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MAPPING ECOSYSTEM SERVICES FOR THE SOUTHEAST UNITED STATES

Conservation Priorities for Open Space Recreation Access

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CONTENTS

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 Climate 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 can be 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 access to recreational open space, which is a key component of mental health and well-being. This analysis maps the supply of publicly accessible open spaces relative to where people live. Regional priority areas for the creation of new open space through conservation are identified based on a metric representing the number of people who would benefit from new recreational open space if it were created in that area. Spatial datasets for these priority areas and associated metrics are available on ScienceBase.

INTRODUCTION

Publicly accessible open spaces provide valuable opportunities for people to exercise, play, socialize, and build community (Giles-Corti et al. 2005; Mowen et al. 2007). People are more likely to use public open spaces that are near (ideally within walking distance) to their homes (Dunton et al. 2013). While larger open spaces may provide more diverse opportunities for recreation, even small "pocket parks" can be important venues for recreational activity, especially if they have attractive amenities (Cohen et al. 2014). The specific amenities and facilities an open space provides (walking trails, playgrounds, athletic fields, etc.) are important determining factors of parks' use (Kaczynski et al. 2008).

To assess the spatial distribution of access to recreational open space in the southeastern United States, we constructed an index of open space access based on the size of the largest publicly accessible open space within 10 miles of each point on the landscape. We used three distance categories to represent whether people can reach the open spaces by walking (within 0.5 miles), via a short drive (within 3 miles), or via a longer drive (within 10 miles). Specific amenities within open spaces were not included in the access index due to lack of data. Using the open space access index, we identified regional priority areas at the county and Census Block Group scales based on the number of people who would have increased access to open space (within the three distance categories) if new open space were created within those areas.

METHODS

Open Space Access Index

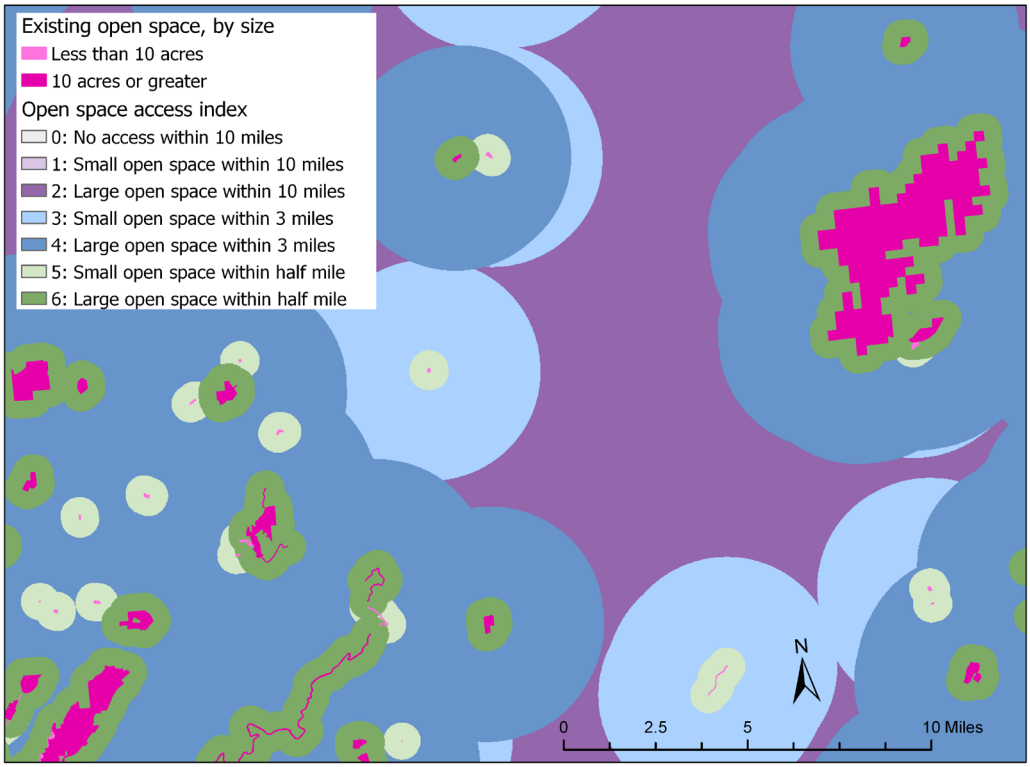
The open space access index is calculated on a 30-meter grid for the 11-state study area based on the distance from each pixel to publicly accessible open space and how large that open space is.

We combined the Protected Areas Database of the United States (PAD-US) with the ParkServe database to identify existing publicly accessible open space. PAD-US is a national dataset of protected lands, compiled from many different sources. While it includes an "access" attribute that identifies whether land is open to the public, has access restrictions, or is closed, we found that many areas open to the public are classified as closed, restricted, or unknown in PAD-US. This was especially true of federally owned lands (national wildlife refuges, national forests, etc.) and privately-owned parks and nature preserves (e.g., those owned by land trusts). Therefore, we did not use the access attribute to identify publicly accessible land within PAD-US. Instead, we included all PAD-US lands in the open space layer except for marine protected areas and Mississippi 16th section public school trust lands, which are state-owned lands managed by local school boards and leased for various uses to generate revenue (State of Mississippi Secretary of State 2019). These are identified as open access in PAD-US but are not actually open to the public. This inclusive approach overestimates access to open spaces in some areas due to the inclusion of land that is not actually open to the public.

The ParkServe database is a national dataset of public parks within Census "places." It was compiled through communication with local governments and satellite photos. While ParkServe is an excellent database of public parks, its limited geographic coverage makes it less useful for classifying access to open space in rural areas. We included all ParkServe parks in the open space layer.

We created three different distance buffers (0.5, 3, and 10 miles, corresponding with walking distance, short driving distance, and longer driving distance) around each of the open space polygons and used these to identify the size of the largest park within each distance class at 30-meter resolution for each pixel in the study area. From these, we created the final index of access to open space, with 0 representing areas with no access to open space within 10 miles and 6 representing areas within walking distance of open space larger than 10 acres (Figure 1).

Figure 1: Example Area Showing Publicly Accessible Open Spaces (Pink) and the Open Space Access Index.



Priority Areas for New Open Space Creation

The open space access index could be used by itself to identify areas with low access to open spaces, which may be good candidates for creating new open space. However, to identify the best areas in which to create new open space, it is necessary to know the number of people who would benefit from any newly created open space. For this analysis, we define people who benefit from new open space as people who do not currently have access to open space within a certain distance threshold (e.g., 0.5 miles) but live within that distance of the newly created open space.

To identify priority areas for new publicly accessible open space based on the number of people who would benefit from that new open space, we combined the park access index with a 30-meter dasymetric population layer (Enviroatlas) (Figure 2). First, we created three "no access" population rasters, which include population data for cells that have no access to open space within the three distance classes (less than 0.5 miles, 0.5–3 miles, and 3–10 miles). For example, the "no access 0.5 mile" layer includes the population for all pixels that are not within 0.5 miles of publicly accessible open space (Figure 2b).

Next, we used focal statistics to create three "benefit" rasters, one for each distance class, that represent the total number of people who currently do not have access to open space within that distance class and are within that distance of the focal pixel, so that they would have access to new open space created on that pixel. For example, the "benefit 0.5 mile" layer shows the number of people within 0.5 miles of each pixel who are currently not within 0.5 miles of open space—in other words, the number of people who would gain access to open space within 0.5 miles if open space were created on that pixel (Figure 2c).

Figure 2a:

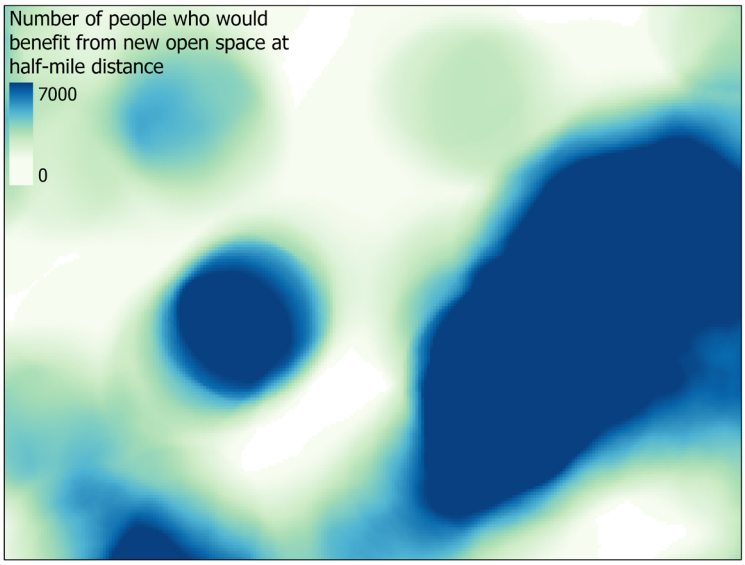
Open space access index for example area in Atlanta suburbs

Figure 2b:

"No access" population raster for the 0.5-mile distance class. This map shows the number of people estimated to live in each pixel that is not within a half mile of existing open space. Gray pixels are within a half mile of existing open space, so the population for these areas is not shown.

Figure 2c:

Benefit raster for the 0.5-mile distance class. This maps shows the number of people who would gain access to open space within a half mile of their homes if new open space were created on each pixel. Dark blue areas are places where creating new open space would benefit the most people, in terms of providing park access within a half mile of their homes.



We used these benefit layers to calculate the mean number of people who would benefit from new open space created on a random pixel within each county and Census Block Group, for each distance class (Table 1). Creating new open space in counties and Census Block Groups with higher means would result in greater benefits in terms of the number of people with increased open space access. Using the mean for a county or block group (instead of, for example, the maximum number of people who would benefit from open space created in a particular location within the county or block group) puts less emphasis on the specific location of potential open space. This was necessary because we could not incorporate information on current land use and ownership (e.g., vacant city-owned parcels would be good candidates for new open space) into the regional-scale analysis.

Table 1: Summary of the Number of People Who Would Benefit if New Open Space Were Created on a Random Pixel within the County or Block Group, at Each Distance Class.

	Mean number of people who would benefit if new open space were created on a random pixel within the county or block group. Minimum – maximum (median)	
Distance class	**County**	**Census block group**
Half mile	0.5 – 929.5 (30.7)	0 – 13,328.5 (126.2)
3 miles	0 – 1,907.2 (219.8)	0 – 12,257.9 (0)
10 miles	0 – 6,605.9 (0)	0 – 9,722.5 (0)

To identify regional priority counties and block groups for creating new open space, we combined the mean number of people benefitting within each distance class. First, we standardized the benefit scores within each distance class to a 0 to 1 scale, by dividing the number of people benefiting in a given county (or Census Block Group) for a certain distance class by the maximum number of people benefiting across all counties (or Census Block Groups) for that distance class (e.g., to standardize the county-level benefits for the half-mile distance class, all county values were divided by 929.5). This prevents the higher absolute numbers in certain distance classes (especially at the county level of aggregation) from dominating the average scores. For each county and block group, we averaged the standardized scores for each distance class to get an overall "benefit score." The top 10 percent of geographic areas of each type (county and Census Block Group) were considered priority areas for new open space creation.

LARGE-PARK ONLY ANALYSIS

The American Planning Association recommends that open space be at least 10 acres to provide meaningful recreational opportunities (APA 2018). Therefore, we repeated the above analysis excluding existing parks less than 10 acres in size, to provide information for organizations that are following American Planning Association guidelines. These versions do not count a location as having access to open space within a given distance class (0.5, 3, and 10 miles) unless it is within that distance of open space of at least 10 acres. The resulting large-park open space access index has fewer classes than the original (because classes are only for distance from parks and are not also separated by park size) (Figure 3). Benefit scores were calculated from the large-park open space access index and a dasymetric population layer as described above. The top 10 percent of geographic areas of each type (county and Census Block Group) based on this benefit score were considered priority areas for new large (10 acres or greater) open space creation.

DATASETS AND USE

County-level and Census Block Group-level datasets for the southeastern U.S., identifying regional priorities for both versions of the analysis (all parks and large parks only) are available on ScienceBase. The priority conservation counties or Census Block Groups can be used to identify where, at the regional level, the creation of new publicly accessible open space through conservation will provide the greatest benefit in terms of the number of people who would gain increased access to open space. These can also be overlaid with other data sources at the appropriate scale, including other ecosystem services maps, to find areas where conservation or restoration would provide multiple benefits.

The additional fields in the county- and Census Block Group-level datasets have the necessary information to make slight changes to the identification of priority conservation areas. For example, if you are particularly interested in enhancing people's ability to walk to open space, you may wish to only consider the number of people who would gain access to open space within the half-mile distance class when identifying priority areas (Figure 4).

Figure 4a:

Regional county-level priorities for new open space based on combined benefit score for three distance classes

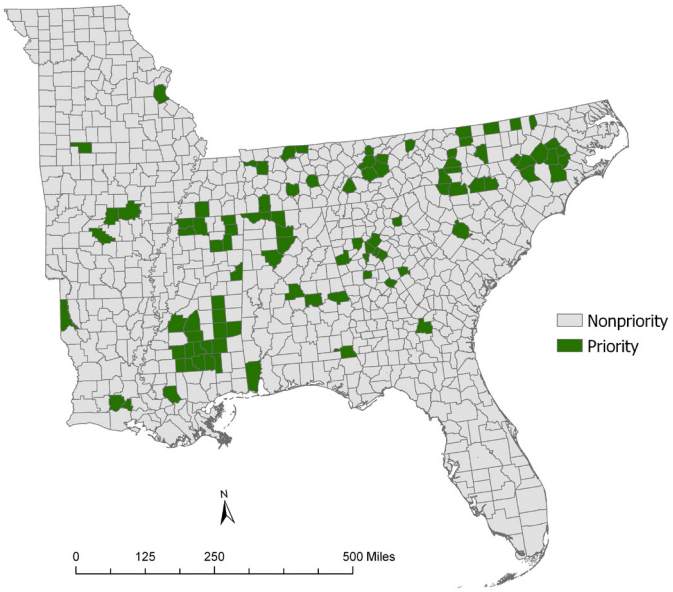
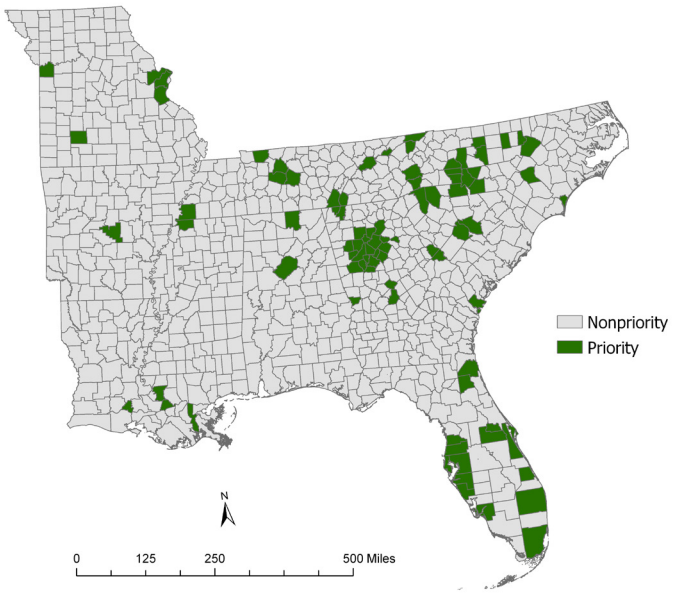


Figure 4b:

Regional county-level priorities for new open space based on half-mile benefit only



If you wish to make more extensive changes to how priority areas are identified (e.g., a different boundary type), you will need to work with the underlying data used to calculate the metrics in the county- and Census Block Group-level priority datasets. These data are available on ScienceBase and include:

- Open space access index (30-meter resolution)—all parks and large parks only versions
- Benefit rasters (30-meter resolution)—all parks and large parks only versions

When using these data, please keep in mind that they are designed for landscape-level assessments. Due to inaccuracies in the national-scale input datasets, they should not be used to identify specific locations for new open space.

LIMITATIONS

As noted above, the current open space data used in this analysis likely overestimates the amount of publicly accessible open space because it includes almost all of the protected areas in PAD-US, even though some of them are not open to the public. It would be ideal to incorporate additional information about existing open space, such as specific amenities, to understand variation in open space quality. Because that data is unavailable, park size (greater than or less than 10 acres) was used as a rough proxy for park quality.

The benefit analysis (identifying the number of people who would benefit from new open space being created at a certain location) was conducted at the 30-meter pixel level, but new open space would most likely encompass multiple pixels. Therefore, the benefit score of an individual pixel may underestimate the number of people who would benefit from new open space created in that area. However, adjacent pixels benefit many of the same people, so the number of people benefiting or benefit scores from multiple pixels cannot be added together.

This analysis does not incorporate information on existing land use or land ownership that could indicate what areas might be suitable for creating new open space.

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DATASET CITATION

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Nicholas Institute for Environmental Policy Solutions

The Nicholas Institute for Environmental Policy Solutions at Duke University is a nonpartisan institute founded in 2005 to help decision makers in government, the private sector, and the nonprofit community address critical environmental challenges. The Nicholas Institute responds to the demand for high-quality and timely data and acts as an “honest broker” in policy debates by convening and fostering open, ongoing dialogue between stakeholders on all sides of the issues and providing policy-relevant analysis based on academic research. The Nicholas Institute’s leadership and staff leverage the broad expertise of Duke University as well as public and private partners worldwide. Since its inception, the Nicholas Institute has earned a distinguished reputation for its innovative approach to developing multilateral, nonpartisan, and economically viable solutions to pressing environmental challenges.

National Ecosystem Services Partnership

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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