

INTEGRATING VISUAL AND CULTURAL RESOURCE EVALUATION AND IMPACT ASSESSMENT FOR LANDSCAPE CONSERVATION DESIGN AND PLANNING

Tara J. Mazurczyk, Ph.D. student, Department of Geography, The Pennsylvania State University¹

Timothy M. Murtha, Associate Professor of Landscape Architecture and Latin American Studies, University of Florida

Lacey K. Goldberg, Ph.D. student, Department of Landscape Architecture, The Pennsylvania State University

Brian Orland, Professor of Geodesign, University of Georgia

Abstract.—While there is increased need for cultural resource conservation and management in North America, there are few assessment approaches that provide robust integration of visual and cultural resources. Our research, focused on the Appalachian Landscape Conservation Cooperative region, used a model to integrate visual and cultural resources for prioritizing landscape-scale conservation. We investigated how “place” can be studied in relation to visual resources given what we know from existing cultural resource databases such as the National Register. The study measured visual quality and viewshed threats to better inform cultural resource planning and management across Pennsylvania. Prominent ridgelines and viewpoints, for example, were designated as integral features of rural and urban aesthetic character. By evaluating potential landscapes for conservation priority, we can bring awareness to important resources for public investment and encourage Federal, private, public, and business stakeholders to engage in scenic and cultural heritage conservation.

INTRODUCTION

The human imprint on the environment is extensive, complex, and often irremediable (Solomon et al. 2009, Vitousek et al. 1997). Anthropogenic activities such as energy development, urbanization, and sprawl can have negative impacts on local landscapes and, through climate change and other effects, are significantly threatening the global environment (Hooke et al. 2012, Marzeion and Levermann 2014). While visual and cultural resource values are often tightly coupled with environmental values, unless they also have some substantial economic benefit such as through tourism, there are few incentives to protect them (Taylor 2011, Throsby 2003). As a result, visual and cultural resources may lack a competitive edge when pitted against economically driven natural resource projects such as material extraction.

Fortunately, visual and cultural resources are becoming recognized for other important values, and there is a growing movement to devise strategies to conserve and protect them in the regional landscape

(Tweed and Sutherland 2007). Cultural resources provide information about the past, which can be used to solve modern day issues and inform future decisions. Together, visual and cultural resources define a community's identity and sense of place, which is fundamental to individual and community well-being and can be a powerful gateway for social and environmental connection for residents and visitors alike (Oakes and Price 2008, Stocker 2013, Williams and Stewart 1998). Finally, visual and cultural resources express a coupled natural and human narrative in landscapes and provide a unique perceptive window into preservation design and planning. For these and other reasons, it is clear that visual and cultural resources must be systematically integrated into landscape-scale conservation design and planning.

Cultural Resource Preservation

It is critical to understand the essence of cultural resources, their significance, and ways we can integrate and ultimately preserve them. In this study, we generally classified cultural resources as tangible and intangible consequences of human action. Tangible resources included physical artifacts or expressions of human action with direct and indirect data that

¹ Contact information for corresponding author: 107 Stuckeman Family Building, University Park, PA 16802, tjm5447@psu.edu.

could be measured, sorted, and/or counted. Intangible resources encompassed the knowledge, skill, and creativity derived from individuals that provide sense of place within the community, including visual resources and scenic quality (Kirshenblatt-Gimblett 2004, UNESCO 2003, Vecco 2010). Together these cultural resources can take many forms including prehistoric and historical sites, structures, bridges, cemeteries, monuments, and landscapes (Knudson 1999, National Preservation Institute 2017).

There are several discourses associated with cultural heritage (Hodder 2010, Kurin 2004, Smith 2004). What is culturally important in one community may be perceived differently in another, and this has led to diverse approaches to cultural resource management based on community participation, conservation planning, and design initiatives. Some regions have attempted to inventory cultural heritage resources and devise programs, such as the historical markers program in Pennsylvania, to enrich cultural understanding of humans in nature (Robinson and Galle 2014). At the same time, many regions are failing to promote cultural resource awareness or prioritize cultural resource management due to budgetary restrictions and/or lack of cultural awareness (Meskell 2013, Timothy 2017). Tourism and community pride are two examples of how cultural heritage preservation can help promote economic stability and growth.

Visual Resource Interpretation

Visual resource assessment came of age with the National Environmental Policy Act (NEPA) in 1969, which in part required that aesthetics be considered along with other environmental values in Federal projects that could significantly impact the landscape (Sheppard 2001). The USDA Forest Service introduced the Visual Management System (VMS) in 1974 to inform management decisions and assess visual quality using human observation, computer generated analysis, theory, and evaluation of change (Bishop and Hull 1991). The Bureau of Land Management introduced its own visual resource management program in 1980, which had a special emphasis on visual impact assessment (VIA) methods that address the visual contrast of project-based activities (Bureau of Land Management 2017). These systems took a largely expert-based approach

to evaluating visual resource quality, incorporating perceptual measures of viewer sensitivity and project impact, and setting management objectives for visual resources (Daniel 2001, Feimer et al. 1979, Smardon et al. 1983). However, the main focus of these systems was on natural public lands in the western United States. A broader definition of visual resources would encompass both the built and natural environment, including compositional cues related to water, vegetation, landforms, and infrastructure (Craik and Feimer 1979, Krause 2001).

Many studies distinguish cultural and visual resources as separate entities, but they are not mutually exclusive. Cultural resources are often tangible; there is a physical structure portraying the significance of a culturally noteworthy event, person, or place. Visual resources tend to be intangible because perception and cognition of a certain view are what predominantly arbitrate a resource's significance. Moreover, the tangible informs the intangible.

Research has found that memory and landscape are integrally linked (Kuchler 1993, Spiegel 2004). The physical environment plays a vital role in constructing meaningful experiences and perceptions, and these constructs are not exclusively social (Stedman 2003). We perceive the landscape around us not only by differentiating the physical features from their natural context but also by incorporating aspects of time, condition, and sentiment. The response to a given landscape will consequently be different for different people and at different times based on interpretational variation.

Few studies since the 1980s have evaluated and/or created methodologies to inventory and manage visual resources across the landscape, though there is now a global movement toward a unified vision of the landscape that integrates culture and nature. Our research transforms common ideology, shifting from a once static view of significance to one that recognizes the complex nature of social meaning (Clarke and Johnston 2003). The amalgamation of a scenic inventory with a comprehensive cultural resource inventory can capture the historic and cultural values of the landscape that are essential not only to government agencies like the National Park Service, but also to society in general.



Figure 1.—Extent of the Appalachian Landscape Conservation Cooperative area.

OBJECTIVES

The primary goal of this study was to evaluate prospective visual and cultural landscapes in need of conservation, management, and/or establishment in order to: 1) bring awareness to important resources for public investment, and 2) encourage Federal, private, public, and business sectors to conserve scenic and cultural heritage. Our main objective was to change the traditional disciplinary mindset by applying a broader conception of cultural resource management that includes visual resources. Presently, there is a lack of consistency and structure within the conservation movement and a critically undervalued and unaddressed understanding of visual and cultural resources within environmental design (Maser 1997, Nowak et al. 2006). Traditional conservation strategies fail to address the social component of conservation planning, instead emphasizing reestablishment and preservation in terms of species viability (Wiens 2007). We are attempting to bridge these knowledge gaps and raise awareness about these issues using a spatially explicit resource assessment of visual and cultural resources at a landscape scale.

METHODS

We developed a conceptual framework that provides direction for understanding resource allocation through a multifaceted mapping methodology, and we devised a landscape-scale approach for integrating cultural resource data into conservation design and planning. Direct and indirect measures of cultural resources were overlaid and compared. Through this process, we examined the role of cultural resource distribution within and between subcategories. The framework distinguishes a series of procedural phases to evaluate quantitative and qualitative aspects of cultural and visual resources using Pennsylvania as the contextual extent.

Jointly funded by the National Park Service, The Pennsylvania State University, the National Council on Preservation Education, and the Wildlife Management Institute, this study investigated and applied landscape-scale conservation priority analysis and modeling to the part of Pennsylvania covered by the Appalachian Landscape Conservation Cooperative (AppLCC) (Fig. 1). Pennsylvania was the principal area of interest, but we shaped our conceptual framework to conform

to multistate conservation goals and priorities. Within this framework, tangible and intangible models were included, with intangible models predominantly representing visual resources.

Our framework relied heavily on research reported by Paul Leonard and Rob Baldwin at Clemson University (Leonard et al. 2015). We adapted their principles and techniques for assessing biodiversity and landscape-scale conservation planning to inform the process by which we evaluated cultural and visual resources. To develop our conceptual framework, we used comparative studies and existing project documentation on landscape and conservation planning. A primary source of reference was Jones and Amidon (2007), who created a GIS-based software tool called ILARIS, to identify aesthetic resources for setting landscape preservation priorities for the Puget Sound region of Washington State. We also used similar approaches from other studies and relied on time tested research methods developed by Ian McHarg (1969) and discussed more recently by Steinitz (2012) as geodesign.

Conceptual Framework Derivation

The Clemson University team completed a preliminary review of cultural resource valuation, which examined the significance of various terms that stakeholders found to be valuable in understanding sense of place (Brown and Weber 2012, Lowery and Morse 2013, Raymond et al. 2010). Using terms from a Public Participatory Geographic Information Systems (PPGIS) study (Brown 2012), we created a brainstorm matrix to represent the significance of landscape resources related to social, economic, and environmental aspects of life. These values included aesthetic, recreation-related, economic, wilderness, biological, heritage, future, learning, intrinsic, therapeutic, spiritual, life sustaining, social, marine, and many others. We categorized and defined similar terms and developed a conceptual framework that combined these terms into regionally appropriate qualitative and quantitative themes.

We examined current National Register, historical marker, and statewide cultural resource datasets from Pennsylvania. We used information on culturally significant places and people to identify potential gaps across the landscape and within classification categories of approved sites. Our approach compared

the spatial distributions of different resources to determine which combinations of data could be used in landscape-scale conservation design and planning. Using the ModelBuilder application in ArcGIS, we devised a cultural resource conceptual framework to highlight potential variables and produce a comprehensive spatial distribution map of high-quality resource areas.

Our theoretical framework applied a series of overlay analyses to explore spatial patterns of resources using direct and indirect sources of data. We assembled the overall model around “tangible” and “intangible” resources as shown in Figure 2. We subsequently broke these resources into 11 discrete submodels or themes that we inventoried and parameterized using available geospatial data. We developed a four-step system: 1) establish potential significance of resource variables by assessing available data layers; 2) determine each data layer’s level of influence; 3) use weighted data layers to create a series of “scenarios” or comprehensive models of tangible and intangible resources; and 4) develop a cultural resource inventory by combining theme data for an eventual design priority and/or threat determination exercise.

The seven tangible themes (recreation, cultural heritage, agriculture, economics, education, water, and wilderness) provided a comprehensive inventory of potential cultural resources; this is uncommon in cultural resource inventories that usually focus on resources in one or several categories. Instead of identifying features based on their unique qualities, our approach allowed for and even anticipated redundancy. We also defined four intangible themes: aesthetics, visual, sense of place, and intrinsic cultural heritage. Although there are fewer themes representing visual resources, the weight each theme brings to the overall inventory will vary as we develop final design recommendations and conservation planning guidelines.

Cultural and Visual Resource Data Attainment

In this study, we assessed numerous variables using a selection and exclusion approach. Many of the geospatial data layers were from government and nongovernmental organization sites such as the Pennsylvania Spatial Data Access (PASDA) clearinghouse, Pennsylvania Fish & Boat Commission,

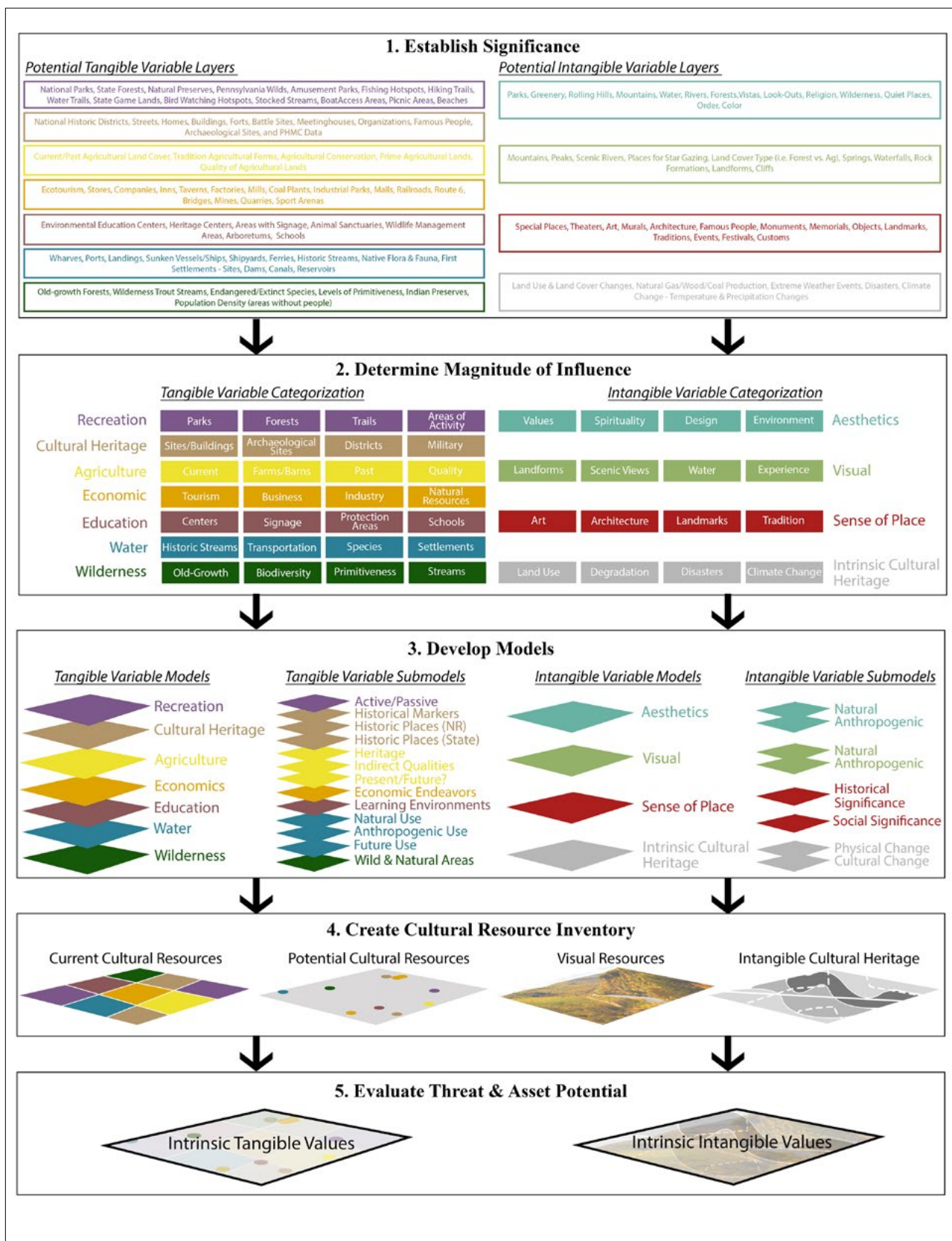


Figure 2.—Cultural and visual resources conceptual framework.

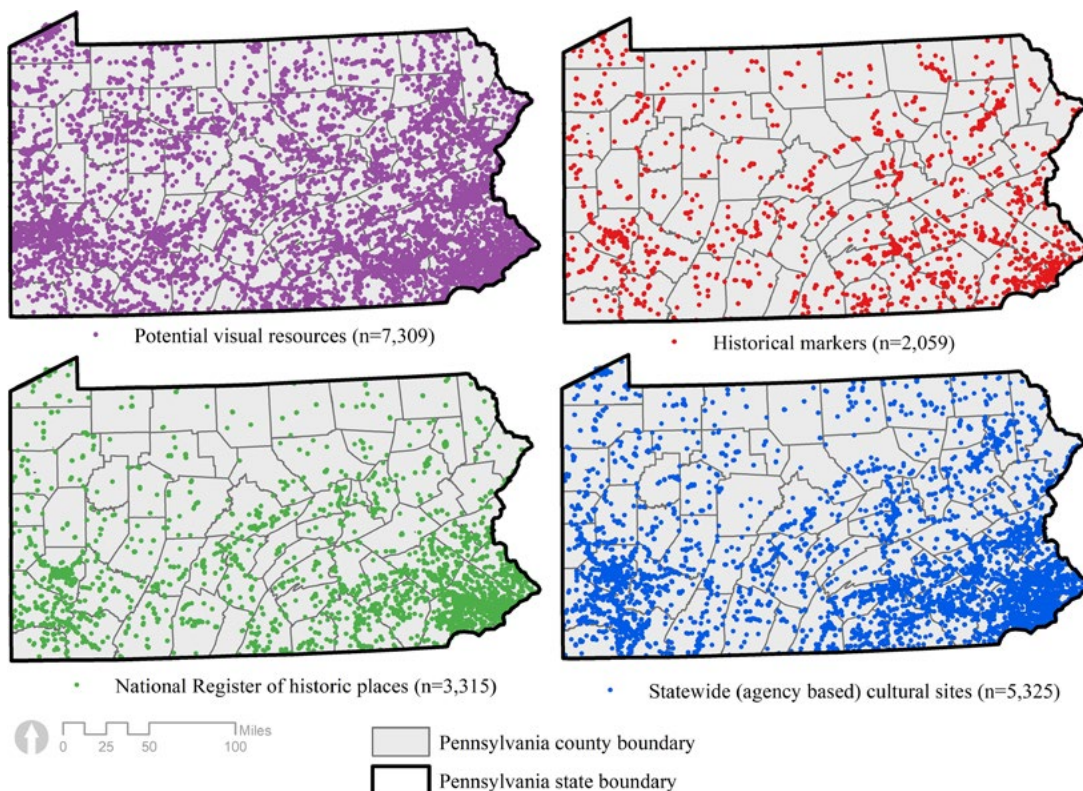


Figure 3.—Clockwise from top left: Map of locations for georeferenced photos (visual resources), historical markers, statewide agency-based cultural resources, and National Register of Historic Places.

Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Historic Museum Commission, and ESRI online. Using overlay methodology within ArcMap, we reconfigured data layers at the small watershed scale (using 14-digit HUC boundaries). We used the natural system as the basic structure of analysis as it proved to be the most suitable for representing results (Bowen and Haynes 2000, Taquino et al. 2002); economic and political boundaries skewed results for variables connected to demographic dynamics.

Cultural resource data for certain themes were easier to obtain than others. For individuals attempting to replicate our process, it may be beneficial to start with recreation themes because data layers relating to recreation, such as National Forests, State Parks, and fishing areas, are open access and available online.

One major challenge we faced in constructing the seven tangible themes was that certain variables overlapped. Variables with high overlap potential were associated with qualitative assessments or experimental datasets where individual opinions mattered. Layers with lower overlapping potential had

predefined geospatial data such as State and National Parks. Some data were also more reliable than others, so overlap (especially with qualitative variables) helped highlight underrepresented areas and helped us evaluate the quality of different data sets. We used a weighted variable value system during submodel production to deemphasize variables that were used multiple times in different models (e.g., variables related to fishing that were included in both recreation and water themes).

Visual resource data were more difficult to obtain than data for the seven cultural resource themes, and we therefore had to do significant data mining and data manipulation. For instance, we categorized georeferenced photos from Google Earth (using Panoramio) based on image title using our classification system that mimicked key categories in the National Register (refer to Fig. 3). We used variables including air quality, signage, vegetation, remoteness, naturalness, and visibility to selectively demarcate our visual resource inventory. We used viewsheds to tap into visibility prerequisites; we applied digital elevation models to help determine

Table 1.—Percentage of statewide cultural sites, historical markers, and National Register of Historic Places with a given proximity to a landscape feature

Location description	Statewide cultural sites	Historical markers	Historic places
City center (1 km)	6.6	8.2	8.2
City center (5 km)	27.0	31.3	29.1
City center (10 km)	41.1	51.1	52.2
Streams (100 m)	26.6	20.5	27.3
State game lands	0.2	0.5	0.1
Preserves	0.0	0.1	0.0
State park	0.3	0.7	1.4
State forest	0.3	0.2	0.2
Wild and natural areas	0.0	0.1	0.1
Pennsylvania wilds	6.3	3.1	1.9

viewsheds (Steinitz 1990). There were opportunities to find additional visual data in georeferenced photos online, though we found this to be too time consuming (see Goldberg et al., this proceedings).

In all, we gathered sufficient cultural and visual resource data to develop a comprehensive list of areas of Pennsylvania with high-quality resources. We integrated all of the variables into themes and identified culturally significant hotspots to guide strategic conservation and landscape planning.

RESULTS

Cultural Resources

Even though we used the natural hydrologic unit boundaries for our analysis, population distribution significantly influenced the distribution of cultural resources, which were largely clustered in urban areas. Approximately 48 percent of statewide cultural resources were located within 10 kilometers of a major city center. This distribution was especially skewed in cultural resource themes that emphasized social and/or economic activity such as education, economics, cultural heritage, and agriculture. Importantly, but perhaps not surprisingly, the three publicly available statewide cultural resource inventories we used in our initial analysis largely lacked cultural resources in rural areas. However, the recreation, wilderness, and water themes filled some of these gaps.

Water influences the distribution of statewide cultural resources according to the Pennsylvania Historic Museum Commission's inventory. Roughly 25 percent of all statewide cultural resource sites are within 100 meters of a stream while fewer than 1 percent are in a national, state, or local natural area (i.e., State Parks, National Forests, and wild and natural areas) (see Table 1).

Visual Resources

From a visual resource perspective, topography and vegetation played a major role in determining areas of high visual quality. Almost all photos associated with nature (such as those referring to a sunset or overlook) were viewed as positive, and many of the negative responses, such as references to a “decaying” landscape, were nostalgic. More than 50 percent of the georeferenced photos depicted a deciduous forest, followed by developed areas (open space, low, medium, and high, 26 percent of the photo inventory) and agricultural lands and/or pasture (15 percent of the photo inventory). With regard to elevation, roughly 22 percent of the photos were taken within 100 meters of a ridgeline. High visual quality regions were usually within wilderness areas or areas with minimal anthropogenic activity. These areas have formal aesthetic characteristics of landscapes (e.g., form, color, texture) and provide a memorable visual experience. The results support other VRM studies that highlight landscape features like prominent ridgelines, knolls, and viewpoints that are integral to rural and urban aesthetic character.

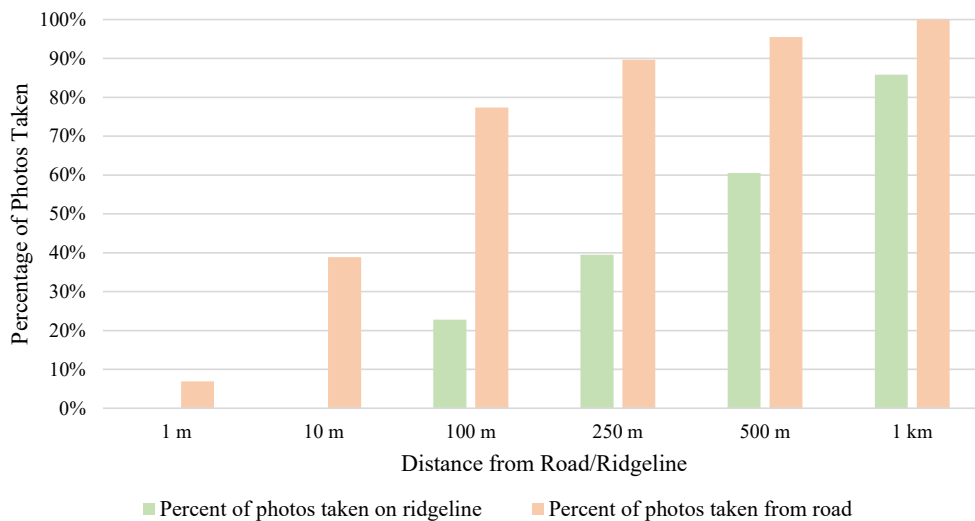


Figure 4.—Percentage of photos taken from roads and ridgelines.

Approximately 77 percent of the georeferenced visual resource locations followed roads since many photos were taken from inside cars or in developed areas (Fig. 4). We also examined viewshed composition to try to understand why people selected popular photo locations. In general, a viewshed in a rural area was larger than a viewshed in an urban area since there were fewer barriers, such as roads or bridges, to distract from the overall view. Viewsheds also changed based on the most desirable view for a given zoning parameter. For example, in commercial areas

the emphasis may have been on capitalizing on the visibility of roads to attract consumers (large viewshed) while in residential areas the emphasis may have been on tranquility without noise pollution from roads (small viewshed).

Overall, our conceptual framework helped us analyze visual resource distribution and allocation, determine which views were significant, and understand how management of significant views could help promote conservation (Fig. 5).



Figure 5.—Examples of cultural and visual resources: (a) Fort Bedford, historical marker; (b) Old St. Luke's Church National Register of Historic Places, historical marker; (c) Philadelphia National Cemetery, National Register of Historic Places; (d) Pittsburgh and Lake Erie Railroad passenger station, state agency-based cultural site; (e) Little Falls Trail in Allegheny Forest, visual resource; and (f) Little Buffalo State Park - visual resource. Image Sources: (a) J. Klotz via Wikimedia Commons; (b) Cbaile19. 2014. Via Wikimedia Commons; (c) Department of Veterans Affairs; (d) Nyttend. 2009. "Pittsburgh and Lake Erie Railroad Complex." <https://www.american-rails.com/pittsburgh-and-lake-erie-railroad.html>; (e) Six local via Wikimedia Commons; (f) Smallbones via Wikimedia Commons.

Table 2.—Potential allocation of resources based on landscape position

Landscape position	Resource allocation
Urban	Cultural resource dominant
Suburban/exurban	Cultural/visual resource mix
Rural	Visual resource dominant

DISCUSSION

This work provides a first attempt to assess how studies of ‘place’ can be combined with information about significant visual and cultural resources. In collaboration with Appalachian LCC, our study is merging disparate data sets to inform landscape conservation design and planning. In the process, perhaps a more comprehensive model of place is emerging. Clearly, there are biases in both types of datasets but when they are combined a more complex and sophisticated perspective of tangible and intangible resources emerges. This perspective can inform design and planning decisions just as natural resource models already do.

The methods described here can help identify highly significant places where visual and cultural resources co-occur, as well as where threats to those resources could occur. At the same time, identifying places with degraded resources and/or lack of resources facilitates strategic planning and suggests where to focus on improving visual quality and cultural heritage resources. Signage is an important first step in landscape conservation and planning since identification signals that the resource is there and that an agency is aware of its importance. The second step is to preserve and protect resources that contribute positively to a place’s scenic, cultural, and historic character.

Since cultural resources are predominately located within urban areas, we can capitalize on existing cultural heritage resources by creating a network of cultural corridors that link urban and rural resources. A cultural corridor can strengthen connections across the landscape, bring awareness and educational value to a region, and, most importantly, enhance social and economic dynamics by highlighting cultural resource sites within highly valued visual resource areas.

Since less than 1 percent of the existing and documented cultural resources are in natural areas, identifying high quality visual resource areas provides

a means to bridge this gap. There is also a significant need to expand cultural resource inventories in broader geographic contexts. Federal and state databases focus on prehistoric and historic cultural resources within and adjacent to urban centers and transportation networks. Comparatively little attention is paid to visual resource management, other than in areas already protected by, for example, the National Park Service. The results from this study provide a means to unify and expand visual and cultural resources (see Table 2). This in turn can help us begin to address the limitations of current conservation protocols and enhance local and regional sense of place.

CONCLUSION

Our work establishes a comprehensive way of integrating cultural resources with visual resources to inform conservation and landscape planning priorities. There are still many challenges to address, particularly when working with qualitative datasets, but as data mining becomes more efficient and reliable, resource inventories will become more inclusive. Also, with higher resolution data, cultural and visual hotspots can be strategically integrated into local planning and design initiatives. Combining visual and cultural resource inventories is becoming ever more crucial for communicating regional heritage. Without proper planning for and management of cultural resources, significant knowledge of the past may be erased forever.

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