

MAPPING ECOSYSTEM SERVICES FOR THE SOUTHEAST UNITED STATES**Conservation Priorities for Recreational Birding**

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**ECOSYSTEM SERVICE MAPPING SERIES
OVERVIEW**

Ecosystem services, the benefits that natural ecosystems provide to people, vary spatially. Mapping where they are abundant or in short supply is useful for a variety of purposes, including land-use planning, assessment of conservation and restoration priorities, identification of environmental equity issues, and communication with diverse stakeholders. The Nicholas Institute for Environmental Policy Solutions at Duke University, supported by the Southeast Conservation Adaptation Science Center, has mapped the supply and demand of a variety of ecosystem services at the landscape level across the southeastern United States. The results for each ecosystem service can be used individually to identify target areas for conservation and restoration to support that service, or overlaid with other ecosystem services to identify areas that can provide multiple benefits.

Map products for each ecosystem service are available on [ScienceBase](#), and more information about the project, including methods briefs for the other ecosystem services, can be found on the Nicholas Institute [website](#).

SUMMARY OF THIS BRIEF

This methods brief focuses on recreational birding, which is a popular activity in the United States. This analysis maps the location of recreational birding activity in the southeastern U.S. Regional priorities for conservation of birding areas are identified based on the total amount of birding activity and the proportion of birding activity that takes place on unprotected land. Spatial datasets for these priority areas and associated metrics are available on ScienceBase.

INTRODUCTION

Recreational birding is a popular activity in the United States, with about 20% of the population participating each year (Carver 2013). To assess the spatial distribution of recreational birding in the southeast, we combined two data sources: eBird and the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

eBird is a citizen science-based repository of bird sightings managed by the Cornell Lab of Ornithology (Sullivan et al. 2009). Since its creation in 2002, the lab has collected data on hundreds of millions of bird sightings from participants around the world. eBird data include information on when and where each participant, or observer, went birding, but it cannot be used to estimate the magnitude of birding activity because the number of people using eBird has grown exponentially over time. For example, there are about 6,000 eBird observer days in the Southeast for 2002 and more than 225,000 for 2012. This could be due to a combination of several factors: a general increase in eBird popularity, higher levels of internet access and comfort with using technology to track birding activities, and the introduction of an eBird mobile app in 2012 (prior to this, birders had to keep written lists in the field and enter them into the eBird database afterward). While eBird is not a good indicator of the magnitude of recreational birding activity, the spatial distribution of eBird occurrences can provide a measure of the relative popularity of various locations for recreational birding. eBird data has previously been used to evaluate how recreational birders select birding locations (Kolstoe and Cameron 2017).

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (NSFHWAR; US Department of Interior, Fish and Wildlife Service, and Department of Commerce 2011) is conducted periodically by the Fish and Wildlife Service and U.S. Census Bureau. A sample of households nationwide is screened to assess participation in fishing, hunting, or wildlife-watching activities, and detailed interviews about these activities and expenditures are conducted with a smaller group. Birding-related data captured in the NSFHWAR includes estimates of the total days of birding that took place in each state. While the NSFHWAR data provides the best available estimate of the amount of recreational birding (measured in birding days) that takes places in the U.S. for a given year, it does not break down where birding occurs beyond the state level.

We combined the eBird data and NSFHWAR data to estimate where and how much recreational birding occurs in the southeastern U.S. We identified counties and watersheds that are priorities for conservation of birding areas because they have a large amount of birding activity on unprotected lands. We did not identify priorities for restoration of areas for birding.

METHODS

Estimates for the total number of birding days away from home were retrieved for each state in the study area from the 2011 NSFHWAR state reports (the most recent version of the survey to include state-level data). These estimates do not include birdwatching on participants' property (in yards or from a window). This analysis represents birding activity as of 2011 because that is the latest year for which all datasets were available.

We extracted eBird observations within the study area for 2011 from the master eBird dataset and excluded "casual observations" (birds observed outside of intentional birding excursions, often around the observer's home) and observations that were part of targeted eBird research projects where the observer did not choose the birding location. The remaining observations represent intentional birding excursions to locations of the observer's choosing. eBird observations include the number of observers represented, to allow groups of people birding together to report a single observation to eBird. We assumed that any observations missing values for the number of observers to represent one observer.

After this preprocessing, we overlaid the eBird observations on the 2011 National Land Cover Dataset (NLCD) (Homer et al. 2015), protected lands (Protected Areas Database of the United States, U.S. Geological Survey 2016), counties, and watersheds (HUC 8) using the latitude and longitude reported in each observation and extracted the county, watershed, land cover class, and land protection status underlying each observation. We considered all land included in the protected areas database as of 2011 to be protected, even if it was classified as having "no known mandate for protection." Land falling into the "no known mandate" category includes local parks, Army Corps of Engineers recreation areas, and military land. While this land may not be formally protected, it is less likely to be developed than land not included in the protected areas database.

In some cases, a single observer reported multiple eBird observations on the same day (for example, a birder canoeing down a river might report a separate observation every mile or so). Because the unit of measurement for birding activity is birding days, we did not want multiple observations from the same person on the same day in our final eBird database; this would result in a higher estimate of birding days in the county (or watershed) and land cover type in which this activity occurred. To avoid this, we retained only one observation per observer per day. When an observer made observations in multiple land-cover classes in one day, we retained an observation belonging to the most common land cover class of all observations made by the observer on that day.

Using the modified eBird dataset, we calculated the total number of “eBird observer days,” defined as the total number of observers reported in the eBird dataset, in each aggregate area (county or watershed) by land cover class and land protection status. To make the conversion from eBird observer days to birding days, we calculated the total number of eBird observer days in each state, and divided the total estimated birding days in each state (from NSFHWAR) by the state’s eBird observer days to get a conversion factor between eBird observers and birding days for each state. We multiplied the number of eBird observer days in each aggregate area (county or watershed), land cover class, and land protection status by the appropriate conversion factor to estimate birding days in each category. Some eBird observations occur in the ocean, outside of the area covered by the county and watershed datasets. We included these offshore eBird observations in our estimates of birding days, but did not attribute them to a particular county, land cover class, or protection status. Instead, they were summarized by state (as identified in the eBird dataset) and included in the attribute tables of the county and watershed priority map products as “[State]-Offshore.”

We defined priority areas for conservation of birding areas as places with a high amount of birding activity where much of that activity takes place on unprotected land (Table 1). Because birding activity is concentrated around developed areas, we identified areas with high levels of birding activity in two different ways, resulting in two sets of priority counties and priority watersheds. The first definition of birding activity is based on birding days per square mile and highlights developed areas. The second definition of birding activity is based on birding days per capita and highlights less-populated areas that may be attracting nonresidents for birding. Both types of priority areas are important to conserve to ensure that birding activity is not threatened by future land conversion and development.

Table 1: Criteria for identifying priority conservation areas for recreational birding.

Amount of birding on unprotected land	“Per capita” priority definition		“Per area” priority definition	
	< 0.5 birding days per capita	≥ 0.5 birding days per capita	< 50 birding days per square mile	≥ 50 birding days per square mile
< 90%		Nonpriority		Nonpriority
≥ 90%	Nonpriority	Priority conservation area	Nonpriority	Priority conservation area

The number of birding days per square mile ranged from 0 to 16,083 for counties (median of 22.9) and 0 to 1,668 for watersheds (median of 25.1). A threshold of 50 birding days per square mile was selected to identify counties and watersheds with relatively high birding activity as possible conservation priorities for the “per area” priority definition.

Population for each county and watershed was calculated from the EnviroAtlas 2010 dasymetric population layer (U.S. EPA). The number of birding days per capita ranged from 0 to 55.1 for counties (median of 0.29) and 0 to 226 for watersheds (median of 0.38). A threshold of 0.5 birding days per capita was selected to identify counties and watersheds with relatively high birding activity as possible conservation priorities for the “per capita” priority definition.

The percentage of birding days that took place on unprotected land indicates counties where popular birding areas are not protected from development or other land-use changes that could reduce the suitability for birding. The percentage of birding days on unprotected land ranged from 0 to 100% for both counties and watersheds (medians of 71% and 66%, respectively); a threshold of 90% of birding days on unprotected land was selected to provide a reasonable number of priority areas distributed throughout the study area. This threshold was used for both the “per capita” and “per area” priority definitions. Counties and watersheds meeting these criteria are good targets for conservation of suitable birding areas to ensure that the current level of birding activity is not adversely affected by land use changes (Figures 1 and 2).

Figure 1: Regional conservation priority counties for recreational birding

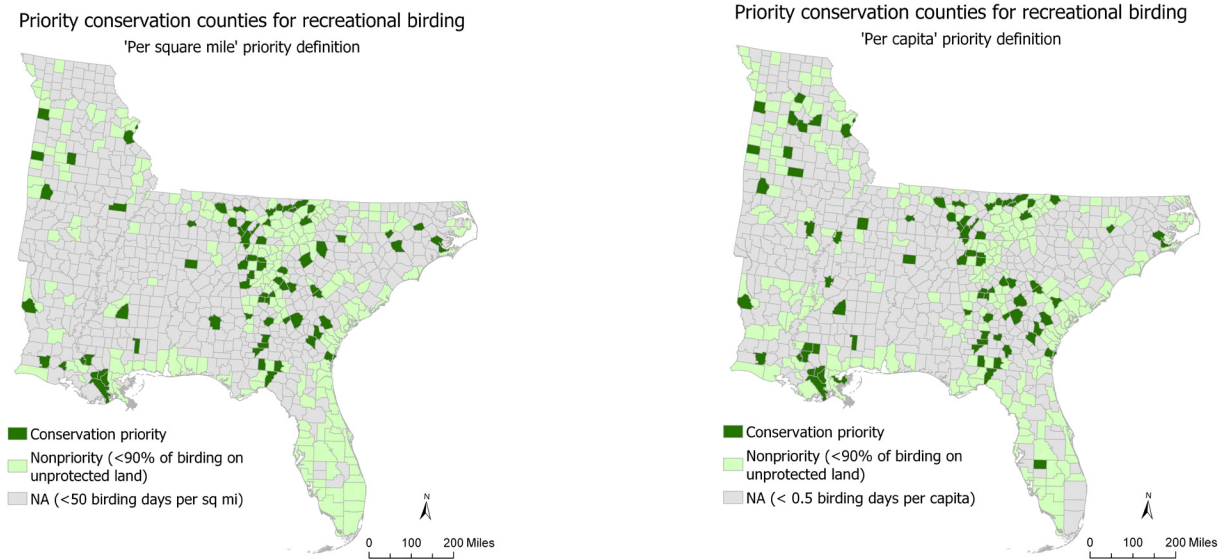
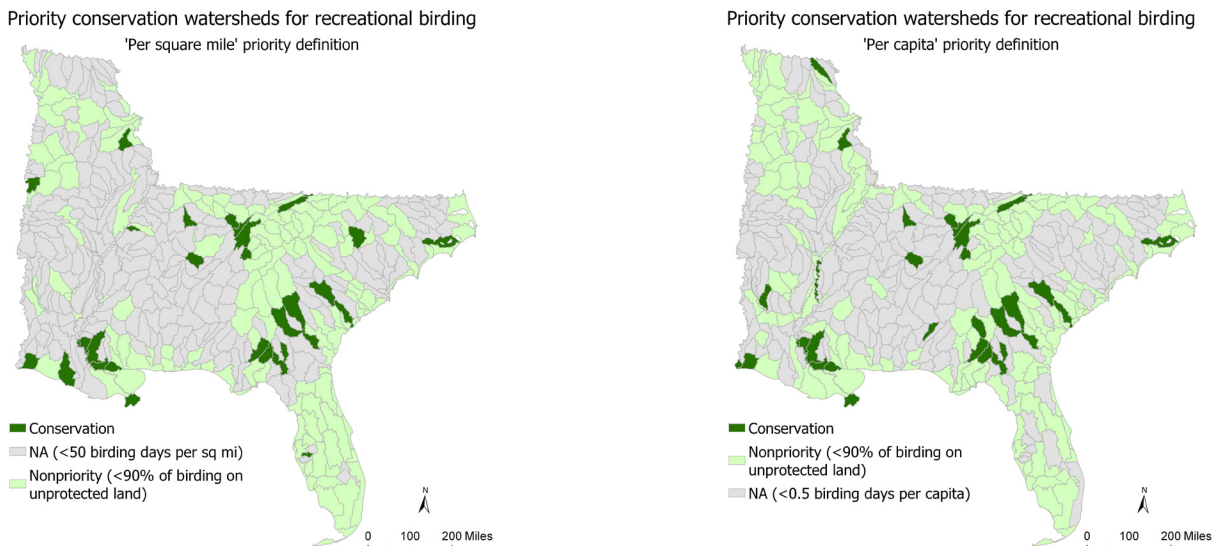


Figure 2: Regional conservation priority watershed for recreational birding



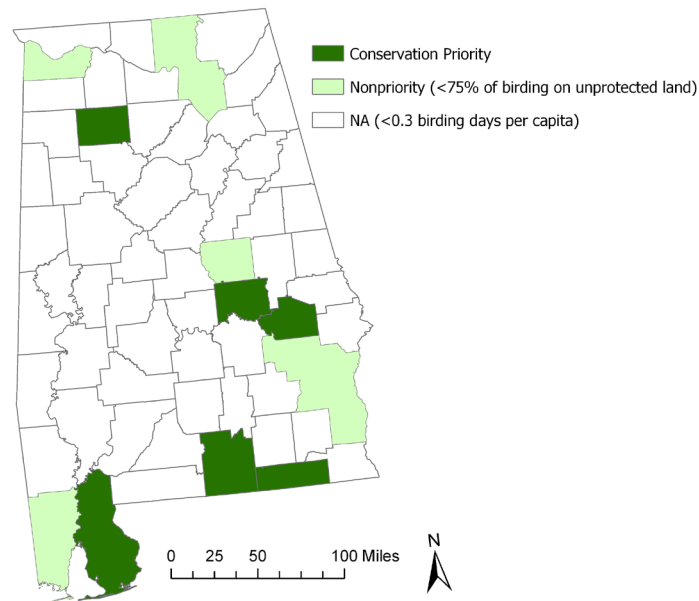
DATASETS AND USE

County-level and watershed-level datasets for the southeastern U.S., including estimated total birding days, birding days by land cover class, proportion of birding days on unprotected land, and priority conservation areas, are available on [ScienceBase](#). The priority conservation counties and watersheds can be used to identify where, at the regional level, conservation of high-quality birding areas will provide the greatest benefit in terms of supporting recreational birding activity. These can also be overlaid with other data sources at the appropriate scale, including [other ecosystem service maps](#), to find areas where conservation would provide multiple benefits.

The additional fields in the county- and watershed-level datasets have the necessary information to make slight changes to the identification of priority conservation areas. For example, if you are only interested in a geographical subset of the study area, you may wish to adjust the criteria used to identify priority areas if more appropriate thresholds are known. You can use the additional fields to extract priorities within your area of interest according to your defined criteria. For example, someone working in the state of Alabama, which has few regional priority areas, may want to identify the highest

priorities within that state for conservation of recreational birding areas. This can be accomplished by adjusting the thresholds in Table 1 based on the distribution of the relevant metrics in Alabama counties (or watersheds), as shown in Figure 3.

Figure 3: Priority counties for conservation of recreational birding areas in Alabama.



Note: Criteria for priorities were adjusted based on relevant attributes of Alabama counties: the minimum birding activity cutoff for consideration as a priority was lowered from 0.5 to 0.3 birding days per capita, and the minimum proportion of birding on unprotected land was lowered from 90% to 75%.

If you wish to make more extensive changes to how priority areas are identified, such as calculating metrics at a different level of aggregation or overlaying another dataset on eBird observations, you will need to use the underlying datasets that were used to calculate the metrics in the county- and watershed-level priority datasets. The conversion table to estimate total birding days from eBird observations is available on ScienceBase, and eBird observations for specific places and time periods can be downloaded from the [eBird website](#).

These data can be used to examine spatial patterns of recreational birding activity at a finer scale than the published county-level data, which may be useful for identifying popular areas for recreational birding in a metropolitan area or another area of interest. However, this information should not be used to assess the magnitude of recreational birding activity at individual sites. Since it is dependent on individual reports and does not capture all birding activity, this information is best used at the landscape scale to consider patterns of birding activity on land of various cover types and protection status.

LIMITATIONS

This approach uses eBird observations to represent the spatial distribution of the birding activity captured in NSFHWAR, but the population that uses eBird to report birding activity may not be representative of the total population of birders captured in the NSFHWAR. This approach also assumes that the eBird points are located accurately in space and that they are representative of the habitat type in which the observation was made. eBird has several tools to help users ensure their observation points are accurately located. When using the eBird app, the observer can use their mobile phone's GPS to capture their location. Users can also enter coordinates from a standalone GPS system or select a point on a map while uploading their data to eBird. In all cases, the location selected by the user is displayed on an aerial imagery map so that the user can verify it is correct before submitting. eBird instructs users to confine each observation to one habitat type to

facilitate research linking the species seen to the observation location. eBird also encourages users to mark the location of the observation in the center of the route or search area. This should limit observations marked at the starting or ending point (which could be a parking lot or other feature of a different land cover type than the rest of the route), but it is likely that some users do not comply with these directions for all of their observations. The NLCD is based on remotely sensed data and is subject to error, especially in differentiating between certain land cover classes. Extracting the land cover class coincident with each eBird observation point will result in some misattribution due to classification errors in the NLCD.

SOURCES

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Citation

Katie Warnell. "Mapping Ecosystem Services for the Southeast United States: Conservation Priorities for Recreational Birding." NI MB 19-02. Nicholas Institute for Environmental Policy Solutions, Duke University.

Dataset Citations

Warnell, K., 2019, Conservation Priorities for Recreational Birding in the Southeast United States, by County (2011): U.S. Geological Survey data release, <https://doi.org/10.21429/qh4e-mj75>.

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Acknowledgements

Thanks to Lydia Olander (Nicholas Institute for Environmental Policy Solutions, Duke University) for providing guidance and feedback on this analysis and to Christoph Hellmayr (Duke University) for assistance with the eBird dataset.

Review

This work benefited from input and feedback from members of the U.S. Natural Capital Accounting Working Group supported by the Powell Center and the National Socio-Environmental Synthesis Center. However, it has not undergone a formal review process.

This work was funded by the Department of the Interior Southeast Climate Adaptation Science Center, through grant no. G17AC00204 from the United States Geological Survey. Its contents are solely the responsibility of the authors and do not necessarily represent the views of the Southeast Climate Adaptation Science Center of the USGS. This manuscript is submitted for publication with the understanding that the United States Government is authorized to reproduce and distribute reprints for Governmental purposes.

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Publication Number: NI MB 19-02

Nicholas Institute for Environmental Policy Solutions

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The National Ecosystem Services Partnership (NESP) engages both public and private individuals and organizations to enhance collaboration within the ecosystem services community and to strengthen coordination of policy and market implementation and research at the national level. The partnership is an initiative of Duke University’s Nicholas Institute for Environmental Policy Solutions and was developed with support from the U.S. Environmental Protection Agency and with donations of expertise and time from many public and private institutions. The partnership is led by Lydia Olander, director of the Ecosystem Services Program at the Nicholas Institute, and draws on the expertise of federal agency staff, academics, NGO leaders, and ecosystem services management practitioners.

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