixel was then 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 these 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.

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 waterfowl and on biodiversity in general; a selection of these resources is 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 Waterfowl 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 Waterfowl 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. Sekercioglu, C.H. 2006. Increasing awareness of avian ecological function. *Trends in Ecology and Evolution* 21(8):464–471.

2. 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. U.S. Environmental Protection Agency, Washington, DC, EPA/600/F-11/006.

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