

Title: Integrating Visual and Cultural Resource Evaluation and Impact Assessment for Landscape Conservation Design and Planning

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Abstract: While there is an increased need for cultural resource conservation and management in North America, there are few approaches that provide robust integration and combined assessment of visual and cultural resources. Determining the scenic value of important views and identifying potential risk for loss of that view are core components needed to design protection preserving scenic quality and the cultural resources contributing to scenic value and overall sense of place. Our research, focused on the Appalachian Landscape Conservation Cooperative, uses a model to integrate cultural resources and visual resources for landscape scale conservation priorities. The goal of this paper was to describe our approach and compare how visual and cultural resources contribute to landscape scale conservation priorities in the Appalachian LCC. We investigated how ‘place’ can be studied from the perspective of visual resources, while compared to what we know from cultural resource databases, including the National Registry, agency-based, and state-wide datasets. In collaboration with Appalachian LCC, the study measures visual quality as compared to viewshed threats (e.g., energy and development expansion) to better inform cultural resource planning and management across the Pennsylvania landscape. Prominent ridgelines, knolls, and viewpoints, for example, are integral to the creation of rural and urban aesthetic character. By evaluating potential landscapes for conservation priority, we can begin to bring awareness to important resources for public investment and inform federal, private, public, and business sectors to engage in conservation of scenic and cultural heritage.

Introduction

The human imprint on the environment is extensive, complex and often irremediable (Sauer, 1956; Lewis, 1979; Vitousek et al., 1997; Solomon et al., 2009). Anthropogenic activities such as energy expansion, urbanization, sprawl, and climate change, for example, significantly threaten the global environment (Steffen et al., 2007; Hooke et al., 2012; Marzeion & Levermann, 2014; AghaKouchak, 2015). Cultural resources are tightly coupled to environmental health and quality, but lack of economic value placed on these resources along with neglect, increase their susceptibility to degradation (Throsby, 2003; Taylor, 2011). Unlike natural resources to which we can profit through material extraction, cultural resources provide a relatively low profit margin in terms of economic productivity unless tied to tourism. However, cultural resources are a critical and necessary component of social identity and well-being, and so, there is an existing movement to devise strategies for the conservation and protection of regional cultural heritage (Tweed & Sutherland, 2007).

Cultural resources are non-renewable, unlike many natural resources, and provide information about the past, which can be used to inform future decisions, particularly those decisions that aid in solving modern-day issues. Cultural resources can also define a society's sense of place, which is a powerful psychological idea that roots humanity in nature, using fond memories as a gateway for social and environmental connection (Williams & Stewart, 1998; Oakes & Price, 2008; Stocker, 2013). Finally, cultural resources express a coupled natural and human narrative in landscapes and provide a unique perceptive window into preservation design and planning. As a whole, it is abundantly clear that cultural resources, including visual resources must be systematically integrated into landscape scale conservation design and planning.

Cultural Resource Preservation

Natural resources are at forefront of conservation design and planning with less attention paid to cultural resources (Lowenthal, 2005; NPCA 2011). That said, it is exceedingly vital for conservation efforts to include cultural resources. There are now limited places in the United States that have been untouched, and thus, embracing a purely natural perspective of the landscape is problematic. We argue that tightly integrating cultural resources and anthropogenic information in the process of environmental protection will provide opportunities and potentially solutions to modern day social and conservation issues. Understanding the essence of cultural resources, their significance, and ways in which we can begin to integrate and ultimately preserve them are important ontologies to discuss and examine.

In this study, we generally classified cultural resources as tangible and intangible dimensions of human action. We selectively added subcategories attempting to identify anthropogenic and natural systems (Ahmad, 2006; NPS, 2015; NRCS, 2017). We classified tangible resources as physical artefacts or expressions of human action with direct and indirect data that 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 (UNESCO, 2001; Kirshenblatt-Gimblett, 2004; Vecco, 2010). Cultural resources can take many forms including prehistoric and historic sites, structures, bridges,

cemeteries, monuments, and landscapes (Knudson, 1999; NPI, 2017). As we began to integrate cultural resources using our model, we immediately identified and explored the spatial relationships of tangible and intangible resources. This paper investigates some of those early observations.

There are several discourses associated with cultural heritage (Kurin, 2004; Smith, 2004; Hodder 2010). What is culturally important to one community may be vastly different to another, and this way of thinking has been used to imply that there can be no single strategy to augment cultural resource presence – it is primarily dependent on community participation and conservation planning and design initiatives to guide establishment. Due to the qualitative bounds of cultural resource establishment, political priorities, and legislation and policy, there is a current imbalance in cultural resource distribution across the nation (Singh, 2010; Timothy, 2011). Some regions have attempted to inventory cultural heritage and devise programs, such as the historical markers program in Pennsylvania, to enrich cultural understanding of humans in nature (Robinson & Galle, 2014). Some areas are less proactive at bringing attention to local heritage than others, however. Partly due to budgetary restrictions and/or lack of cultural awareness, many regions can alternatively benefit from improving cultural resource awareness and enhancing management priorities (Frey, 1997; Meskell, 2013; Timothy, 2017). Tourism and community pride are just a few examples of how cultural heritage preservation can promote economic stability and growth.

Visual Resource Interpretation

With the advent of the National Environmental Policy Act (NEPA) in 1969, environmental values became a significant part of the decision-making process (Sheppard, 2001). Particularly of interest was the visual landscape and how agencies could best manage these delicate systems – visual impact assessment (VIA) methods were initiated to aid landscape architects and the United States Forest Service (USFS) personnel in the development of better management protocols (BLM, 2017). In 1976, the USFS established a visual resource management (VRM) system to inform management decisions, using human observation, computer-generated analysis, theory, and evaluation of change to assess visual quality (Bishop & Hull, 1991). Several years later, the USFS updated this system now referred to as a Scenic Management System (Smardon, 2016). These systems were used to classify the landscape, promote recreational activities to a suite of users, and determine how visual impacts influenced landscape vulnerability. The methodology applies a visual ranking system to evaluate visual resource quality (Feimer et al. 1979; Smardon et al., 1983; Daniel, 2001).

However, the main focus of these systems was on natural public lands of the western United States whereas a broader definition of visual resources encompass both the built and natural environment, defining a visual landscape using compositional cues related to water, vegetation, landforms, and infrastructure (Craik & Feimer, 1979; Krause 2001). Similar to cultural resources, the significance of a visual resource differs by individual. Some people place a higher value on a landscape with a babbling brook while others are more engrossed by the sight of a mountain range or a quiet farmhouse with adjacent fields (Kaplan, 1979). Although all perspectives are aesthetically pleasing, some visual resources resonate more strongly with a given individual because of the perpetuated memory inscribed in that particular landscape – camping in a forest during childhood,

these memories may surface in adulthood when a similar experience is sought; when exposed to similar circumstances, the memory of camping is nostalgic, bringing a sense of comfort to the individual when that particular visual cue is witnessed. To untangle the semiotic entity of visual resources, we need to understand how visual resources were previously recognized in order to improve visual resource management for future decision-making and landscape priorities.

Many studies distinguish cultural and visual resources as separate entities, but they are not mutually exclusive concepts. Memory and landscape are integrally linked (Kuchler 1993; Spiegel 2004). The physical environment plays a vital role in constructing meaningful experiences and perspicacity, and these constructs are not exclusively social (Stedman, 2003). Cultural resources are 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 the significance of a visual resource. Moreover, the tangible inform the intangible. We perceive the landscape around us not only differentiating the physical features from their natural context but also incorporating aspects of time, condition, and sentiment. The response to a given landscape will consequently be different due to interpretational variation.

Few studies have evaluated and/or created a methodology that adequately inventories and manages visual resources across the landscape since the 1980s, though there is now a global movement towards a unified vision of the landscape, one 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 & Johnson, 2003). The amalgamation of a scenic inventory with a comprehensive cultural resource inventory can more robustly capture the historic and cultural values of the landscape essential to not only governmental agencies, like the National Park Service, but also to society in general.

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) engage federal, private, public, and business sectors to in conservation of scenic and cultural heritage. Our main objective was to change the traditional disciplinary inset by applying cultural resource management within transdisciplinary facets. Presently, there is a lack of consistency and structure within the new conservation approach and a critically undervalued and unaddressed understanding of visual and cultural resources within environmental design (Maser, 1997; Nowak et al., 2006; Luloff et al., 2013). Traditional conservation strategies fail to address the social component of conservation planning - rather they often emphasize reestablishment and preservation in terms of species viability (Wiens, 2007; Lowe et al., 2008). Thus, we attempt to bridge these gaps in knowledge and raise awareness using a spatially explicit resource assessment of visual and cultural resources at a landscape scale.

We developed a conceptual framework that provides direction towards understanding resource allocation, through a multifaceted mapping methodology, and devised a landscape-scale approach for integrating cultural resource data for 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.

Methods

Jointly funded by the National Park Service, Penn State, National Council on Preservation Education, and the Wildlife Management Institute, this study investigated and applied landscape-scale conservation priority analysis and modeling to the portion of Pennsylvania contained within the Appalachian Landscape Conservation Cooperative (AppLCC). Pennsylvania is the principle area of interest, but we have catered our conceptual framework to conform to multi-state conservation goals and priorities. Within this framework, tangible and intangible models are incorporated, with intangible models representing predominately visual resources. Visual resources were measured qualitatively while cultural resources, although calculated using some forms of qualitative analysis, were assessed using a quantitative methodology.



Figure 1: Extent of the Appalachian Landscape Conservation Cooperative (AppLCC) Regional Map

Our framework relied heavily on the first phase of research completed by Paul Leonard and Rob Baldwin at Clemson University. We adapted their principles and techniques used for assessing biodiversity and landscape scale conservation planning of natural resources 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 & Jones (2007) who created a GIS-based

software tool, called ILARIS, that developed intrinsic landscape preservation priorities in the northwest coast of the United States. The work allowed practitioners and landscape planners to investigate aesthetic resources through their model. The Jones & Jones conceptual model highlighted impacts of multiple landscape types to local aesthetics within the Puget Sound region in Washington. We also used similar approaches from other studies and relied on time-tested research methods developed by Ian McHarg (1969), and more recently, discussed by Steinitz as geodesign (2012).

Conceptual Framework Derivation

A preliminary review of cultural resource valuation was completed by the Clemson University team, which examined the significance of various terms stakeholders found to be valuable in understanding sense of place (Brown, 2004; Raymond et al., 2010; Brown & Weber, 2012; Lowery & Morse, 2013). Using the terms from the Public Participatory Geographic Information Systems (PPGIS) study, a brainstorm matrix was created to determine each term's significance to social, economic, and environmental aspects of life. These values included aesthetic, recreation, economic, wilderness, biological, heritage, future, learning, intrinsic, therapeutic, spiritual, life sustaining, social, and marine and many others. We categorized and defined similar terms and developed a conceptual framework that combined these terms into difference qualitative and quantitative themes.

We examined current National Register, historical marker, and statewide cultural resource datasets within Pennsylvania using existing and documented culturally significant places and people to understand and examine potential gaps across the landscape and within classification of approved sites. Simply, we compared the spatial distributions of different resources to determine what combinations of data could be best leveraged for integration within landscape scale conservation design and planning. Within *Model Builder* in ArcGIS, we devised a cultural resource conceptual framework to highlight potential variables (arranged in tangible and intangible categories) and produced 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. The overall model was assembled around 'tangible' and 'intangible' resources as shown in *Figure 2*, of which were broken into 11 discrete submodels or themes. The themes are inventoried and parameterized using available geospatial data. A four-step system was developed: (1) establish significance of potential resource variables by assessing importance of available data layers, (2) determine magnitude of influence for each data layer, (3) use weighted data layers to create a series of scenarios/comprehensive models for tangible and intangible preservation priority review, and (4) develop a cultural resource inventory by combining theme source data for an eventual design priority and/or threat determination.

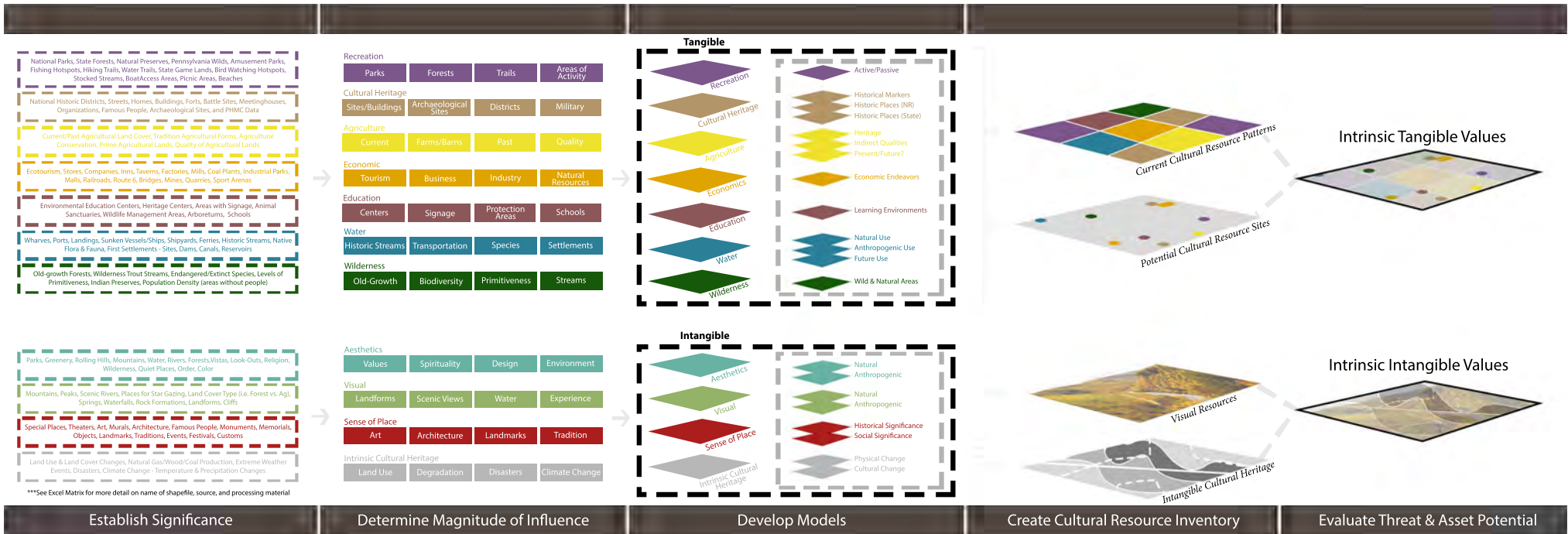


Figure 2: Cultural & Visual Resources Conceptual Framework

The seven tangible themes (recreation, cultural heritage, agriculture, economics, education, water, and wilderness) were created to provide a comprehensive inventory of potential cultural resources, which is uncommon in cultural resource inventory. Simply, instead of identifying features based on their unique qualities, our approach allowed for and even anticipated redundancy. We also defined four intangible themes, including: 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 documentation.

Cultural & Visual Resource Data Attainment

In this study, we assessed numerous variables using a selection and exclusion approach. Many of the geospatial data layers we integrated into the themes were obtained from government and non-governmental organization sites such as the Pennsylvania Spatial Data Access (PASDA) clearinghouse, PA Fish & Boat Commission, PA Department of Conservation and Natural Resources, the Pennsylvania Historic Museum Commission and ESRI online. Using overlay methodology within an ArcMap interface, data layers were reconfigured at the small watershed scale, meaning that values were aggregated to the smallest hydrologic unit (14-digit HUC) available. We used the natural system as the basic structure of analysis, as it proved to be the most suitable representation of results compared to county and municipality designations (Bowen & Hynes 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. And so, for individuals attempting to replicate our process, it may be beneficial to start with the recreation themes because most data layers relating to recreation, such as national forests, state parks, and fishing areas, are open access and publicly available online. One major challenge we faced in constructing the seven tangible themes was that certain variables overlapped. Layers that tended to have lower overlapping potential were those variables that had predefined geospatial data such as state and national parks. Variables with high overlapping capacity were those associated with qualitative assessments or experimental datasets where individual opinion mattered. Some data were also more reliable than others, and thus having overlap (especially with qualitative variables) was particularly important in highlighting underrepresented areas or evaluating the quality of data. Variables that were given greater emphasize as a result of multiple use in different models (e.g., recreation and water themes incorporated elements of fishing) are deemphasized using a weighted variable value system during submodel production.

Visual resource data was more difficult to obtain than data for the seven cultural resource themes, and significant data mining and data manipulation was required. For instance, georeferenced photos from Google Earth (using Panoramio) and categorized based on title of image using our classification system that mimicked key categories in the National Register. A number of diverse variables including air quality, signage, vegetation, remoteness, naturalness, and visibility were used to selectively demarcate our visual resource inventory as well. Viewsheds were used as a way to tap into visibility prerequisites – digital elevations models were applied to help determine these

areas (Steinitz, 1990). Though time consuming, there is a great opportunity for data expansion, particularly with visual resources, using georeferenced photos publicly available online.

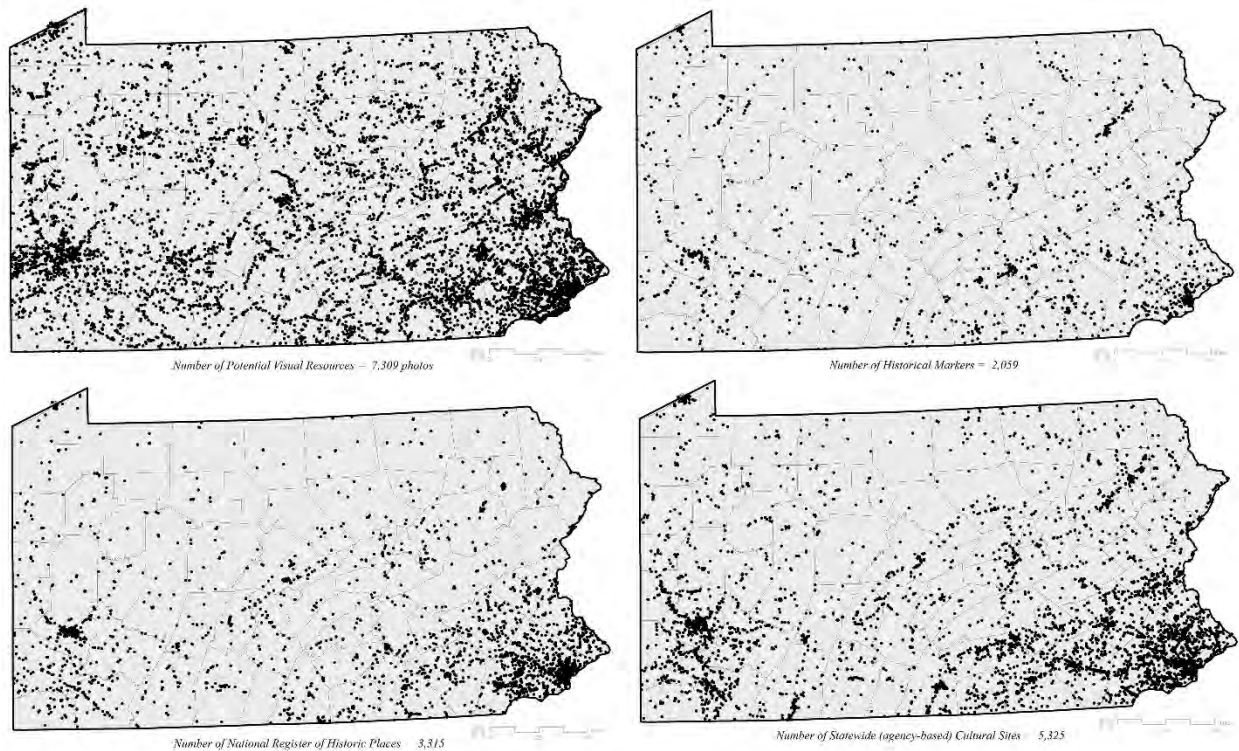


Figure 3: The map depicts point locations for georeferenced photos (visual resources) and National Registry of historic places, historical markers, and statewide agency-based cultural resources.

In all, we gathered sufficient data for both cultural and visual resources to develop a comprehensive view of areas with high quality resources in Pennsylvania. The variables were integrated into the themes and were then used to identify culturally significant hotspots as a means to guide sustainable and strategic conservation and landscape planning.

Results

Cultural Resources

Cultural resources are predominately clustered within urban areas. Even though we used the natural hydrological units to summarize our analysis (i.e. boundary designation), demographics significantly influence the distribution of documented cultural resources. Approximately 48% of explicitly defined statewide cultural resources are located within 10 kilometers of a major city center. This distribution is especially skewed in particular cultural resource themes, especially those that emphasized social and/or economic activity such as education, economic, cultural heritage, and agricultural themes. Importantly, but perhaps not surprisingly, the three publicly available statewide cultural resource inventories we used in our initial analysis expressed a lack of cultural resource allocation in rural areas. However, the recreation, wilderness, and water themes highlighted potential areas within these regions.

Interestingly, water is an influential variable when investigating the distribution of statewide cultural resources as inventoried by the Pennsylvania Historic Museum Commission. Roughly 25% of all statewide cultural resource sites are located within 100 meters of a stream with less than 1% of sites located within a national, state, or local natural area (i.e., state parks, national forests, wild and natural areas). Simply, we observed a skewed distribution that ‘places’ the majority of cultural resources within developed areas.

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 |
|---------------------------------|----------------------------|----------------------|-------------------|
| <i>City Center (1 km)</i> | 6.62% | 8.16% | 8.21% |
| <i>City Center (5 km)</i> | 27.03% | 31.33% | 29.05% |
| <i>City Center (10 km)</i> | 41.13% | 51.09% | 52.16% |
| <i>Streams (100 m)</i> | 26.58% | 20.50% | 27.27% |
| <i>State Game Lands</i> | 0.17% | 0.49% | 0.09% |
| <i>Preserves</i> | 0.01% | 0.05% | 0.00% |
| <i>State Park</i> | 0.30% | 0.68% | 1.39% |
| <i>State Forest</i> | 0.29% | 0.24% | 0.18% |
| <i>Wild & Natural Areas</i> | 0.02% | 0.05% | 0.06% |
| <i>PA Wilds</i> | 6.29% | 3.11% | 1.93% |

Visual Resources

From a visual resource perspective, topography and vegetation played a major role in determining areas of high visual quality. Almost all photos were positively associated with nature such as those referring to a sunset or overlook with very few photo titles negatively associated, though many of the negative responses, in terms of a “decaying” landscape, were nostalgic. More than 50% of the georeferenced photos were located within deciduous forest, followed by developed areas (open space, low, medium, and high) and agricultural lands and/or pasture represented in 26% and 15% of the photo inventory, respectively. In relation to elevation, roughly 22% of all the photos were taken within 100 meters of a ridgeline. High visual quality regions were located within wilderness areas or areas with minimal anthropogenic activity. These areas tend to enhance our cognitive growth and provide a memorable visual experience, and so, these results support many other VRM studies in highlighting the idea of landscape features, such as prominent ridgelines, knolls, and viewpoints are integral to the creation of rural and urban aesthetic character.

Approximately 77% of the georeferenced visual resource locations followed roads, to within 100 meters – a large number of photos were taken on roads, from inside of cars, or from roads within developed areas. We also examined viewshed composition and configuration to understand the reasoning behind 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 most desirable view for a given zoning parameter. For example, commercial areas may prefer to capitalize on the visibility of roads to

attract consumers (large viewshed) while residential areas may want tranquility without noise pollution from roads (small viewshed).

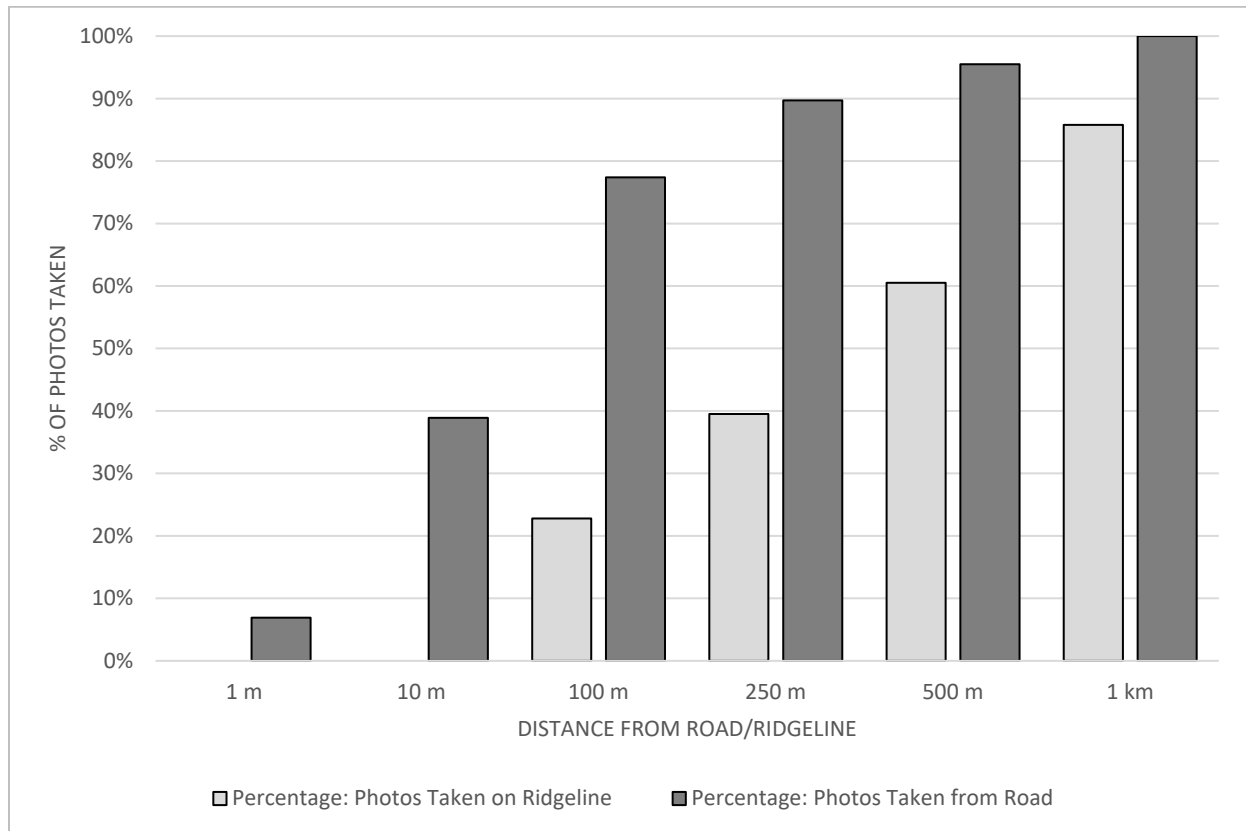


Figure 4: Percentage of photos taken from roads and ridgelines

Overall, using our conceptual framework to understand visual resource distribution and allocation helped determine what views were significant, what defined a significant view based on visitor insight, why the view was important in general, and how management of this view could help to promote conservation.

Discussion

We are beginning to scratch the surface here on how ‘place’ can be studied from the perspective of visual resources, while compared to what we know from cultural resource databases, including the National Registry, agency-based, and state-wide datasets. In collaboration with Appalachian LCC, our study is integrating these disparate data sets to inform landscape conservation design and planning. In process, perhaps a more comprehensive model of place is emerging from these analyses. Clearly, there are biases and skewness in both datasets, though when combined, a more complex and sophisticated perspective of tangible and intangible resources emerges. This perspective can more effectively inform design and planning decisions in a similar way to models commonly completed for natural resources.

The results of the study can help to locate highly significant regions where visual and cultural resources co-vary as well as where threats to significant combinations of resources could occur. Identification of these degraded resources and/or lack of resources allows for strategic planning and improvement of visual quality and cultural heritage in these areas. Signage is an important first step to landscape conservation and planning – identification means that the resource is there and an agency is aware of its importance. The second step is to preserve and protect these resources that contribute positively to a place’s scenic, cultural, and historic character.

Since cultural resources are predominately located within urban areas, it is necessary to capitalize on the expansion of cultural heritage by creating a network of cultural corridors that link urban and rural resources. A cultural corridor can strengthen overall connection across the landscape, bringing awareness and educational value to the region, and most importantly, enhance social and economic dynamics by incorporating cultural resource sites within highly valued visual resource areas.

With less than 1% of the existing and documented cultural resources within natural areas, the identification of high quality visual resource areas provides a means to bridge this gap. There is a significant need to expand cultural resource inventories in broader geographic contexts. Federal and state cultural resource databases are predominantly focused on inventories of prehistory and history within and adjacent to urban centers and transportation networks; little attention is paid to visual resource management, other than areas already protected such as landscapes maintained by the National Park Service. The results from this study provide, however, a means to unify and expand visual and cultural resources (*see Table 2*). By identifying visual and cultural resource hotspots, we can begin to address the limitations in current conservation protocols and enhance local and regional sense of place.

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 |

Conclusion

Our work establishes a comprehensive way of integrating cultural resources with visual resources to inform conservation and landscape planning priorities alongside increased development. 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, these cultural hotspots can be strategically implemented into local planning and design initiatives. Combining visual and cultural resource inventories is becoming ever more crucial for communicating regional heritage – without proper planning and management of these resources, significant knowledge of the past may be forever erased.

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