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A framework for mapping cultural resources in landscape conservation planning

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Abstract

Cultural resources can be an important means of connecting people to conservation efforts. Currently, it is difficult to identify and map these tangible and intangible aspects of the landscape. We propose a framework to include cultural resources in spatial conservation planning that acknowledges the different scales of importance and management of sites. Through categorizing and mapping sites of national, state, local, interest group, and community management, cultural resources can be measured and included in existing planning tools. Data on cultural resources are a primary limitation due to availability and fragmentation. Until data sources improve, our framework provides a stopgap that allows for cultural resources to be included in conservation-planning efforts.

KEYWORDS

conservation planning, cultural landscapes, cultural resources, mapping

1 | INTRODUCTION

Determining conservation priorities at the large-landscape level requires the integration of both biological and social knowledge (Balmford & Cowling, 2006; Ban et al., 2013; Karimi, Tulloch, Brown, & Hockings, 2017). Cultural resources are an important social component of the landscape and can be an integral part of landscape level conservation planning (Satterfield, Gregory, Klain, Roberts, & Chan, 2013). These assets represent the connection between people and the places where they live, work, and recreate. They also represent the connection between today's society and the people and events of the past. The tie to place and history can be a strong motivation for land protection and stakeholder involvement in conservation planning, but is often neglected in planning efforts (Bryan, Raymond, Crossman, & Macdonald, 2010). This general omission is due to the difficulty in identifying cultural resources and their relative importance across the larger landscape (Chan et al., 2011). In this article, we propose a framework for mapping cultural resources that is efficient and effective at incorporating cultural resources as social characteristics in planning tools and present a case study to illustrate its use.

To date, efforts in the United States to include cultural resources in landscape-scale conservation planning have primarily focused on mapping significant locations such as historical sites and structures (Natural Resources Conservation Service, 2016; South Atlantic LCC, 2016). Initiated as a result of the National Historic Preservation Act of 1966, the locations of registered historic sites, structures, and districts have been mapped through the National Register of Historic Sites program, with this database maintained by the U.S. National Park Service (NPS) (National Park Service, 2017). These historic places are seen to embody significant elements of the nation's culture and offer a connection between the past and present (National Park Service, 2002).

However, this approach maps only one dimension of cultural resources, sites, and objects deemed of "significance in American history" (National Park Service, 1995). Cultural resources also include both tangible and intangible aspects of place, which contribute to identity, culture, and economies, and may vary on the geographic scale and importance from the local level to the national (Page, Gilbert, & Dolan, 1998; Schaich, Bieling, & Plieninger, 2010). Because of their intangible and variable nature, mapping the full array of important cultural resources across a landscape has been proved to be a difficult task (Tengberg et al., 2012).

Efforts to quantify and map cultural resources, including more intangible elements and local perspectives regarding the range of values assigned to specific parts of the landscape, have been attempted in different ways. Techniques have ranged from hand drawn maps to focus groups and the use of volunteered data.

Incorporating local knowledge and values has been an important part of including stakeholders in conservation planning. Cultural mapping has been used in identifying indigenous territory (Nietschmann, 1995), identifying cultural diversity and values (UNESCO, 2017; Young, 1995), and in recording cultural knowledge (Cook & Taylor, 2013; Ngāi Tahu Archive Team, 2018). This work incorporates often omitted local knowledge about important places and values, but requires intensive effort to involve stakeholders and build relationships of trust. Additionally, the focus is often on identifying the cultural resources of a particular stakeholder group and not a wide variety of groups at once.

An effort in the US to map both ecological and human values associated with specific geographies and communities of people, and hence potentially identify cultural resources, was the Greater New Haven Watershed Project (Kellert, 2012). This study quantified resident opinions through survey research and linked values associated with specific geographic locations, general environmental values, and environmental features and attributes such as water quality (Kellert, 2012).

Another approach to mapping the values associated with specific geographic locations is Public Participatory Geographic Information Systems (PPGIS) (Brown, 2004). The method seeks to incorporate public input in land management decision-making by identifying locations within a geographic region that have nonconsumptive and more intangible values, such as intrinsic, spiritual, recreational, historic, or sense of place values (Brown & Kyttä, 2014; Brown & Raymond, 2007). PPGIS has been used for assessing public lands (Sherrouse & Semmens, 2014), national parks (van Riper, Kyle, Sherrouse, Bagstad, & Sutton, 2017), and sense of place (Lowery & Morse, 2013).

More recent approaches to measure cultural importance have focused on using user-created data such as photos. By mining photo-sharing services (e.g., flickr.com or panoramio.com), thousands of digital photos can be retrieved and used as a proxy for important places (Figueroa-Alfaro & Tang, 2017). Through analysis of the information attached to photographs, such as keywords or descriptive text, aspects of value can be extracted. This "big data" approach can aggregate the input of large populations to highlight locations of value, such as scenic or recreation. Despite the efficiency of using these services, they tend to represent visitors more than local residents and are susceptible to changes that affect future use (i.e., changes in terms of use or discontinued availability [www.panoramio.com])(Murdock, 2011).

The existing methods can capture the cultural values and important places of local groups through maps, providing spatial information to use in planning efforts. While they incorporate detail, they can be time and resource intensive, with the validity and generalizability of the results dependent upon the composition of the sample (Brown & Fagerholm, 2015; McLain, Banis, Todd, & Cerveny, 2017). These approaches are, therefore, better utilized to assess smaller geographic locations and are not as applicable in the context of large-landscape efforts that require methods more appropriate to the scale of an ecoregion. This leaves a gap between detailed local data from specific stakeholder groups and the need for consistent and efficient data on cultural resources across an ecoregion.

2 | PROPOSED MAPPING FRAMEWORK FOR CULTURAL RESOURCES

How could cultural resources be efficiently incorporated into a large-landscape conservation-planning effort, particularly in the USA? For a method to identify cultural resources on a multistate scale, it must provide both the geographic location of cultural resources as well as a consistent and replicable assessment of the relative value of these resources. To identify and value cultural resources, we propose using a classification framework similar to that used by the Gap Analysis Program (GAP) and the International Union for Conservation of Nature (IUCN) Protected Areas Categories to classify land stewardship (Dudley, 2008; Jennings, 2000). Both the IUCN and the GAP program aim to assess the level of protection that exists for different protected areas across the landscape, while seeking to provide a consistent and cost-effective means of assessing the management and protection level of biodiversity over large geographic areas (Scott et al., 1993). This matches our aims for assessing cultural resources in the conservation-planning context across ecoregions and in an efficient manner.

Like the GAP and IUCN efforts, our proposed framework focuses not only on identification of local, state, and

national cultural resources broadly defined, but also on measurable distinctions of designation and management as an indicator of the cultural values of that place. The mapping framework serves as a coarse filter of cultural resources, in the way that the GAP serves as a coarse filter for biodiversity (Noss, 1987; Scott et al., 1993). Identifying spatially explicit resources of value to different audiences, from the national to the local, can also serve to identify more ambiguous cultural resources across the landscape. This cultural resources mapping framework, therefore, accounts for the relative importance of cultural resources to local, state, and national interests and avoids difficulties that might arise from attempting to reconcile the varying valuation of importance that different groups hold for particular places. This approach would also allow for the identification of resources beyond those cataloged within the National Register programs. By considering different levels of designation and stewardship, places of state and local cultural value could be accounted for as well.

2.1 | Cultural resource stewardship categories

Our framework includes specific geographic locations that have a use designated by a community, interest group, local, state, or national agency. Classification of sites would be based on the agency or group that manages the physical site, moving from the national level down to the community (Figure 1). This approach seeks to capture the multiple spatial scales of cultural resources that mirror the different spatial scales of biodiversity (Poiani, Richter, Anderson, & Richter, 2000). The assigned level of management is an indicator not of the overall value of a cultural resource, but rather is seen to indicate the particular public that the site is important to, from the national to the local stakeholders. Sites included would be lands that are considered public or semipublic (i.e., have a relationship with the public), and allow public access or are visually accessible to the public (e.g., lands that contribute to scenic landscape). This wide array of potential cultural resources would, therefore, also account for a range of values including Recreation/Tourism, Spiritual/Religious, Aesthetic/Scenic, and Heritage/Historic values (Brown, 2004; Millennium Ecosystem Assessment, 2003).

The proposed framework is conceived within the US context, but could be applicable in other regions. In the US, tribal lands function under the national government and would be classified in the "State" category. In other counties, indigenous lands could be categorized as "Local" if managed at the

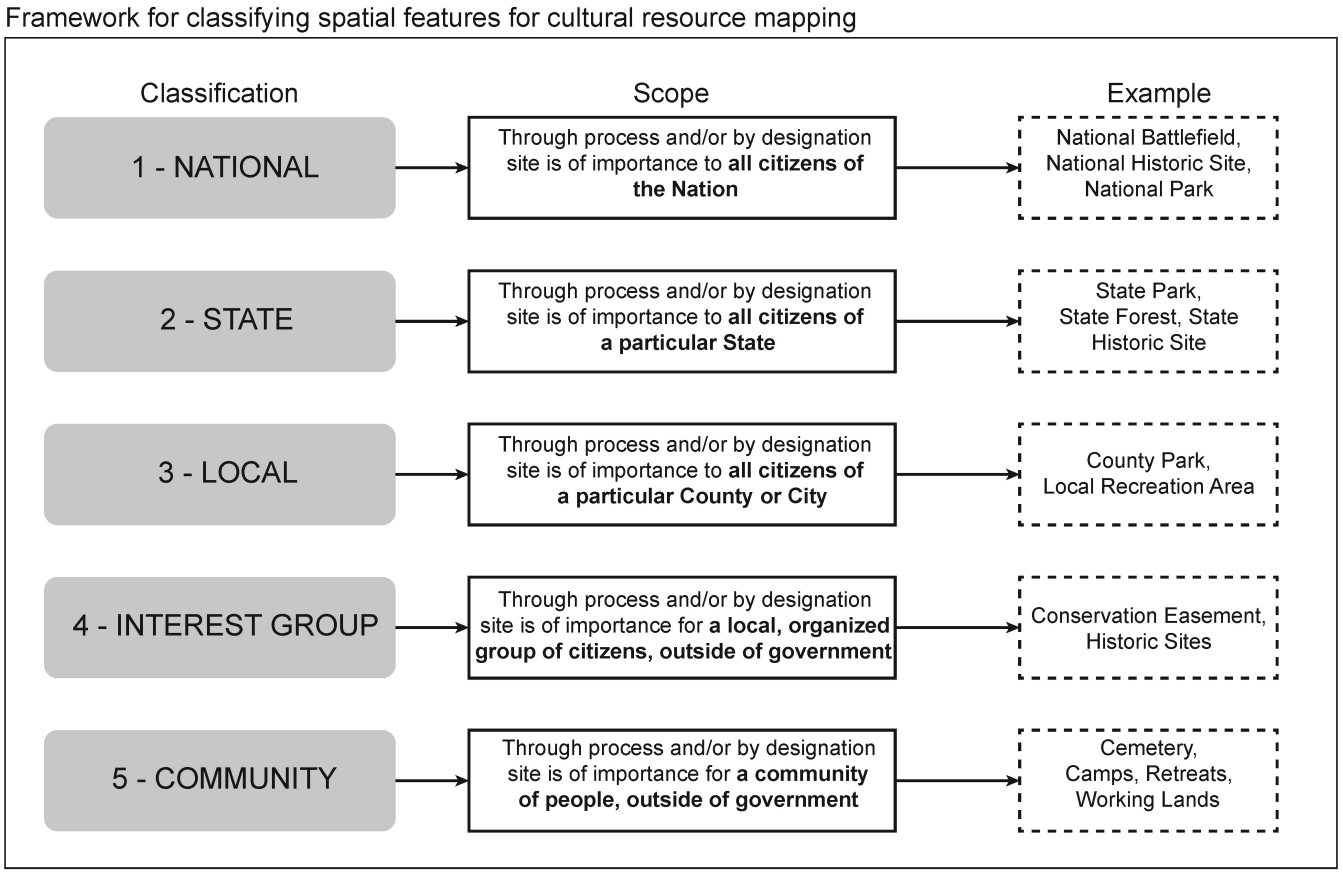

FIGURE 1 Conceptual approach for classification of cultural resource importance, based on management of site and scope of stakeholder audience

village level, or "State" if managed on a large scale. The framework could also account for other formal or informal land designations if data were available by considering a group's assigned values, designation, and management.

This framework allows for cultural resources to be integrated into large-scale spatial planning efforts. State, local, and community resources would be included to enrich the existing national level data, and thus create a more representative picture of places important to the people and culture of a region. This data-centric approach could be replicated by agencies that face resource constraints and would avoid more intensive methods of assessing cultural resources.

3 | CASE STUDY EXAMPLE

To illustrate how this framework might be implemented, we created a Geographic Information System (GIS) cultural resource layer for the 14 county area around Chattanooga, TN. The city lies within the Tennessee River Basin, a key ecological area within the landscape-level conservation-planning effort we were working in (the Appalachian Landscape Conservation Cooperative) (see Figure 2). Additionally, Chattanooga has a number of significant historical and cultural sites.

3.1 | Methods

The aim of the case study was to compile relevant spatial data that could be collected from publicly accessible data sources. Data collection began with the National Register of Historic Places as this dataset has formed the basis of other cultural resource measures (South Atlantic LCC, 2016; Southern Appalachian Vitality Index, 2016). In addition, spatial data were collected from various state-level agencies in Tennessee, as well as Federal-level agencies related to recreation and scenic values (i.e., Protected Areas Database [US Geological Survey, 2016]). Data were also used that are provided by Esri, Inc., which included features such as local parks, institutions, and cemeteries (Esri, 2015). Interest group data sources included the National Conservation Easement Database (The National Conservation Easement Database, 2015) (see Table 1 for data sources).

Agricultural lands, representing working lands and small farms, can play a part in both local economies and the visual aspects of the landscape. For this case study area, small family farms have been historically important and are part of its contemporary rural character (The Land Trust for Tennessee, 2018). These lands are not managed by one agency or group, but are influenced by community decisions regarding land use and contribute to the culture of a place and its visual character. To capture this component of community culture, lands that were classified

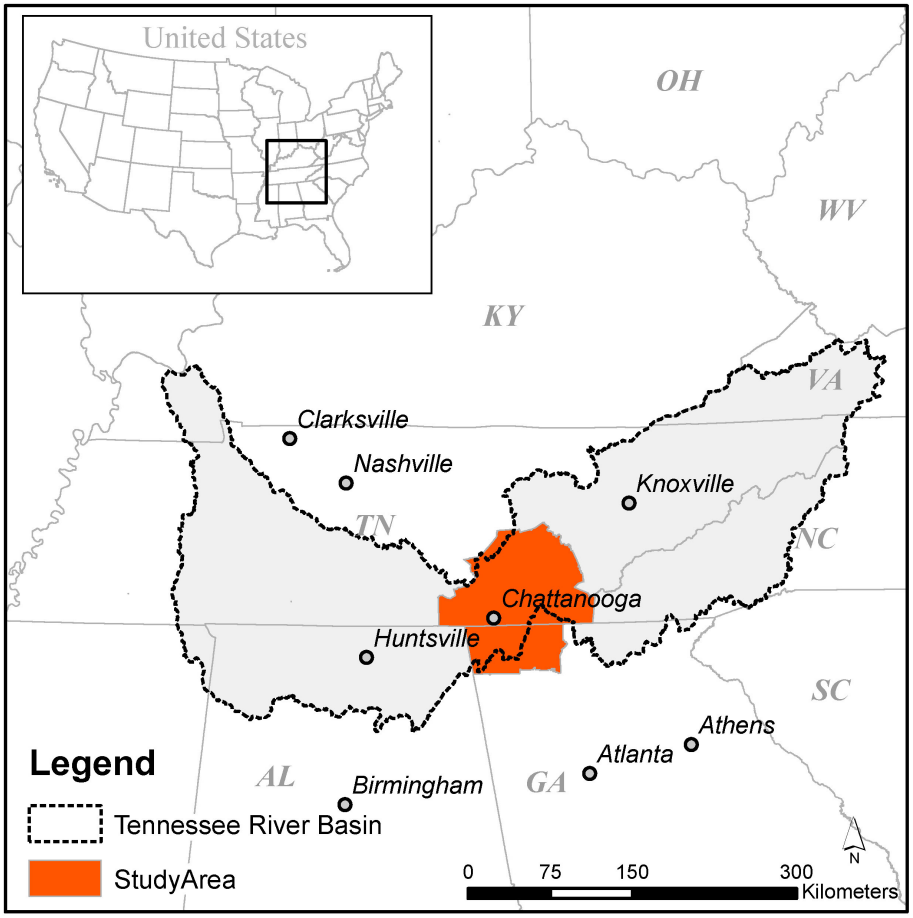

FIGURE 2 Location of the cultural resources mapping framework case study area, Chattanooga, TN

TABLE 1 Data provider, source, and spatial layers for cultural resource features used in the case study area of Chattanooga, TN

Data provider	Source	Layers
Tennessee GIS Data Server	tngis.org	Background data for state (county and city boundaries), state parks and natural areas, scenic rivers
University of Tennessee at Chattanooga	geoportal.utc.edu http://geoportal.utc.edu/webshare/	Infrastructure, recreation, open space, farm land, farmers markets
The Commission for Environmental Cooperation	https://web.archive.org/web/20150331153728/ http://www.cec.org/Page.asp?PageID=122&ContentID=2336	Terrestrial protected lands
Esri, Inc.	Data and maps collection	Cultural data- USA parks (federal, state and local), state lands, State Park Forest, community institutions
The Nature Conservancy	www.tnclands.tnc.org	TNC lands in Tennessee and Georgia
Land Trust for Tennessee	landtrusttn.org	Land trust properties
National Conservation Easement Database	Conservationeasement.us	Conservation easements
National Park Service	irma.nps.gov	National Register of historic places, National Parks
USGS	gapanalysis.usgs.gov/padus/	Protected areas database—PAD-US 1.4
Tennessee Historical Commission	https://tnmap.tn.gov/historicalcommission/ https://www.arcgis.com/home/item.html?id=fa1485bb27ad4b47a070483371a42857	Historical sites and properties
Tennessee Valley Authority	https://hub.arcgis.com/items?tags=TVA	Developed and undeveloped recreation sites
United State Department of agriculture (USDA), National Agricultural Statistics Service (NASS)	http://nassgeodata.gmu.edu/CropScape/	Agricultural lands
Tennessee Wildlife Resources Agency	https://www.tn.gov/twra/gis-maps/download-data.html	Hunting lands

by the USDA National Agricultural Statistics Service as in agricultural production were isolated (National Agricultural Statistics Service, 2016). The percentage of each analysis unit in agricultural use was then calculated and added to the community category.

We cleaned and verified the datasets to avoid duplicate spatial features and then organized features according to the proposed categories. All of the features were then mapped and analyzed within a 1 km^2 hexagonal grid across the study area. Hexagons were chosen as this was the unit of analysis for the larger conservation-planning effort we were working within (Leonard, Baldwin, & Hanks, 2017).

The number of cultural resource features present within the analysis hexagons was aggregated at each level of the framework to determine a cultural resource score that could serve as a surrogate for the amount of cultural resources across an area. A method was explored for aggregating cultural features that would capture the diversity of cultural features, based on the framework. A Cultural Resource Diversity Index was calculated according to Simpson's Index of Diversity, a familiar means of determining species diversity in the field of ecology (Simpson, 1949). Subtracting Simpson's Index from 1 produces a measure of the diversity of cultural resource types within an analysis hexagon, with 0 equal to no diversity (all one type of feature) and 1 equal to perfect diversity (equal amounts of all feature types). The formula for the Cultural Resource Diversity Index would be

$$1 - \sum_{i=1}^{s} \left(\frac{p}{N}\right)^2,$$

where p is the number of category features in the area, N is the total number of features in the area, and s is the number of categories.

3.2 | Results

The number of features identified across the study area is shown in Figure 3, showing the Community and State categories

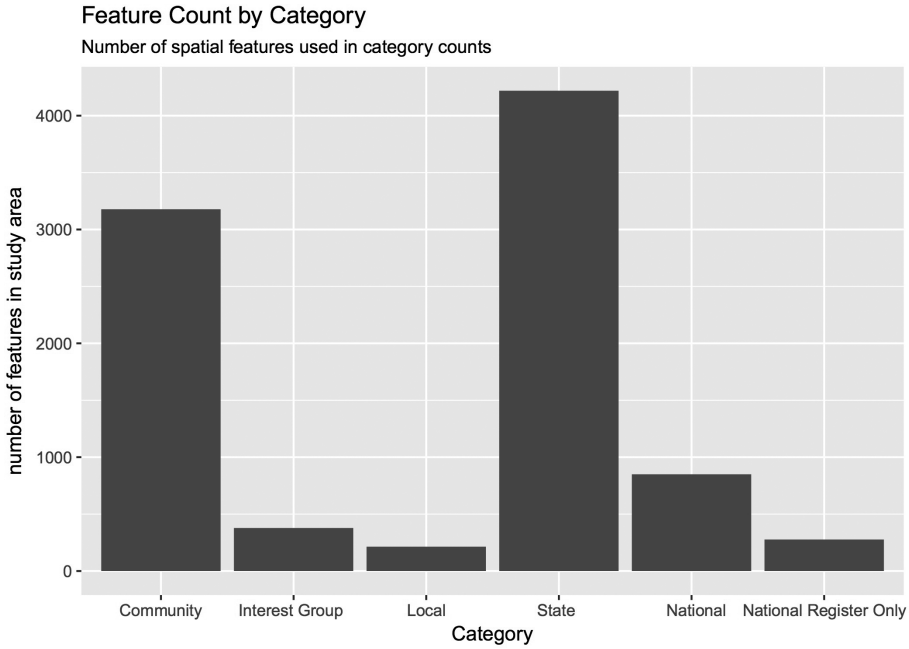

FIGURE 3 Count of all spatial features in the study area by cultural resources category

containing the largest number of cultural resources. Descriptive statistics for the counts found in the analysis hexagons are provided in Table 2. The greatest representation was at the State level (mean of 0.62 features per hexagon) and the least at the Local level (mean of 0.04 features per hexagon).

Creating an index of cultural resources diversity provided information for 97% of hexagons in the study area (see Figure 4). The range of the index was from 0 to 0.765, with a mean of 0.114 and a standard deviation of 0.177. The mean would indicate that if two features were selected from an analysis hexagon there would be, on average, a 11% chance of them being from different categories. The values of the diversity index are mapped in Figure 5.

3.3 | Issues and data gaps

The accuracy of the input datasets used in the case study varied, with some layers containing more detail than others.

TABLE 2 Summary statistics for the count of cultural resource features in analysis of hexagons across the study area of Chattanooga, TN

	Count of features in analysis hexagons			
Category	**Mean**	***SD***	**Min**	**Max**
Community	17.30	20.10	0.0	95.9
Interest group	0.14	0.79	0.0	30.0
Local	0.04	0.32	0.0	10.0
State	0.62	3.72	0.0	155.0
National	0.69	1.51	0.0	21.0
National register	0.29	1.51	0.0	49.0

Additionally, there were features repeated between some datasets, such as large parks or state and national forests. When aggregating features from the different categories of cultural resources, duplicated features were removed if they represent the same resource at the same category to avoid inflating counts. This task is straightforward if the duplication is obvious but may prove difficult for smaller features in an ecoregion.

The datasets used were taken as being accurate, without effort made to verify individual features. Some databases are known to contain discrepancies between the shape of the designated area and the representation within the spatial data (National Park Service, 2017). As these data sources are viewed as the standard within their domain, for example the National Register of Historic Places, we did not correct features that may have appeared simplified or incorrect on the map.

Data may also be missing in the sources due to the intentional restriction of information on sensitive historic or archeological sites (Hitchcock, 2006). To ensure protection of sites, information such as location may be censored or simply not provided by historic protection agencies under the National Historic Preservation Act of 1966.

Some current gaps in the data are being addressed through ongoing digitizing efforts. The Tennessee Historical Commission, source for state historical data, is continually adding features as they are processed from paper documents (Tennessee Department of Environment and Conservation, 2013). Local park data for many urban areas are being compiled by the Trust for Public Land and will be added to the Protected Area Database—US (PAD-US) in the future (The Trust for Public Land, 2016; US Geological Survey, 2016).

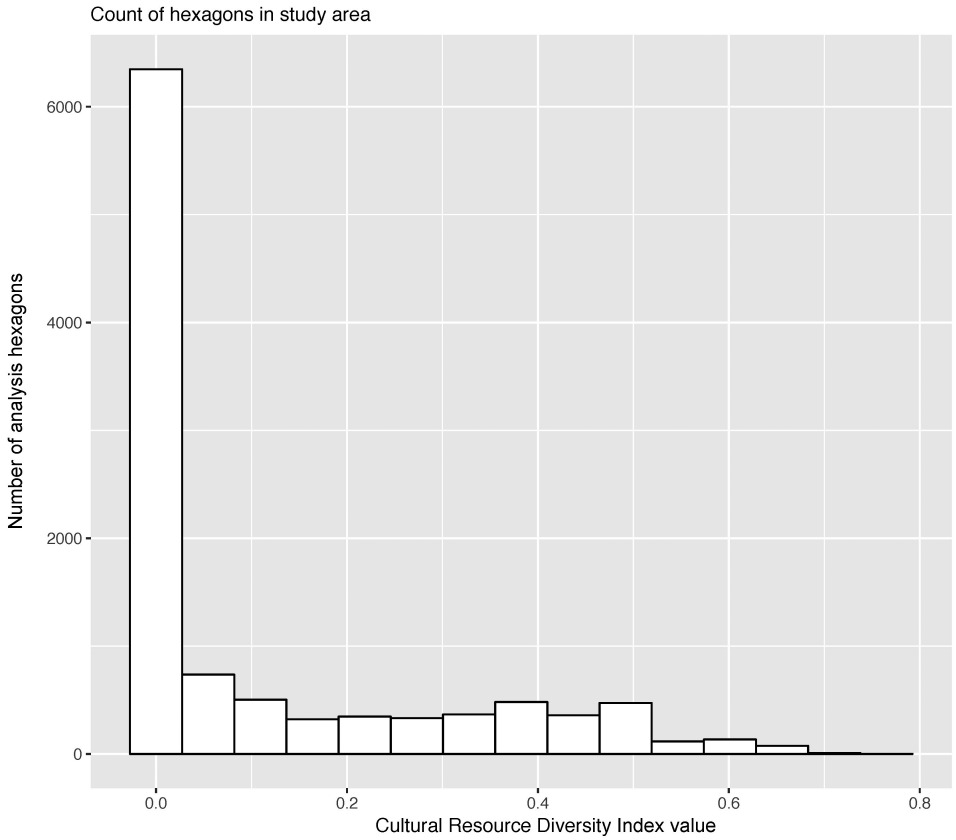

FIGURE 4 Histogram of cultural resource diversity index values identified in analysis hexagons

In this case study, our framework resulted in a higher numbers of features for Community and State categories, with lower representation in the Interest group and Local categories (Figure 3). While identifying all features existing in an ecoregion would defeat the aim of the framework to be efficient, categories with lower counts can point to potential data gaps. These categories could then be examined to see if there are datasets that could be included or if the lower values are representative of the region.

The case study illustrates that data may include gaps or discrepancies across the categories. For example, we encountered many broken links for data from State environmental agencies. While these data were found elsewhere, this may not always be the case. Necessary datasets most likely exist within various organizations but would require inquiry to obtain. Across multiple states, it is possible that there will be inconsistent availability of data that will require communication with the appropriate agencies to acquire.

4 | DISCUSSION

Our cultural resources framework interprets management policy decisions as a proxy for the values assigned to sites across the landscape by different audiences. This serves as a surrogate for cultural resources, just as surrogates are identified for biodiversity in existing conservation plans (Margules & Pressey, 2000). While analogous to methods of protected area classification (i.e., GAP Analysis), this cultural resource approach differs in its multiscale focus and in its attempt to represent less-tangible characteristics of the landscape, such as places of recreational or spiritual value.

In assembling the necessary inputs there will likely be variations in data availability, especially at the more local levels. Across ecoregions, there may be more searching or even creation of datasets required to reach consistency at each classification level. Data on cultural resources are currently very sparse as compared to biodiversity data (i.e., NatureServe, National Gap Analysis Project, Global Biodiversity Information Facility). The data that do exist are fragmented across numerous agencies and nonprofit groups, with varying levels of completeness. Our framework can serve as stopgap to begin including cultural resources in the planning process until better cultural data are available in the future.

We found it was possible to construct a cultural resources data layer that could be integrated into a conservation-planning process. Most study units in our case study had some level of cultural features as defined by our multiple categories of management. The measure of resources was found to occur beyond areas just around cities, with the diversity index showing a spectrum of cultural resources.

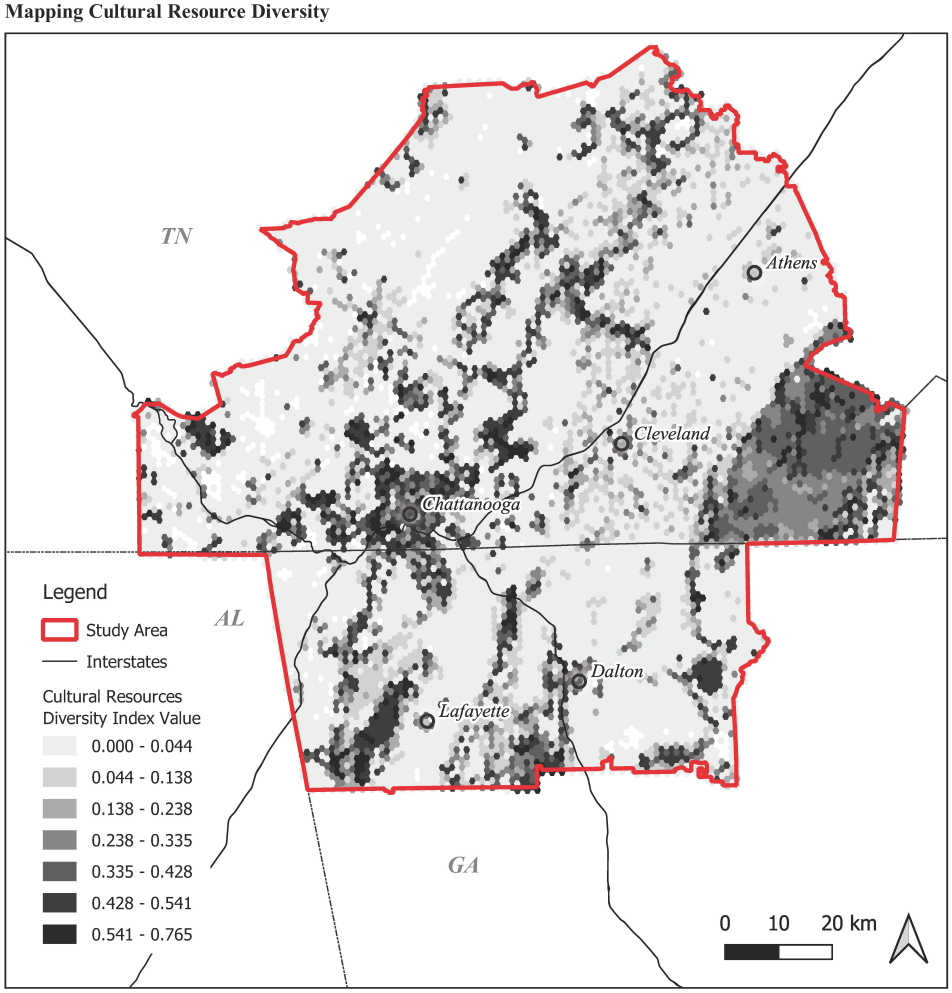

FIGURE 5 Map of study area with application of the cultural resources mapping framework using the cultural resources diversity index

The intensity of these features coincided with areas of human settlement and activity across the region. In the ridge and valley landforms around the Chattanooga case study, this manifests in lower elevation areas where people have historically lived and worked.

Our method does have some limitations, primarily regarding the data inputs to the process. The availability of data on the different types of landscape features is likely to be inconsistent across the large multistate areas that make up ecoregions in the USA. Considering the many actors who produce data, identifying the appropriate inputs will vary from region to region. Also, using stewardship as a proxy for values limits the inclusion of places that might contribute to regional culture but are not accessible to the general public. Site stewardship serves as a coarse filter for cultural resources and will not directly capture detailed cultural aspects, such as symbolic meaning that landscapes might hold for communities. The benefits of the proposed method of measuring cultural resources come from its greater coverage, avoidance of more relativistic valuation of places, and greater efficiency in data collection.

This cultural resources framework captures characteristics of the landscape that would be omitted if only focusing on mapping species habitat. If included into conservation models, this information can indicate value in areas outside of traditional protected lands. We found a wide range of features that could be classified according to our approach. Compared to just using features of the National Register programs, our method would extend the scope of cultural resources to capture local and community places.

Existing methods of capturing cultural resources across the landscape have used different approaches to describe the values people hold for the land they live on. These techniques provide geographic attributes to history, social conditions, and values, allowing for this information to be used in planning tools. While existing tools begin to enrich the cultural resource aspect of conservation planning, individually they have been too limited in scope or scale. The proposed method seeks to build on previous ideas about cultural resources and to provide a means of capturing multiple scales and meanings through techniques that are feasible for the conservation-planning process.

Practitioners and policymakers can use the outputs of our method to identify areas of cultural resources in an ecoregion and visualize the spatial distribution of those resources. The outputs can also be incorporated by planners in modeling tools that are used to establish conservation priorities (Leonard et al., 2017). The additional information from the framework can highlight areas where cultural resources and biodiversity overlap or are proximate, helping to identify where biodiversity value might be aligned with cultural value. In allowing for cultural resources to be included in conservation planning as a social component of the landscape, the framework can help in recognizing lands for protection outside of "high and far" characteristics (Joppa & Pfaff, 2009; Scott et al., 2001).

Future work on mapping cultural resources could focus on issues of data management, data sources, and on methods of incorporating the outputs into modeling processes. Identifying and developing the data used in the framework will require attention to detail to ensure quality inputs from the many sources within a region. Additional datasets, such as surveys or cultural events, could be considered for inclusion as they are developed and available across ecoregions. We have proposed a method of calculating cultural resources diversity for analysis areas, but there may be better techniques to develop that fit into existing or future conservation-planning tools.

Determining conservation priorities at the large-landscape level requires the integration of both biological and social knowledge (Balmford & Cowling, 2006; Karimi et al., 2017). The cultural resources of a place, region, or ecoregion currently are not included in spatial decision-making tools, despite the value that such data could add to the planning efforts (Chan et al., 2011). The aim of creating a new method of assessing and measuring cultural resources across large landscapes is to include a greater amount of the social and cultural values that people hold for places in the conservation-planning process. While it cannot capture all components that contribute to local or regional culture, by including a larger range of features this method can serve as a valuable surrogate for cultural value and allow for historic and contemporary places to play a part in the conservation of important landscapes across an ecoregion.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interests.

AUTHOR CONTRIBUTIONS

S.O. and R.P. conceived the study approach; S.O. conducted the case study and led the writing of the manuscript; S.O., R.P., R.B., and P.L. contributed original ideas, text, and references to the manuscript; and all authors reviewed, edited, and approved the final manuscript.

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