



Assessing Public Preferences of Landscape and Landscape Attributes: a Case Study of the Proposed Appalachian Geopark Project in West Virginia, USA

Ganga Nakarmi¹ · Michael P. Strager² · Charles Yuill¹ · Jasmine C. Moreira³ · Robert C. Burns⁴ · Peter Butler¹

Received: 1 December 2022 / Accepted: 23 May 2023 / Published online: 8 June 2023

© The Author(s), under exclusive licence to International Association for the Conservation of Geological Heritage 2023

Abstract

Photographs have been utilized as substitutes for on-site scenes in the assessment and evaluation of landscape's visual quality, perspective, and preference. Visual quality, perception, and preference are assessed through human eyes and their judgment. However, the human judgement is often generally categorized as expert vs. citizen. Literature searches show that the expert-based assessment dominates over the citizen level judgement. There is a lack of information on methodologies to assess public preference of landscape and landscape attributes. This paper discussed two different approaches of assessing landscape preferences of the public (local and visitors) in the proposed Appalachian Geopark Project (hereafter referred as pAGP) covering Fayette, Greenbrier, and Raleigh Counties in West Virginia (WV). A set of two questionnaire surveys were administered. There were questions for answering as a cognitive preference exercise and a set of photographs for rating as a visual stimulation exercise. Both instruments were delivered to respondents as anonymous links using Survey123 and Qualtrics software respectively. The results from both surveys revealed the highest preference was found for forested landscapes followed by water features and the associated landscapes. This study's findings revealed how multiple methods of assessing public preferences can strengthen and justify the results from different methods. Surveys were completed by 47 respondents.

Keywords Photograph rating · Landscape attributes · Users' preference · Proposed Appalachian Geopark

✉ Ganga Nakarmi
gn0001@mix.wvu.edu; ganga116@gmail.com

Michael P. Strager
mstrager@wvu.edu

Charles Yuill
cyuill@wvu.edu

Jasmine C. Moreira
jasminecardozo@gmail.com

Robert C. Burns
robert.burns@mail.wvu.edu

Peter Butler
peter.butler@mail.wvu.edu

Introduction

Because landscape means different things to people depending on their context and background (Antrop 2005; Fairclough et al. 2018; Griffiths 2018), perspective and preference of landscape varies greatly and there is not a universally accepted theory for landscape aesthetics (Kaymaz 2012). Literature searches show that there is limited information on methods of assessing users' perception and preference in the USA (Palmer and Hoffman 2001; Smardon 2016; Zube, et al. 1982). Daniel and Boster (1976; as cited in Peng and Han 2018) introduced a scenic beauty estimation (SBE) method to quantitatively measure aesthetic preferences for alternative wildlife management systems, which was probably the earliest objective method that used photographs.

Using photographs as substitutes for on-site viewing of landscapes has been a commonly accepted approach in assessing public preference for a number of years. In another previous study by the authors, a contemporary method of using technology to assess users' preferences for landscape and landscape attributes in the pAGP was implemented. In

¹ School of Design and Community Development, Davis College of Agriculture, Natural Resources and Design, West Virginia University, Morgantown, WV 26506, USA

² Division of Resource Economics and Management, Davis College of Agriculture, Natural Resources and Design, West Virginia University, Morgantown, WV 26506, USA

³ Tourism Department, Ponta Grossa State University, Ponta Grossa, Brazil

⁴ Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506, USA

that study, a combined method of geographic information system (GIS) and machine learning (ML) approach was employed by using photographs that were uploaded in the Flickr crowdsourcing, an indirect approach. Previous studies have used density of photographs as an indicator to assess users' interest and cultural ecosystem services (Callau et al. 2019; Tieskens et al. 2018; Wood et al. 2013). However, the researchers also pointed out that the density of photographs from a specific location alone may not necessarily relate to the public interest in the location (Wood et al. 2013) or be sufficient for measurement of cultural ecosystem services (Richards and Tunçer 2018). They also discussed biases inherent with such crowdsourcing data as presented in the previous paper (Malik et al. 2016; van Zanten et al. 2016; Wang et al. 2018; Wood et al. 2013). Previous studies sought a combination of different methods to assess public preference.

In addition to the previous approach of implementing Flickr photographs in combination with GIS and ML, we executed two more approaches to assess users' preferences. Previous studies have used various theories and models. These include phenomenological (e.g., Lynch), ecological (e.g., McHarg & Mumford), prospect-refuge (e.g., Appleton), affordance (e.g., Gibson), psychology (e.g., Kaplan & Kaplan), and psychophysical models (e.g., Daniel & Boster). This research was conducted based on psychophysical aspects of landscape and assumed that the preference was about viewers' perception and cognition (Peng and Han 2018). Photograph rating and questionnaire survey methods were employed. The aim was to investigate how participants interpret landscapes and landscape attributes visibly (pictorial and sense of sight based) and invisibly (cognitive and thought process based). This is a semi-direct approach as we provided photographs of landscape scenes and questionnaires using anonymous survey links. The potential participants were then asked to rate those photographs and answer the questions. This study seeks answers for the following research questions: Can we relate specific landscape settings and features with users' preferences? What landscape features are preferred by the users? Is the demography of users associated with preference for landscape and landscape features?

Background

Objective and Subjective Philosophies of Landscape

Human perspective of land resources has increasingly been considered not just as a plot of land that provides food and shelter, but also as a visual resource for its aesthetic, scenic, and recreational values since the middle of the nineteenth century. Since then, keeping the best and unique landforms

and landscapes aside for protection and recreation began by designating such areas as national parks, reserves, areas of outstanding beauty and wilderness areas. One approach is through the designation of a Landscape Park as implemented in Poland (Dmytrowski and Kicińska 2022). Two major philosophies, viz., objective and subjective have been widely discussed, particularly in the field of visual quality assessment of the landscapes (Brooks and Lavigne 1985). In the objective philosophy, the importance is given to the landscape's biophysical aspects and beauty in terms of forms, shape, texture, color, vividness, uniqueness, pattern, etc. (Daniel 2001). "Biophysical landscape interactions are those biotic and abiotic processes in a landscape that have an influence on the developments within and evolution of a landscape" (van der Ploeg et al. 2018, p. 1167). The subjective philosophy is dominated by human cognitive constructs such as needs, wants, feelings, observations, behaviors, attitudes, perspectives, etc. (Brooks and Lavigne 1985; Dearden 1981; Zube et al. 1982) and landscape's use values (Tveit et al. 2006) for agriculture, industry, transportation, refuge, etc. For instance, the European settlers viewed the minerals of American lands as objective values (e.g., gold of California), whereas the desire of the European settlers for gold (e.g., seeking for economic benefits) is a subjective aspect of the landscape (Langschwager 2018). Both of these philosophies of beauty are equally important. However, the objective philosophy has dominated in landscape evaluations and studies for a number of years compared to the subjective or user-centered landscape evaluations (Kvan 2013). According to Brooks and Lavigne (1985), "Neither the extreme subjective nor the objective cognitive philosophies of beauty is completely wrong." As Swanwick (2002, p.10) said, "There has been long-standing debate about the role of objectivity and subjectivity in dealing with landscape. The search for supposedly objective approaches has reflected a desire, in some quarters, to remove the element of personal judgement from the process. In Landscape Character Assessment it is accepted that there is a role for subjective inputs, but these must be made in a systematic and transparent way."

Landscape preference depends on what the landscape offers (Gibson 1979; Herzog 1987). The "affordances are features and configurations" of landscapes. The greater the positive objectivity or higher the beauty of the landscape, the greater the subjectivity of the landscape or preference is (Peng and Han 2018). This is valuable information for planning and development of the landscape.

Experts vs. Citizens in General in Landscape Studies

The subjective aspect of the landscape "can be measured objectively through surveying people's likes and dislikes—their aesthetic preference" (Lothian 2017). Landscape assessment, planning and evaluation depends largely upon

human judgment. However, the human judgement is often discussed over expert vs. citizen perspectives in general (Daniel 2001). Usually, the expert's judgement is based on training and experience. This type of assessment is often based on certain established standards and frameworks (Kaplan and Kaplan 1989) where experts/planners usually compare a particular example that is to be assessed for its value (Daniel 2001) or decide using their own intuition (Daniel and Boster 1976). It is mostly a top-down approach and lacks psychophysical aspects (Liu et al. 2018). Expert domination is generally found in objective resource assessment and is often focused on scientific, ecological, and physical aspects of the landscape (Liu et al. 2018). Citizen opinion is a perception-based approach (Daniel 2001) where neither training nor experience and standards or frameworks are required. It simply deals with human sentiments, stimulation, and interaction with visible landscape characteristics (perception, aesthetic, artistic, etc.) (Antrop 2000; Daniel 2001; Kaplan 1989; Kvan 2013; Zube et al. 1982). So, it is a bottom-up approach. Herzog et al. (1982) pointed out a number of ways in which "citizens' perceptions and preferences differ from those of planners/[experts]." Daniel (2001) pointed out inconsistencies in opinions even between the experts for the same landscape and found that perceptions greatly vary from person to person (U.S. Department of the Interior n.d.). Public perspectives and preferences play a vital role in making right decisions, policies, and plans (Shafer and Brush 1977). A shortcoming of research due to the exclusion of the public was experienced by Lothian in his study in Australia (Lothian 2012; Kvan 2013). Daniel and Vining (1983; as cited by Daniel 2001) criticized expert-based landscape quality assessment "for having inadequate levels of precision, reliability and validity." Jensen (2007) also pointed that "expert-led approaches to landscape assessment are no longer viable as local people might view their landscape very differently from landscape specialist." According to Wartmann et al. (2021), even though there has been significant work done for measuring physical aspects of landscape, there is a lack of information about measuring public perspective and preference.

Photography in Landscape Studies

"People are particularly aware of information that is visual, that concerns what they see" (Kaplan and Kaplan 1989, p. 4). Since the introduction of photography during the nineteenth century, photographs became an important tool in the studies of environmental conditions, including landscapes (Daniel and Meitner 2001; Bergen et al. 1995; Steiner 2009). Photographs are two-dimensional visual representations of landscapes which have been increasingly used as surrogates for an on-site assessment of the landscape

(Lothian 2017). "Few studies provide guidance for photographs" (e.g., Kaplan and Kaplan 1989; Lothian 2017). Both color and black-and-white photographs have been used in the studies of landscapes (Kaplan and Kaplan 1989). Kaplan and Kaplan (1989) have presented both advantages and disadvantages of color and black-and-white photographs in their book *The Experience of nature: Psychological Perspective* (p. 16-17). According to them, the participants' ability to rate photographs was not thwarted by the color or black-and-white photographs. Kellomäki and Savolainen (1984) also noted that "black-and-white photographs may[be] reliable tool[s] for estimating scenic value of forest landscapes." However, Lothian (2017) emphasized color photographs in horizontal view. According to Lothian, "black-and-white photographs emphasizes formalist qualities but lose the life-giving quality that color conveys." This statement is supported by Shuttleworth's (1980; as cited by Lothian 2017) finding that "black and white photographs gave more extreme rating and had lower correlations with field assessments than color."

Different Approaches of Using Photographs in Landscape Studies

Subsequently, different approaches of obtaining and using landscape photographs have evolved in landscape studies. In some studies researchers and professionals take photographs of their interest area and analyze them (Svobodova et al. 2015). In other instances, individuals are provided landscape photographs to rate based on their preferences (Kalivoda et al. 2014; Lothian 2017). In other cases, the individuals are given cameras and asked to take landscape photographs of their interest to get their perspective on landscapes and landscape attributes (Goldberg 2019; Steiner 2009). Dorwart et al. (2010) provided disposable 24-exposure digital cameras to intended visitors and asked them to take photographs of features along the Appalachian Trail, North Carolina. Landscape studies also used other visual imaging techniques such as photomontage, simulation (Mahdjoubi and Wiltshire 2001), graphically enhanced images (Lee et al. 2019; Liu et al. 2018; Lothian 2017, 2012) and videos to present animated landscape scenes such as water motion and public participation geographic information systems (PPGIS) (Brown and Weber 2011). Today, photographs uploaded in the social domains have been widely considered as suitable substitutes for measuring public interest and preference in landscape studies (Bubalo et al. 2019; Callau et al. 2019; Hansen 2016; Richards and Tunçer 2018; Ros-Candeira et al. 2020; Stepchenkova and Zhan 2013; Tenerelli et al. 2016; van Zanten et al. 2016; Wood et al. 2013). These techniques may all be used to study and manage lands.

Other studies also used photographs in combination with other techniques to assess the visual quality as well as preference for landscapes and landscape attributes. Kellomäki and Savolainen (1984) used photographs in combination with questionnaire surveys to assess the scenic value of forest landscapes. They used on-site forest stands and photographs of those stands to see the correlation between the scenic values. They found that the mature stands of moderate density had the greatest scenic value. Hull IV and Stewart (1992) carried out a comparative study of scenic beauty judgements based upon photographs of landscapes and on-site experiences of landscapes in national forests and wilderness areas in Colorado by using the same persons, but in different time periods. They observed insignificant correlations between photo-based and on-site scenic beauty assessments. They concluded that there was an uncertainty in the validity of photo-based scenic beauty assessments. Daniel and Meitner (2001) performed a comparative study of photographs of the forest landscape and computer-rendered photographs of the same forest landscape to assess the representational validity by using different groups of viewers. They noticed a low correlation between the ratings of the two visualizations and uncertainty about the representational validity of the computer-rendered visualizations. A similar approach was used by Bergen et al. (1995) by creating computer images with vantage points. They found a lack of correlation between the two visual representations due to the omission of important landscape elements in the vantage point images. They concluded that the photographic images were promising over the computer-rendered landscape images and noted that this might be useful for preliminary assessment through modification, especially in landscape designing.

However, Scott and Canter (1997) questioned the method of using photographs for individuals to analyze, pointing out that people have limited choices to focus on because the photograph is imposed by the researcher. According to the researchers, photographs are inadequate for eliciting potentially important humanistic factors (actions, thoughts, feelings, etc.) which constrain or do not accurately measure the viewers' preferences for the landscape and landscape features while using photographs (Shuttleworth, 1980a as cited by Kaplan and Kaplan 1989). Daniel and Meitner (2001) also reported that still photographs may not adequately represent potentially important actions. Therefore, they may not be a valid medium for perception studies.

The researches cited above pointed out both pros and cons concerning the use of photographs in landscape studies. This study attempted to investigate public preference through visual as well as cognitive stimulation exercises. This was not a new approach; however, it was used to support and supplement our machine learning approach. This would contribute to an investigation of the findings from different approaches.

Methodology

Study Region

The study region is the proposed Appalachian Geopark (pAGP) and is located in the Appalachian region covering Fayette, Greenbrier and Raleigh counties in WV. The pAGP covers an area of 5963 sq. km. which is approximately 10% of the total area of the state (62,258 sq. km.). Of the total pAGP area, approximately 5923 sq. km. is land and 40 sq. km is water (rivers and lakes) (Fig. 1).

The proposed Appalachian Geopark's landscape is characterized by two major physiographic provinces,¹ namely, Appalachian Plateau and Valley and Ridge. The Appalachian Plateau is composed of a higher rugged section and a relatively flat section which are named as the Appalachian High Plateau Province (Allegheny Mountain) and the Appalachian Low Plateau Province. Of the three counties of the pAGP, whole counties of Fayette and Raleigh lie in the Appalachian Low Plateau Physiographic Province. This province is characterized by flat-lying to gently folded rocks of Pennsylvanian period² and a dendritic stream pattern. The relief of the region is a few hundred feet with the hills between major streams possessing rounded summits and relatively shallow slopes. Greenbrier County lies both in the Appalachian Low Plateau and the Valley and Ridge provinces. The Valley and Ridge Province consists of folded and faulted rocks ranging in age from the late Precambrian³ to the early Mississippian period.⁴ "The steeply dipping folded beds, the harder layers-particularly the sandstone tend to form ridges whereas the softer shale beds with limestone tend to form valleys" (Cardwell 1975). This province is characterized by long folded mountains and parallel valleys made of asymmetric to overturned anticlines exposing rocks from the Ordovician age⁵ (the oldest rocks of this region) and with a trellis stream pattern. There is a structural break differentiating the Appalachian Plateau and Valley and Ridge provinces which is known as the Allegheny Structural Front and is represented by a prominent escarpment/cliff. These fundamental

¹ A physiographic province is a region of which all parts are similar in geologic structure and climate and which had a unified geomorphic history; a region whose pattern of landforms differ significantly from that of adjacent regions.

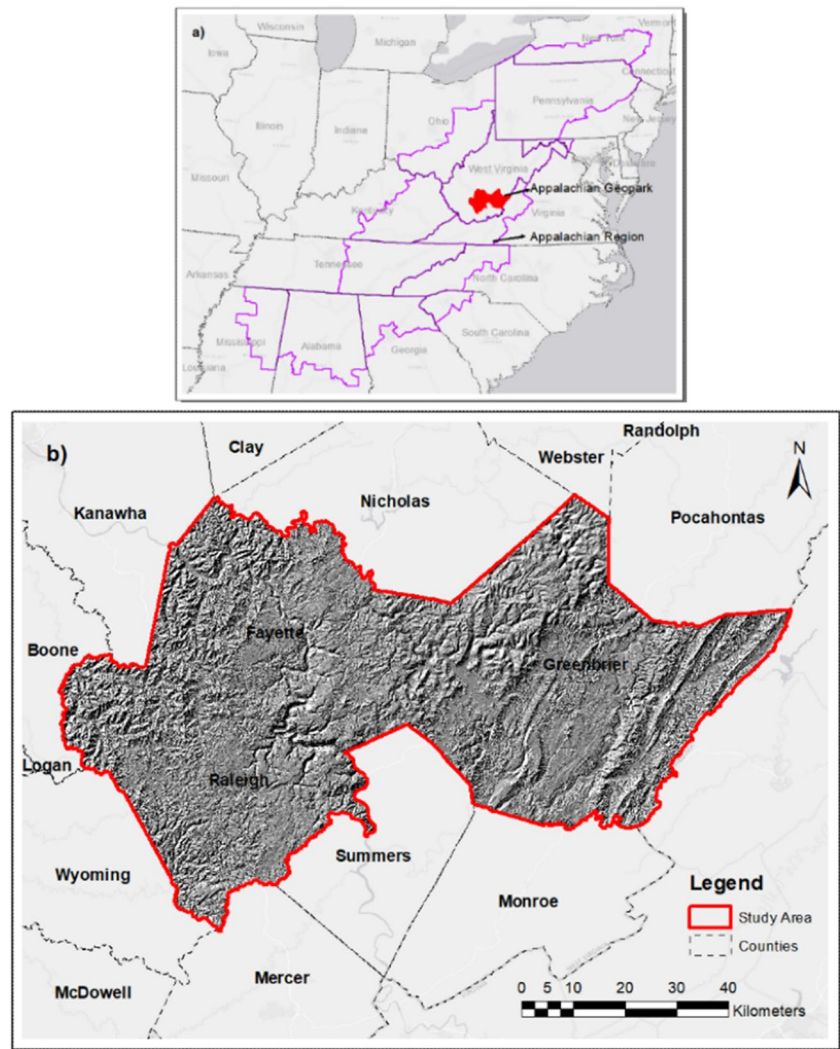
² Pennsylvanian Period began about 315 million years ago and lasted approximately 45 million years.

³ Precambrian began about 4.5 billion years ago and lasted approximately to the beginning of the Cambrian period, 541 million years ago.

⁴ Mississippian Period began about 345 million years ago and lasted approximately 30 million years.

⁵ Ordovician Period began about 488 million years ago and lasted approximately 444 million years.

Fig. 1 (a) The whole state of West Virginia lies in the Appalachian Region. The study region is the proposed Appalachian Geopark encompassing three counties: Fayette, Greenbrier, and Raleigh. (b) The study region consists of mountains and valley and ridges. Greenbrier County has more flat areas compared to other two counties



structures along with the action of wind, water, heat, glaciation, vegetation, wildlife, and anthropogenic activities determine landscape characters in the pAGP (Figs. 2 and 3).

“The Appalachian Low Plateau is composed of sedimentary rocks including sandstone, conglomerates and shales deposited during the late Paleozoic era”⁶ (National Park Service 2018). A large part of the study region is represented by sandstone (69%) followed by shale (19.5%), limestone (4%), and others such as alluvium, and a combination of sandstone and shale as well as sandstone and limestone. The majority of Raleigh and Fayette counties is made up of sandstone with some shale and siltstone making the area unique with high and magnificent rock cliffs, canyon walls, gorges, and valleys. In addition, the plateau region consists of coal beds due to the deposition of plants and animals in between the

hard sedimentary rocks, whereas the distribution of shale and limestone became the major bedrock in the Greenbrier County, featuring wide valleys, gently rolling hills, and flatter land. The imperviousness of shale and its deposition made the Greenbrier County suitable for karst landscapes in the form of caves, caverns, sinkholes, etc. According to Dasher (2000), in WV, if there is coal, there is generally no significant karst, and if there is karst, there is no coal (Fig. 5).

Coal towns in sandstone and karsts in limestone-rich areas are represented by green triangles. Caves and caverns are represented by red polygons. The very different landscapes in eastern and western ends are evident.

The remarkable landforms and landscapes such as deep gorges, ancient rivers, mountains, and karsts along with mixed-mesophytic forests, land-use history, and archeological significances are some influential characteristics that have provided recreational, educational, scientific, aesthetic, and economic values in the pAGP. These attributes

⁶ Paleozoic era—the earliest geological era dating back from 541 to 251 million years ago.

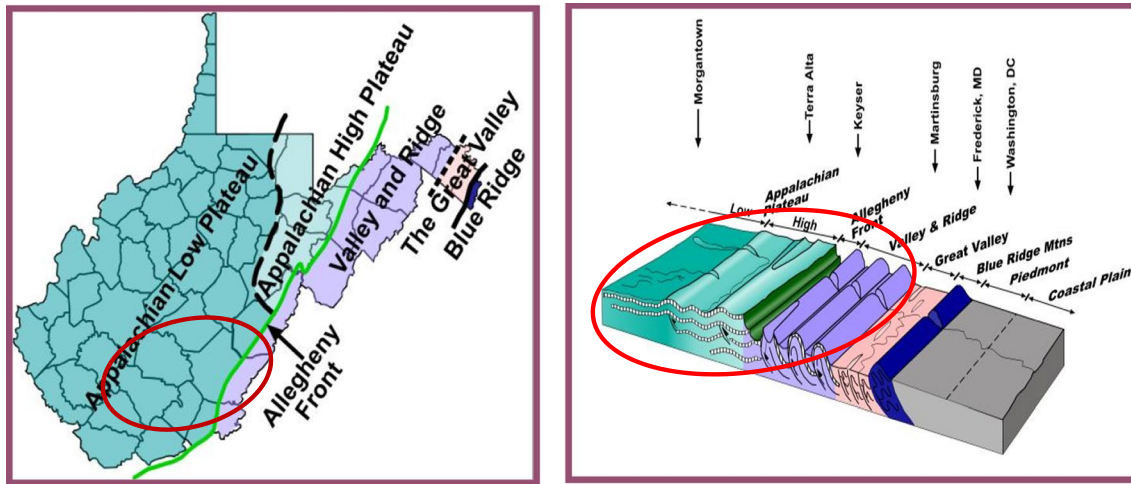
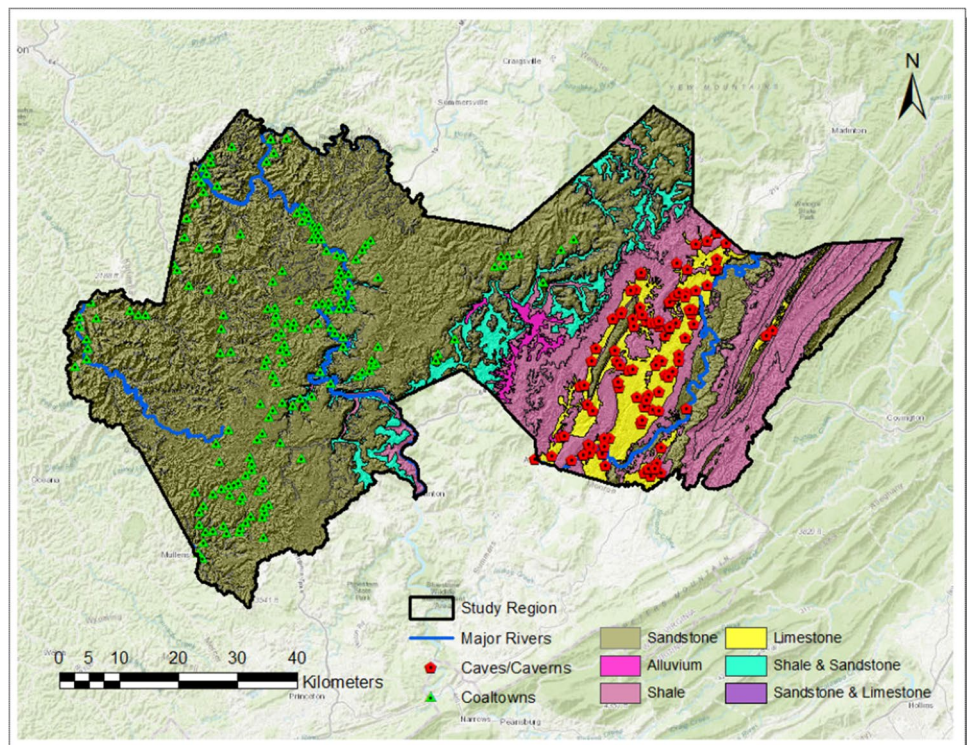


Fig. 2 Appalachian low plateau and valley and ridge provinces (source: 2016 Geologic History of WV John J. Renton & Thomas Repine. The red circles represent the physiographic provinces of the study region)

Fig. 3 Distinctive geology of landscape due to sandstone and limestone-rich areas



are the potential nature merchandizing assets of this region that support a Geopark concept. *Even though the USA was a founding member of the United Nations Educational, Scientific and Cultural Organization (UNESCO), it withdrew the membership in 2018. At the time of this writing, there is no avenue forward for gaining Geopark designation. However, there are three aspiring Geoparks in the U.S. There is currently no regional geopark network in North America.* The New River Gorge is one of the most prominent landscape features in the pAGP and was designated as the New

River Gorge National Park and Preserve (NRGNP&P) in 2020. The Gauley River National Recreation Area, Blue- stone National Scenic River, and the underground wonders of caves and caverns are other attractions in the pAGP (National Park Service 2012). According to the NPS, about 1.4 million people visited the New River Gorge and two other scenic areas nearby in 2019. There was an increase of 20% in visitors after receiving a national park designation. We can expect more visitors if the pAGP receives an official Geopark designation.

In the pAGP, approximately one-third of land resources is owned by private sectors (corporates, individuals). More land in the study region is owned by private absentee owners. Kayden (2000) reported that the “states have constitutional authority under so called ‘political powers’ to plan and regulate the use and development of land.” The public land/water resources in the pAGP have been managed by agencies under federal, state, and local principles of conservation, protection, multiple use, and sustainable development. The National Park Service (NPS) manages the NRGNP&P. The National Forest Service (USFS) manages federally owned forests. The West Virginia Department of Natural Resources (WVDNR) manages wildlife management areas and the West Virginia Division of Forestry (WVDOF) manages state owned forests.

Research Instrumentation

Initially, the research instruments were designed to utilize in the study region for face-to-face interviews and group discussion as direct approaches. Because of the unforeseen situation of COVID-19, instruments were developed in the form of anonymous links. In this paper, two methods of assessing public preferences of landscapes and landscape attributes were implemented. They were as follows:

Photograph Rating

This is a photo-based, visual stimulation exercise. We took approximately 1000 photographs during several field trips. These photographs were taken using smart phones and digital cameras. Taking photographs during field visits helped us become more familiar with the study region. They were taken from the grounds, hill tops and overlook outlets, etc. Seventy selected photographs that represented various types of landscapes including natural, natural looking, and historical and cultural landscapes of the study region were used to develop a Photograph Rating survey instrument using Qualtrics software. Some photographs consisted of a single attribute that helped make up the landscape scene. Color photographs in landscape format (i.e., horizontal) were used assuming that the color photographs and horizontal view conveyed a natural look. We selected photographs that exhibited disturbance free objects (e.g., pole, animals, people, etc.) as best as possible. For instance, photographs were not modified digitally by removing grazing animals in the pasture landscape scene.

A preference rating scale was designed with a sliding scale bar consisting of 1–10, where 1 is the lowest and 10 is the highest preference score. The respondents were asked to slide the sliding bar to a point of their interest to show their preference for landscape and landscape attributes (i.e., the degree of preference value need not

necessarily be an integer). We chose to use the sliding bar to get more granularity in the preference rating. However, this approach is not immune to the shortcomings of the traditional 5–7 Likert scale. It too may fail to measure the true attitude of respondents. People’s answers can be influenced by preceding questions, and individuals can be reluctant to choose the extreme options even when they are the most accurate.

Questionnaire Survey

This survey is a cognitive-based elicitation. An anonymous link of the questionnaire survey was constructed by using ArcGIS Survey123 which is a map and form-based product useful for creating, sharing, and analyzing surveys. The majority of questions were structured to keep the method simple, clear, and relevant with approximately 20% open-ended questions. Most questions were developed using a Likert scale from 1 to 5.

Data Collection

The target population for the study was the public in general including both residents and visitors. A list of emails of different government agencies, public organizations, and individuals was prepared. The accessible population were all the populations that we contacted via emails/social media. We planned to obtain data using simple random sampling. However, this was impossible due to COVID-19. Thus, the sample was obtained via a self-selective statistical process, typically termed to be “convenience” sampling (Babbie, 2010 in Kalivoda et al. 2014). Anonymous links of Photograph Rating Method and Questionnaire Surveys were distributed through emails and social media. Respondents were invited to participate in the surveys and to share the survey instruments with those who were interested in participating in the survey. The survey links were also distributed among friends, colleagues, and associates. Because we distributed anonymous survey links and encouraged email recipients to share the links for participation and most of the respondents were not associated with the researchers, our only option was to assume that the sample was representative of the population of visitors and residents.

Two online surveys were employed to collect input from respondents. Both the Survey123 and Qualtrics surveys were publicly available on the internet. Both products collect responses on their web servers and made the survey results available to us as developers. We imported the results into spreadsheets and a database for aggregate analysis and statistical processing. The survey instruments provided instructions on how to take the survey.

Data Analysis

A data matrix was prepared in Excel. The data was then analyzed using the statistical software John's Macintosh Project (JMP). JMP is a powerful statistical analysis software and a subsidiary of the Statistical Analysis System (SAS)⁷ Institute. The scenes were categorized into different visual types, and means were calculated. The mean scores represent preferences for the scenes. Ratings of the landscape scenes (photographs) represent the preference assigned to them by the viewers (Kaplan and Kaplan 1989; Lothian 2017). Landscape scenes contain physical attributes that remain constant regardless of who is viewing the scenes. The ratings given to the landscape scenes by the viewers refer to the observed variables which may largely be influenced by characteristics associated with the viewers (Kaplan and Kaplan 1989; Lothian 2017) such as gender, age, emotions, familiarity, and benefits. The data was analyzed by comparing the means that each visual type scored. We also assumed that the higher the mean for a scene/visual type or attribute, the higher the preference of the viewers to that particular landscape scene/visual type or landscape attribute.

Categorization of Photographs

The photographs were chosen to cover the representative landscape types which included rivers, creeks, forests, trails, buildings (commercial, historical, residential), townscapes, parks, highways, country sides, etc. The selected photographs were categorized into different landscape character types for further analysis.

First, the photographs were categorized into three major visual types such as:

1. Natural visual type: this type consists of only natural landscape visual types that were without any human induced or built features in them.
2. Natural appearance visual type: in this type, those photographs that were natural looking, but are not natural in-deed, were considered. Man-made lake landscapes, for example, represent this type of landscape.
3. Historical/cultural/built visual type: as the name suggests, this type of landscape consisted of historical and cultural (human induced features) attributes in the photographs.

Second, the photographs were categorized based on landscape features such as water, vegetation, and built features.

1. Water feature
2. Vegetation feature
3. Built features

Third, the photographs were categorized based on unique natural and built features because they act as the center of attraction, and viewers compose landscape based on these features (Karjalainen and Tyrva 2002).

1. Unique natural feature
2. Unique built feature

We set up hypotheses as follows:

- Null hypothesis (H_0): there is no difference in the preferences of each of the different categories of visual types of landscapes (i.e., preference to all landscape categories of visual types is equal).
- Alternative hypothesis (H_1): there is at least some variation between the preferences of each of the categories of different visual types (i.e., at least two of the preferences are not equal).

We then tested three sets of hypotheses, each set corresponding to one of the visual category types to investigate if the landscapes and landscape attributes matter to respondents by comparing the mean preference that each of the categorized landscape types obtained. A generalized analysis of variance (ANOVA) was performed to assess the difference between the preference means of these different landscape character types by using statistical software JMP. The general assumption was that the observations are independent of one another and the sample data was representative of the population of residents and visitors.

Figure 4 shows a stepwise process of photograph rating method.

Results

General Findings

Unsurprisingly, as previous studies found, we received the highest mean preference for natural landscapes with forest and water features indicating that these features were mostly preferred by the respondents. The bar chart (Fig. 5) showed an order of mean preferences for landscape and landscape attributes. The natural features including New River and forest landscapes received the highest mean scores between 7 and 8. The lowest mean score was obtained for a commercial landscape scoring between 2 and 3 (Fig. 6).

⁷ SAS = statistical analysis system.

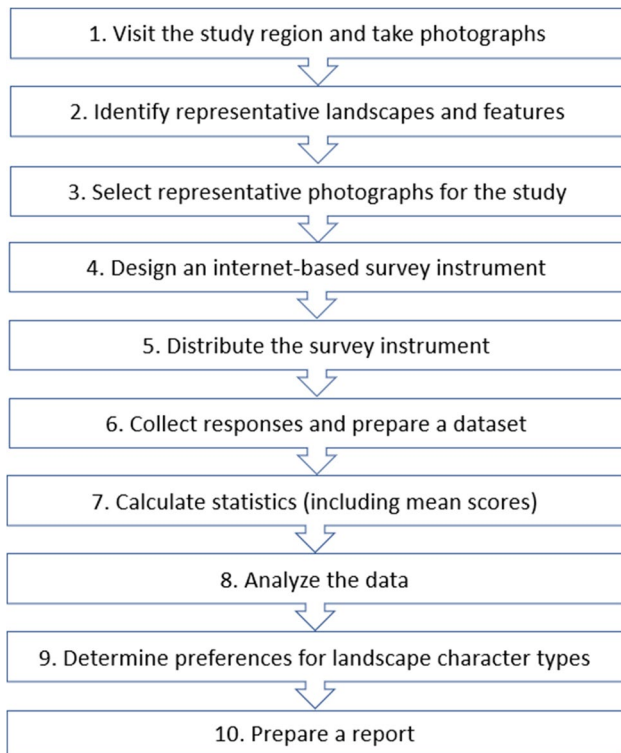


Fig. 4 Photograph rating method (adopted and modified from Lothian, 2017)

Preference Using Landscape Visual Types

Upon testing the hypothesis, the JMP output showed that the p -value was less than 0.05,⁸ i.e., $p \leq 0.0001$ (Table 1). This p -value indicated that the null hypothesis must be rejected. This means the alternative hypothesis was more likely to be correct rather than the null hypothesis. This revealed that there was some variance in the preferences of the three visual landscape types.

For post hoc analysis, we performed multiple comparisons using Student's t -test to determine how participants' preferences differ for different visual types. The JMP output showed all p -values being less than 0.05 (Table 2). This test showed that preferences for the three visual types were statistically significantly different from each other. Figure 7 presented discernible display of the mean preferences of the respondents.

Preference Using Landscape Feature Types

We also looked at major landscape features such as water, vegetation, and built features to investigate how participants' preferences differ from each other. The resulting p -value of

⁸ In one-way ANOVA, I chose the significance level to be $\alpha = 0.05$. The symbol asterisk in the tables was a part of the output of the statistical analysis. Generally, one asterisk (*) reflects a p -value is less than 0.05. I used a 0.05 significance level in data analysis.

0.0001, which was less than significance level ($\alpha = 0.05$), indicated that the null hypothesis must be rejected and the alternative hypothesis was more likely to be correct. This illustrated that there was a statistically significant difference in the mean preferences of the three types of landscape features (Table 3).

We then conducted post hoc multiple comparisons using Student's t -test. This resulted in all p -values of less than 0.05 (Table 4). These provided sufficient evidence to conclude that water, vegetation, and built features were preferred differently (Figs. 8 and 9).

Preference Using Unique Landscape Feature Type

Studies (e.g., Karjalainen and Tyrva 2002) noted that when viewing a landscape, people focus their attention on unique features forming the landscape. We tested how viewers' preferences for unique natural feature and unique built feature differ in the study region. The ANOVA resulted in a p -value of 0.0554 (Table 5) which was slightly greater than $\alpha = 0.05$. This indicated that the two means were not statistically significantly different.

The pooled t -test table exhibited a result similar to the ANOVA. Notice that the p -values were the same (p -value = 0.0554) (Table 6). This was to be expected when our effect variable in the ANOVA had only two possible levels, i.e., unique natural feature and unique built feature.

This result was further supported by the 95% confidence interval on the difference of the two mean preferences. This confidence interval contains the value 0. This implies that 0 is a plausible or believable value for the difference of these two means, further implying that the two mean preferences were not statistically significantly different. Unique natural feature had a mean of 7.25 compared to the unique built feature mean of 6.01. This indicated that the respondents were attracted by the natural unique feature approximately equally with the built unique feature. New River Gorge Bridge, Grist Mill of Babcock State Park, unique rock cliffs, and historic buildings in the town center were some examples that supported Karjalainen and Tyrva's (2002) statement in the study region (Fig. 10). These unique features provided conspicuous vistas with which people form landscapes.

Gender, age, and residency were chosen as anonymous demographic classification. Where the respondents reside and who they are influence their preferences. The sections below expand our findings on each of these classifications (Table 7).

Preferences by Demographic Measures

We tested for consistency of respondents' preferences with respect to some demographic measures by calculating standard deviations. Standard deviation is the spread

Fig. 5 Order of respondents' mean preferences for landscapes and landscape features (the numbers next to the pictures are the photograph identifier number)

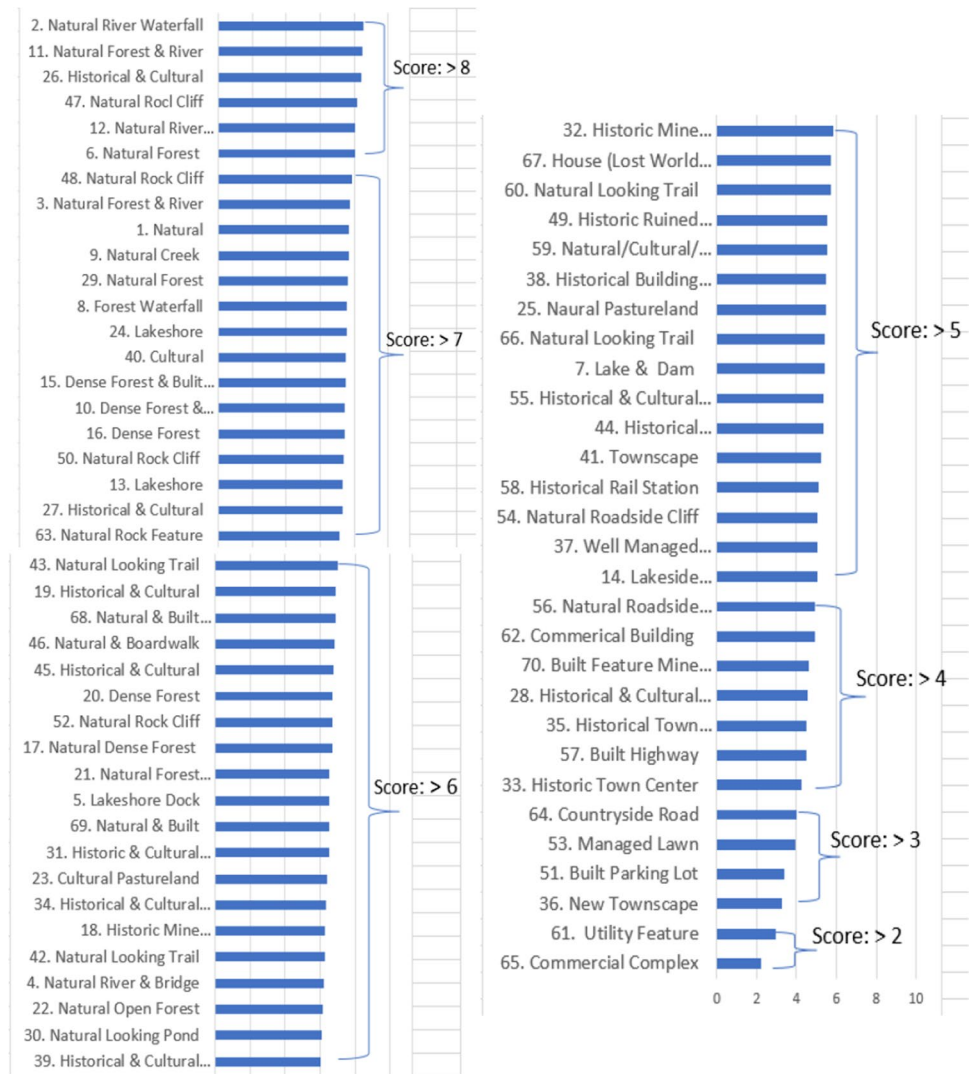


Fig. 6 Most preferred (left) (number 2) and least preferred (right) (number 65) landscape scenes/photographs (photography by March G. Nakarmi, 2020)



of the data from the mean value that helps measure consistency of opinions among respondents. A low standard deviation suggests preferences are fairly similar whereas a high standard deviation suggests diverse preferences

(Lothian 2017). Table 8 shows that rivers and forested mountains have smaller standard deviations, i.e., more clustered around the mean preferences which indicates for consistency.

Table 1 Preferences using landscape visual types

Analysis of variance					
Source	DF	Sum of squares	Mean square	F ratio	Prob > F
Landscape visual types	2	54.52	27.25	21.64	< .0001*
Error	67	84.41	1.26		
C. total	69	138.93			

p-value less than 0.05

Testing Preference for All Landscape Character Types Using Gender

We performed several two-tailed tests using a significance level of 5% for all landscape character types. We investigated whether the preferences differed according to gender. The results revealed all p-values greater than 0.05, so we cannot say that there is a statistically significant difference in mean preferences for males and females (Table 9).

Table 2 Multiple comparison of preferences using landscape visual types

Level	-Level	Difference	Std Err Dif	Lower CL	Upper CL	p-value
Natural	Historical/cultural	1.99	0.30	1.38	2.59	< .0001*
Natural	Natural appearance	1.12	0.45	0.23	2.02	0.0144*
Natural	Historical/cultural Appearance	0.86	0.41	0.04	1.69	0.0413*

p-value less than 0.05

Fig. 7 Mean preference scores for natural, natural looking, and historical and cultural visual types

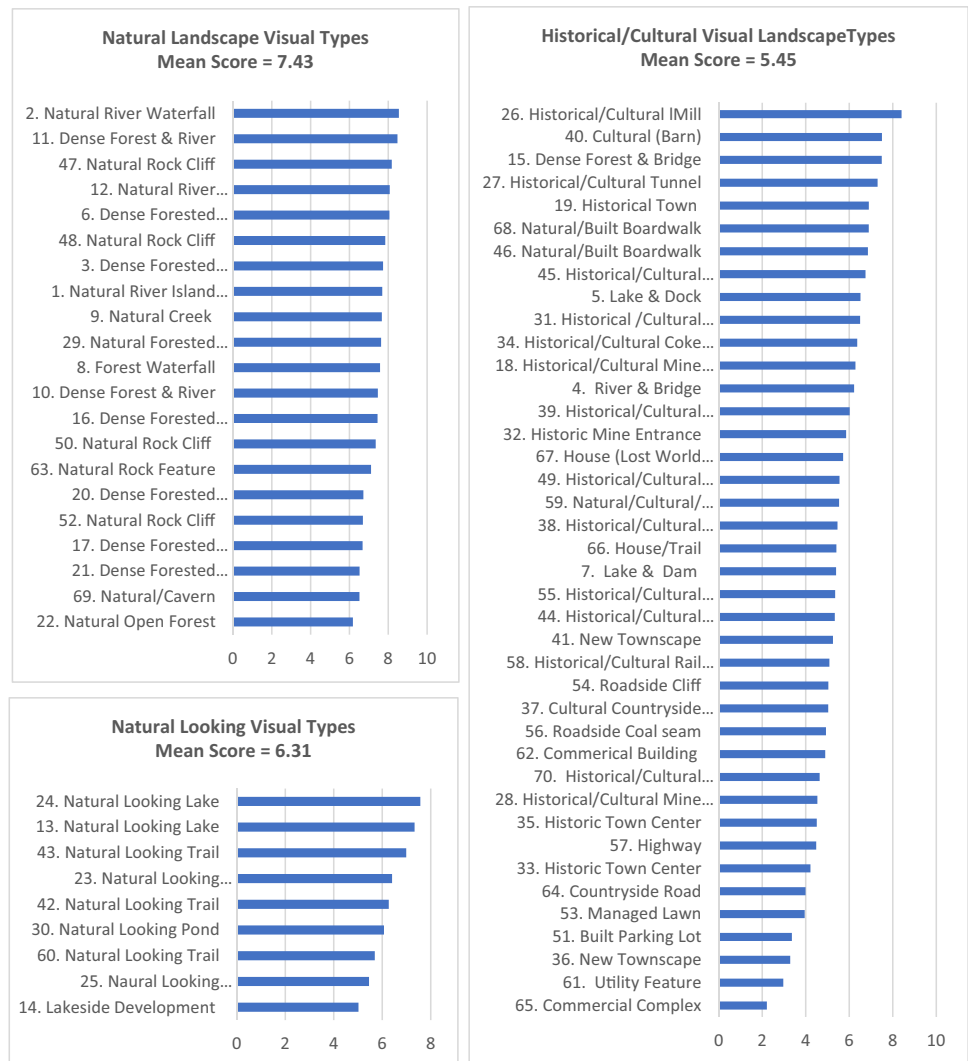


Table 3 Preferences using landscape features

Analysis of variance					
Source	DF	Sum of squares	Mean square	F ratio	Prob > F
Landscape visual types	2	34.39	17.20	9.74	<.0001*
Error	114	201.19	1.76		
C. total	116	235.58			

p-value less than 0.05

Testing Preference for All Landscapes Character Types Using Residency Status

Upon performing a two-tailed test for preferences for visitors and residents under the significance of 5%, the p-values that were greater than 0.05 show that we cannot say there was a statistically significant difference in mean preferences for visitors and residents. For example, the mean preferences for rivers were not statistically significantly different between visitors and residents (Table 10).

Table 4 Multiple comparison of preferences using landscape features

Level	Level	Difference	Std Err Dif	Lower CL	Upper CL	p-value
With water feature	With built feature	1.62	0.38	0.87	2.38	<.0001*
With water feature	With vegetation feature	0.91	0.37	0.18	1.64	0.0151*
With vegetation feature	With built feature	0.72	0.27	0.19	1.25	0.0085*

p-value less than 0.05



Fig. 8 Landscape visual types: **a** natural. **b** Natural looking. **c** Historical/cultural (photography by G. Nakarmi, March 2020)

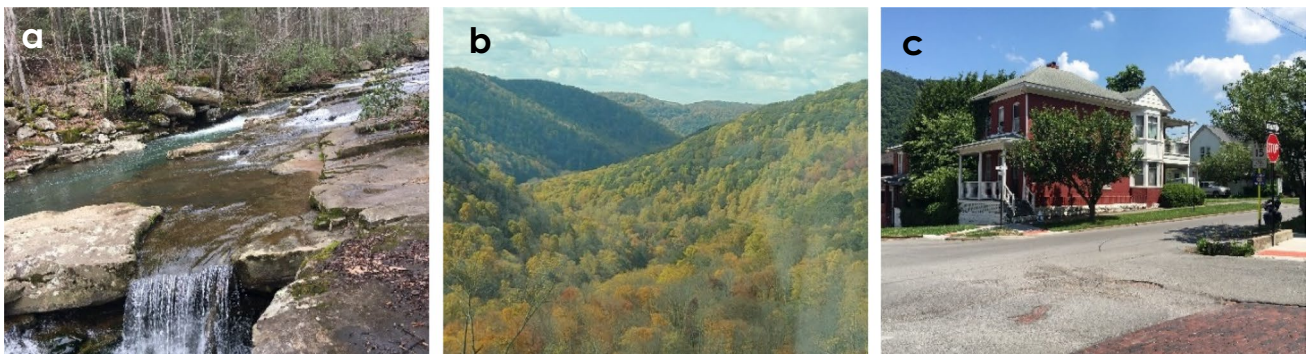


Fig. 9 Landscape features: **a** water. **b** Vegetation. **c** Built (photography by G. Nakarmi, March 2020)

Table 5 Preferences using unique features

Analysis of variance					
Source	DF	Sum of squares	Mean square	F ratio	Prob > F
Landscape visual types	1	5.07	5.06	4.1	0.0554
Error	21	25.68	1.23		
C. Total	22	30.95			

Table 6 Pooled *t*-test using unique natural feature–unique built feature assuming equal variances

Difference	1.2385	<i>t</i> ratio	2.028165
Std error difference	0.6107	DF	21
Upper confidence level difference	2.5085	Prob > <i>t</i>	0.0554
Lower confidence level difference	−0.0314		
Confidence	0.95		

a indicated that there was an interaction between gender and age with respect to natural/scenic mean preferences. The preference for natural/scenic landscape for females’ age 18 to 30 years was less than that of males. However, the preference for 31–50-year-olds was found to be the opposite. The preference remained the same for females when age increased from 51 to 70, but males’ preference increased along with the increase of age from 51 to 70 years. Likewise, preference decreased drastically as females became older, 70+, whereas the males’ preferences did not change with the increased years. Figure 11 b indicated there was not an interaction between age and gender with respect to historical/cultural mean preferences. Males’ preference for historical/cultural landscape was higher than that of females regardless of age.

Interaction of Gender and Residency Status

We also tested preferences with respect to gender and resi-



Fig. 10 Unique natural and built features that make landscape: **a** rock cliff, **b** historical mill, and **c** bridge (photography by G. Nakarmi, March 2020)

Table 7 Attributes of the respondents

Demography	Gender		Age groups (years)				Residency	
	Male	Female	18–30	31–50	51–70	70+	Resident	Visitor
Respondents	19	28	4	12	20	8	22	24

The *p*-values less than 0.05 showed that we can say there was a statistically significant difference in mean preferences for visitors and residents. For example, the mean preferences for forested mountains were statistically significantly different between visitors and residents.

Interaction of Gender and Age Group

We performed a two-way ANOVA and constructed an interaction plot (least square means plot) (Fig. 11) to investigate the relationship between age group and gender for both natural/scenic and historical/cultural landscape types. Figure 11

dency status. In the interaction plot, Fig. 12a, there was an interaction between residents and visitors with respect to natural/scenic landscapes. The male residents’ preference for natural/scenic was relatively less than that of female residents. The male visitors’ preference was higher than the female visitors. For historical/cultural landscapes, there was not an interaction between gender and residency status. Males’ preference for historical/cultural landscapes was higher than that of females regardless of age (Fig. 12b).

The participants reported the New River Gorge and Bridge as the highest preferred places of the pAGP, followed

Table 8 Preferences for landscape character types using the entire sample

Landscape character types	Sum	Mean	Std Dev	Variance
Rivers	220	4.68	0.52	0.27
Forested mountains	224	4.77	0.56	0.31
Streams	217	4.62	0.57	0.33
Unique geology	217	4.62	0.61	0.37
Forested valleys	213	4.53	0.65	0.43
Woodlands	213	4.53	0.65	0.43
Waterfalls	220	4.68	0.66	0.44
Forested ridges	217	4.62	0.68	0.46
Distinctive rocks	211	4.49	0.69	0.47
Natural/scenic landscapes	213	4.73	0.75	0.56
Historic townscapes	194	4.13	0.82	0.68
Rural landscapes	184	4.00	0.97	0.93
Birds/wildlife	197	4.19	0.97	0.94
Urban landscapes	93	2.02	0.98	0.96
Monuments	183	3.98	0.98	0.96
Lakes/dams	181	3.93	0.98	0.95
Churches/cemeteries	143	3.11	1.02	1.03
Caves/caverns	186	3.96	1.02	1.04
Historic/cultural landscape	177	3.85	1.03	1.07
Highways	105	2.28	1.09	1.19
Bridges	175	3.80	1.09	1.18
Wetlands	182	3.87	1.10	1.20
Pastures/grasslands	168	3.57	1.10	1.21
Croplands	133	2.89	1.10	1.21
Townscapes	185	3.94	1.11	1.23
Springs	176	3.91	1.14	1.31
Orchards	169	3.60	1.14	1.29
Farmsteads	172	3.66	1.18	1.40
Railways	159	3.46	1.19	1.41
Swimming pools	119	2.59	1.39	1.94
Mining sites	122	2.65	1.59	2.54

by Greenbrier River Trail, Babcock State Park, Lewisburg, and others (Fig. 13).

The respondents' preferences for landscapes and landscape features for recreational activities is the highest for trails, rivers, woodland forests, and campsites. They preferred those landscapes and landscape features mostly for hiking, biking, canoeing, kayaking, swimming, fishing, hunting, vacationing, climbing, and others (Fig. 14). Surprisingly, the preference was less for karst landscape such as caves and caverns.

Discussion

Using photographs as surrogates of landscapes and landscape attributes and questionnaire surveys are common processes in landscape studies and planning, and have

been used in evaluations for years. Photographs are two-dimensional visual representations of landscapes while the questionnaire survey is designed to elicit information from participants where cognitive processes are often used. Also, the photography depends on what the landscape offers, what catches viewers' eyes, how pleasant and unique the location is. and so on. We used color photographs. However, Kaplan and Kaplan (1989) and others reported that small black-and-white printed photographs were more reliable over the badly colored photographs and concluded that preference rating by viewers was not hampered. In addition, it was cost effective.

Content in the photographs has a strong impact on preference (Herzog et al. 1982), and this statement aligned with Gibson's theory of affordance (as cited by Herzog 1987). As was true in the previous studies, naturalness was the highest preferred landscape in the pAGP. The landscape visual types with vegetation and water features were the highest preferred landscapes. The highest preference was obtained for densely forested mountains, hills, valleys, and woodlands. However, Daniel (2001) noted that a relatively flat landscape with dense forest vegetation does not offer vista perspectives and was less preferred as a result. According to Herzog et al. (1982), vegetation is a potential content category that increases preferences, and thus, the presence of vegetation can improve urban landscape. We found rivers, waterfalls, and creeks as the most important water features probably due to the significance of the New, Gauley, Kanawha, and Greenbrier Rivers and the associated waterfalls and creeks for scenic and recreational values. Peng and Han (2018) reported a similar result of preference for vegetation and water. Arriaza et al. (2005) used photos and regression analysis to assess public preferences on agricultural landscapes. According to them, degree of "wilderness and positively evaluated man-made features play a key role in determining the visual quality of the rural scenes." The respondents also opined that the geology, distinctive rock and cliff, rock types, forests, and wildlife made this region different from other regions. They also reported that increased tourism would be the best way to improve the economic activities of the region. Therefore, implementing a geopark and geotourism may have a potential role in developing this region.

Surprisingly, although the study region abounds with karst landscapes such as caves and caverns, the respondents reported their preference relatively low. This may be because the photograph rating instrument did not consist of many photos of caves and caverns since they are subordinate landscapes or people have very limited or no information about this attribute in the study region. The reason for this limited access may be due to a lack of publicity because of White Nose syndrome or some safety issues. Only Organ Cave and Lost World Caverns were famous among the visitors. There may be a need for prior contact with cave owners to visit the caves and caverns. We visited Organ Cave and

Table 9 Differences in mean preferences according to gender (male–female)

Landscape character types	Difference	<i>p</i> -value	Landscape character types	Difference	<i>p</i> -value
Distinctive rocks	−0.379	0.062	Railways	−0.150	0.677
Unique geology	−0.328	0.069	Natural/scenic	0.074	0.749
Swimming pools	−0.731	0.079	Forested mountains	0.039	0.815
Historical/cultural	0.432	0.167	Lakes/dams	−0.068	0.818
Highways	−0.391	0.233	Townscapes	−0.069	0.835
Farmsteads	0.394	0.266	Orchards	0.060	0.860
Rivers	−0.171	0.268	Streams	0.024	0.887
Wetlands	−0.315	0.337	Monuments	0.037	0.901
Historical townscapes	0.227	0.358	Forested ridges	0.024	0.905
Waterfalls	−0.171	0.391	Urban landscapes	−0.035	0.905
Mining sites	−0.393	0.415	Bridges	−0.025	0.939
Birds and wildlife	−0.233	0.424	Forested valleys	−0.009	0.962
Caves/caverns	−0.193	0.529	Woodlands	−0.009	0.962
Springs	−0.222	0.529	Croplands	0.005	0.986
Rural landscapes	−0.182	0.537	Churches/cemeteries	0.003	0.989
Pasturelands/grasslands	0.184	0.578			

Table 10 Differences in mean preferences according to residence status (visitor–resident)

Landscape character types	Difference	<i>p</i> -value	Landscape character types	Difference	<i>p</i> -value
Swimming pools	−1.181	0.003	Farmsteads	0.159	0.656
Mining sites	−1.231	0.008	Railways	0.158	0.663
Croplands	−0.751	0.021	Bridges	−0.124	0.708
Forested mountains	0.325	0.049	Rural landscape	0.087	0.763
Forested ridges	0.295	0.144	Monuments	−0.088	0.764
Lakes/dams	−0.397	0.179	Caves/caverns	0.090	0.769
Streams	0.208	0.224	Orchards	−0.094	0.783
Unique geology	0.208	0.254	Townscapes	−0.083	0.803
Woodlands	0.215	0.271	Pasturelands/grasslands	0.079	0.810
Distinctive rocks	0.174	0.399	Historical/cultural landscape	0.056	0.854
Birds and wildlife	−0.234	0.423	Wetlands	0.056	0.862
Rivers	0.113	0.457	Natural/scenic landscape	0.035	0.875
Forested valleys	0.128	0.513	Churches/cemeteries	0.039	0.899
Historical townscapes	−0.143	0.555	Springs	−0.035	0.920
Highways	−0.189	0.567	Waterfalls	−0.015	0.939
Urban landscape	−0.132	0.651			

Lost World Cavern with a prior contact with the cave owners. More consultation and strategies should be developed to promote the karst landscapes in the study region because this is a strength of this region that possesses potential for geopark and geotourism development.

People tend to visit popular areas (Antoniou et al. 2010) that are easily accessible (Gill et al. 2015; Muñoz et al. 2020) and possess elements of interest (Gill et al. 2015; Karjalainen & Tyrva 2002). This information is true in the case of the study region. Despite being potentially attractive, only a few locations are popular among the public (Fig. 13).

We found different preferences given the age and residency status for natural/scenic and historical/cultural

landscapes. For instance, females of 70+ years were less attracted to natural/scenic landscapes. This may be because at that age, they tend to go out in nature less than males do.

Since landscape is an end product of human-interaction with land resource, landscape management is basically a management of people, their perspective and behavior which is not an easy task. Because landscape means different things to people and can be described in varying perspectives, there is not a concrete or universally accepted single approach in terms of its studies, planning, evaluation, and management. While talking about aesthetic preference, objectivity, and subjectivity, there is a concern that “if everyone is different,

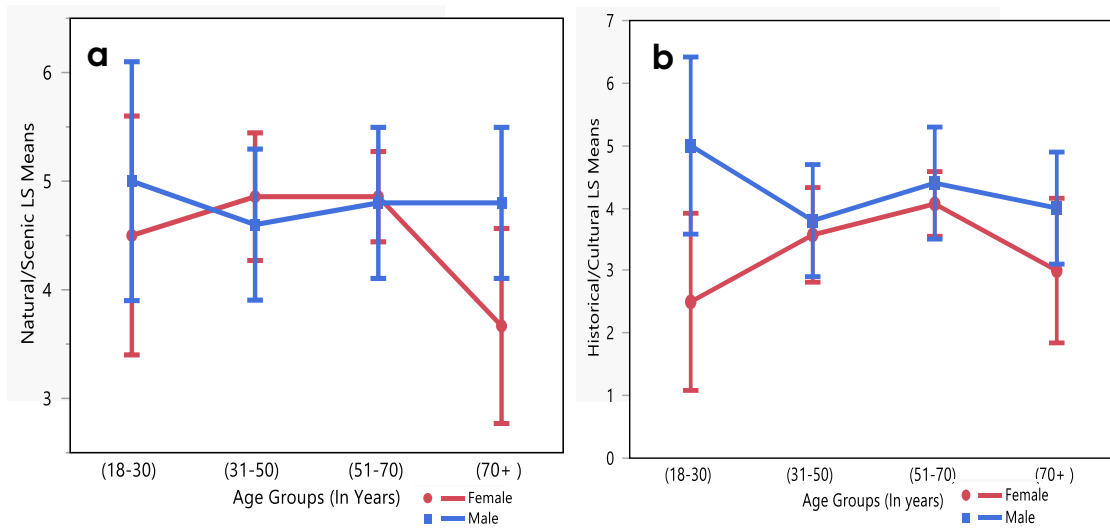


Fig. 11 Preference ratings by gender and age groups. **a** Gender preference by age group for natural/scenic landscapes. **b** Gender preference by age group for historical/cultural landscapes

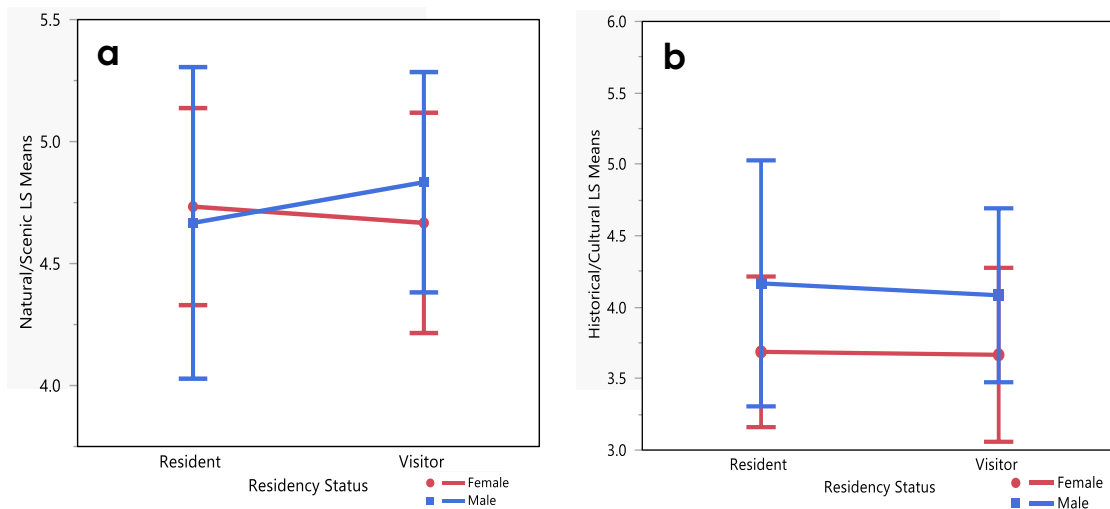


Fig. 12 Preference ratings by gender and residency status. **a** Gender preference by residency status for natural/scenic landscapes. **b** Gender preference by residency status for historical/cultural landscapes

then preference is a matter of taste and irrelevant to policy” (Michigan Law Review 1973).

The findings contained herein would be beneficial to the planning authorities in the counties, cities, and towns to raise awareness about potential utility of the landscapes and geological heritages for tourism through new concepts of geopark and geotourism. Although visiting geological heritage sites in general has been considered a part of tourism development for a long time, it has emerged in its own importance since the development of the Geopark concept and the network between the participating countries called the Global Geopark Network

(GGN). The GGN member countries get benefits through knowledge sharing in terms of raising awareness about earth sciences, geological values, consequences, and economic development through tourism development (Ólafsdóttir and Tverijonaite 2018).

There are certain limitations to this study, especially for the photograph ratings part of the survey. Some respondents reported that they could download the survey only partially. Therefore, it is of utmost importance to ensure adequate internet facilities, especially for a photograph rating method that is accessed through an anonymous link.

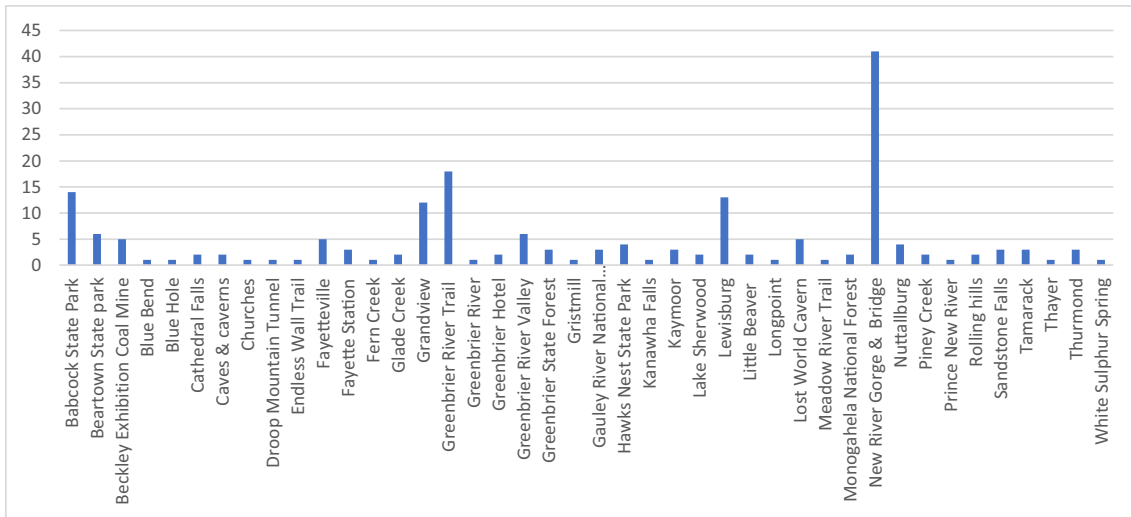


Fig. 13 Most preferred places reported by the respondents (vertical axis represents the frequency of responses)

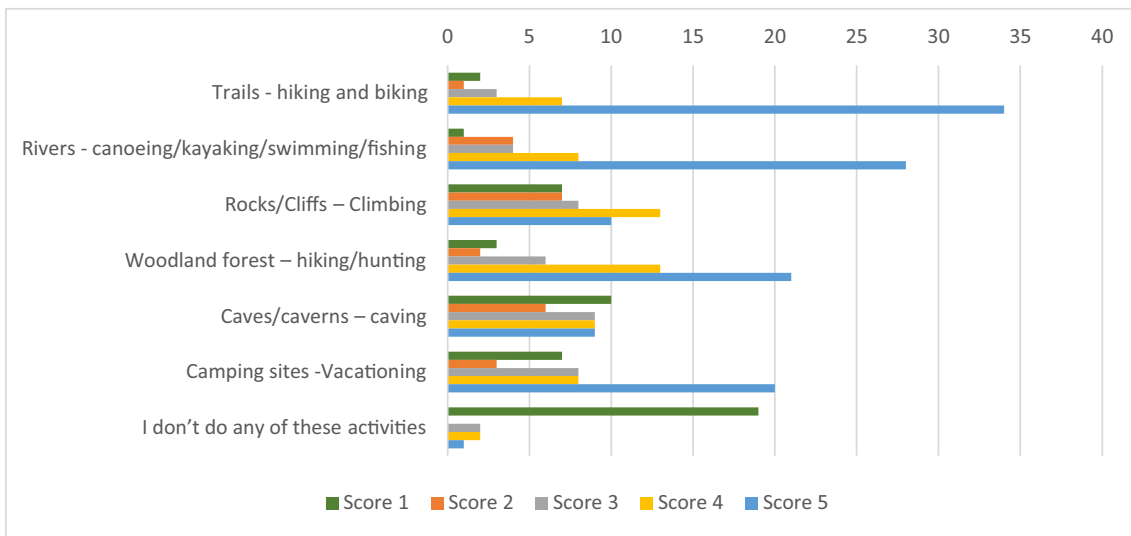


Fig. 14 Recreation preferences (bars represent number of responses for each score)

Conclusions

Questionnaire and photograph ratings are both simple and straightforward methods for assessing public preferences of landscape and landscape features. A combined approach of photographs and questionnaires provided greater potential for understanding respondents’ preferences for landscape character types. We looked at the character types from different perspectives such as visual, feature, and individual and unique elements. A combined approach enabled us to look at preference in relation to demographic aspects. This approach can be applied in other areas at any scale and with any kinds of variables.

Overall, the study revealed that the participants’ preference increases with the increase of degree of naturalness and unique built features in the landscape scenes. Naturalness has a strong impact on preference. Natural and natural looking landscapes were preferred over cultural landscapes. Also, forest and water features were highly preferred landscape attributes. Such studies could provide a basis for comparing preferences for landscape character types that enrich the decision-making process. We also concluded that a combination of different methods could be helpful/effective depending on objective, resources, and time. We believe that the most effective methods are the in-person interviews, workshops, public meetings, and

landscape analyses. They should be based on real world or three-dimensional settings because a researcher can use all of his/her senses and can obtain more information to come to sensible conclusions.

We found that naturalness of the landscape and the features were shown to be highly preferred landscapes as were reported by previous studies. Therefore, future research can exclude already well-established features in order to avoid general or obvious findings. Careful research design is needed for specific details of preferences for landscape type and feature.

The significance of the study is that the local authorities and individuals can locate regions of natural and cultural heritages. Public knowledge regarding landscapes and landscape attributes would significantly impact landscape planning and decision-making which also aligns with a bottom-up approach of the concept of a Geopark (Dowling 2017). The significance of this study also lies in the Landscape Character Assessment (LCA) guideline of “people’s perspective” which plays a vital role in landscape planning and management. This would help the identification of potential geosites through peoples’ involvement and preferences. The findings can be helpful for students, researchers, locals, government, and other stakeholders to communicate about important locations and most preferred landscapes so that the land management policies incorporate this information in their plans and managements. It also advocates for geoparks and geotourism as new approaches to benefit from the landscapes of this region. This study connects community and conservation through non-exploitive, educational and appreciative ways of diversifying lands.

A bigger sample size would be helpful in gaining more confidence in the accuracy of the results. Due to COVID-19, on-site surveys could not be conducted which can be considered for future research. It would also be interesting to analyze the amount of natural or cultural characteristics in each picture. Likewise, the degree of lighting and respondents’ familiarity with the region maybe considered to investigate how they affect preferences.

Acknowledgements I am very grateful to the School of Design and Community Development, West Virginia University for this opportunity. I am grateful to all respondents who have participated in the surveys. I am very thankful to Dale Colyer Division of Resource Management Award for financial support for field visits. This material is based upon work that is partially supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Hatch under ascension number 7004979 and scientific article No: 3458 of the West Virginia Agricultural and Forestry Experiment Station, Morgantown. My sincere gratitude to Llew Williams and Anthony Billing for their indefatigable support.

Author Contribution All authors reviewed the results and approved the final version of the manuscript.

Data Availability The data that support the findings of this study are available from the corresponding author, [GN], upon reasonable request.

Declarations

Competing Interests The author declares no competing interests.

References

- Antoniou V, Morley J, Haklay M (2010) Web 2.0 Geotagged photos: assessing the spatial dimension of the phenomenon. *Geomatica* 64(1):99–110
- Antrop M (2000) Geography and landscape science. *Belgeo* (1–2–3–4):9–36. <https://doi.org/10.4000/belgeo.13975>
- Antrop M (2005) History & Research. Belbin. <https://www.belbin.com/about/history/>. Accessed 14 June 2022
- Arriaza M, Cañas JF, Canas JA, Ruiz P, Gonzalez-Arenas J, Barea F (2005) Landscape assessment via regression analysis. European Association of Agricultural Economists, International Congress, Copenhagen, Denmark
- Bergen SD, Ulbricht CA, Fridley JL, Ganter MA (1995) The validity of computer-generated graphic images of forest landscape. *J Environ Psychol* 15(2):135–146. [https://doi.org/10.1016/0272-4944\(95\)90021-7](https://doi.org/10.1016/0272-4944(95)90021-7)
- Brooks RO, Lavigne P (1985) Aesthetic theory and landscape protection: the many meanings of beauty and their implications for the design, control and protection of Vermont’s landscape. *UCLA J Environ Law Policy* 4(2):1–45. <https://doi.org/10.5070/1542018695>
- Brown G, Weber D (2011) Public participation GIS: a new method for national park planning. *Landsc Urban Plan* 102(1):1–15. <https://doi.org/10.1016/j.landurbplan.2011.03.003>
- Bubalo M, van Zanten BT, Verburg PH (2019) Crowdsourcing geo-information on landscape perceptions and preferences: a review. *Landsc Urban Plann* 184(December 2018):101–111. <https://doi.org/10.1016/j.landurbplan.2019.01.001>
- Callau AA, Albert MYP, Rota JJ, Giné DS (2019) Landscape characterization using photographs from crowdsourced platforms: content analysis of social media photographs. *Open Geosci* 11(1):558–571. <https://doi.org/10.1515/geo-2019-0046>
- Cardwell DH (1975) Geologic history of West Virginia. *West Virginia Geol Econ Surv*
- Daniel TC, Boster RS (1976) Measuring landscape esthetics: the scenic beauty estimation method. https://www.fs.usda.gov/rm/pubs_rm/rm_rp167.pdf. Accessed 13 Oct 2022
- Daniel TC (2001) Whither scenic beauty? Visual landscape quality assessment in the 21st century. *Landsc Urban Plan* 54(1–4):267–281. [https://doi.org/10.1016/S0169-2046\(01\)00141-4](https://doi.org/10.1016/S0169-2046(01)00141-4)
- Daniel TC, Meitner MM (2001) Representational validity of landscape visualizations: the effects of graphical realism on perceived scenic beauty of forest vistas. *J Environ Psychol* 21(1):61–72. <https://doi.org/10.1006/jevp.2000.0182>
- Dasher GR (2000) The Karst of West Virginia. In G. R. Dasher (Ed.), *The caves of East Central West Virginia. The Guidebook of the National Speleological Society’s 2000 Convention* (pp. 152–190). West Virginia Speleological Survey (WVASS), Bulletin # 14
- Dearden P (1987) Consensus and a theoretical framework for landscape evaluation. Department of Geography, University of Victoria, Victoria, B.C. Canada. *J Environ Manage* 34:267–278
- Dmytrowski P, Kicińska A (2022) Protection and monitoring of inanimate nature in the actions of landscape parks — the example

- of Poland (EU). *Geoheritage* 14:117. <https://doi.org/10.1007/s12371-022-00757-x>
- Dorwart CE, Moore RL, Leung YF (2010) Visitors' perceptions of a trail environment and effects on experiences: a model for nature-based recreation experiences. *Leis Sci* 32(1):33–54. <https://doi.org/10.1080/01490400903430863>
- Dowling R (2017) Geoparks- a vehicle for fostering community based, sustainable, regional development in Northern Australia: Briefing to Federal Parliament's Joint Standing Committee on Northern Australia (pp. 1–6). <https://doi.org/10.1017/cbo9781139567657>
- Fairclough G, Herlin IS, and Swanwick C (2018) Landscape character approaches in global, disciplinary and policy context. *Routledge Handbook Landsc Character Assess* 3–20. <https://doi.org/10.4324/9781315753423-1>
- Gibson JJ (1979) The “theory of affordances” the ecological approach to visual perception. In *The ecological approach to visual perception* (pp 127–137). Lawrence Erlbaum Associates, Inc., Publishers. https://monoskop.org/images/c/c6/Gibson_James_J_1977_1979_The_Theory_of_Affordances.pdf. Accessed 2 Oct 2022
- Gill N, Dun O, Brennan-Horley C, Eriksen C (2015) Landscape preferences, amenity, and bushfire risk in New South Wales, Australia. *Environ Manag* 56(3):738–753. <https://doi.org/10.1007/s00267-015-0525-x>
- Goldberg L (2019) Toward conservation of visual resources at the regional scale. *Environ Pract* 21(4):201–215. <https://doi.org/10.1080/14660466.2019.1687231>
- Griffiths G (2018) Transferring landscape character assessment from the uk to the eastern mediterranean: challenges and perspectives. *Land* 7(1):1–11. <https://doi.org/10.3390/land7010036>
- Hansen AS (2016) Testing visitor produced pictures as a management strategy to study visitor experience qualities – a Swedish marine case study. *J Outdoor Recreat Tour* 14:52–64. <https://doi.org/10.1016/j.jort.2016.05.001>
- Herzog TR (1987) A cognitive analysis of preference for natural environments: mountains, canyons, and deserts. *Landsc J* 6(2):140–152. <https://doi.org/10.3368/lj.6.2.140>
- Herzog TR, Kaplan S, Kaplan R (1982) The prediction of preference for familiar urban places. *Popul Environ* 5(1):43–59. <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.928.7312&rep=rep1&type=pdf>. Accessed 23 Sept 2022
- Hull RB IV, Stewart W (1992) Validity of photo-based scenic beauty judgments. *J Environ Psychol* 12(2):101–114. [https://doi.org/10.1016/S0272-4944\(05\)80063-5](https://doi.org/10.1016/S0272-4944(05)80063-5)
- Jensen LH (2007) Changing conceptualization of landscape in English landscape assessment methods. *From Landsc Res Landsc Plan* 161–171. https://doi.org/10.1007/978-1-4020-5363-4_12
- Kalivoda O, Vojar J, Skřivanová Z, Zahradník D (2014) Consensus in landscape preference judgments: the effects of landscape visual aesthetic quality and respondents' characteristics. *J Environ Manage* 137:36–44. <https://doi.org/10.1016/j.jenvman.2014.02.009>
- Kaplan R, Kaplan S (1989) The experience of nature: a psychological perspective. In *First Publication*. Cambridge University Press. <https://ia802204.us.archive.org/32/items/experienceofnatu00kapl/experienceofnatu00kapl.pdf>. Accessed 25 Sept 2022
- Karjalainen E, Tyrva L (2002) Visualization in forest landscape preference research: a finnish perspective. *Landsc Urban Plan* | ScienceDirect.com. 59. <http://www.sciencedirect.com/science/article/pii/S0169204601002444>. Accessed 6 May 2022
- Kayden J (2000) National land-use planning in America: something whose time has never come. *Wash UJL Pol'y* 3:445–472. http://heinonlinebackup.com/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/wajlp3§ion=21. Accessed 22 Feb 2022
- Kaymaz IC (2012) Landscape perception. In *Ozyavus DM (ed), Landscape planning*. InTech. <https://www.intechopen.com/books/landscape-planning/landscape-perception>. Accessed 26 Jul 2022
- Kellomäki S, Savolainen R (1984) The scenic value of the forest landscape as assessed in the field and the laboratory. *Landsc Plan* 11(2):97–107. [https://doi.org/10.1016/0304-3924\(84\)90033-9](https://doi.org/10.1016/0304-3924(84)90033-9)
- Kvan M (2013) Visual quality assessment methods in landscape architecture studies. *Adv Landsc Archit*. <https://doi.org/10.5772/55769>
- Langschwager D (2018) The perspective of place and landscape. 1–10. <https://research.library.kutztown.edu/cgi/viewcontent.cgi?article=1008&context=englisheng366>. Accessed 23 Aug 2022
- Lee J, Lee HS, Jeong D, Shafer CS, Chon J (2019) The relationship between user perception and preference of greenway trail characteristics in urban areas. *Sustainability (Switzerland)* 11(16):1–16. <https://doi.org/10.3390/su11164438>
- Liu Q, Fu W, van den Bosch CCK, Xiao Y, Zhu Z, You D, Zhu N, Huang Q, Lan S (2018) Do local landscape elements enhance individuals' place attachment to new environments? A cross-regional comparative study in China. *Sustainability (Switzerland)* 10(9):1–17. <https://doi.org/10.3390/su10093100>
- Lothian A (2017) The science of scenery: how we view scenic beauty, what it is, why we love it, and how to measure and map it. United States: CreateSpace Independent Publishing Platform
- Lothian A (2012) Measuring and mapping landscape quality using the community preferences method. Paper presented at New Zealand Planning Institute Annual Conference, Blenheim, Germany
- Mahdjoubi L, Wiltshire J (2001) Towards a framework for evaluation of computer visual simulations in environment design. *Des Stud* 22(2):193–209. [https://doi.org/10.1016/S0142-694X\(00\)00027-2](https://doi.org/10.1016/S0142-694X(00)00027-2)
- Malik A, Dhir A, Nieminen M (2016) Uses and gratifications of digital photo sharing on Facebook. *Telematics Inform* 33(1):129–138. <https://doi.org/10.1016/j.tele.2015.06.009>
- Michigan Law Review (1973) Beyond the eye of the beholder: aesthetics and objectivity 71(7). <https://repository.law.umich.edu/cgi/viewcontent.cgi?article=4471&context=mlr>. Accessed 2 Oct 2022
- Muñoz L, Hausner VH, Runge C, Brown G, Daigle R (2020) Using crowdsourced spatial data from Flickr vs. PPGIS for understanding nature's contribution to people in Southern Norway. *People Nat* 2(2):437–449. <https://doi.org/10.1002/pan3.10083>
- National Park Service (2012) Connecting the parks with their gateway communities conception plan. <https://parkplanning.nps.gov/document.cfm?parkID=259&projectID=11040&documentID=85242>
- National Park Service (2018) Appalachian plateaus province. National Park Service. <https://www.nps.gov/articles/appalachianplateausprovince.htm>
- Ólafsdóttir R, Tverijonaite E (2018) Geotourism: a systematic literature review. *Geosciences (Switzerland)* 8(7). <https://doi.org/10.3390/geosciences8070234>. Accessed 4 Dec 2022
- Palmer JF, Hoffman RE (2001) Rating reliability and representation validity in scenic landscape assessments. *Landsc Urban Plan* 54(1–4):149–161. [https://doi.org/10.1016/S0169-2046\(01\)00133-5](https://doi.org/10.1016/S0169-2046(01)00133-5)
- Peng SH, Han KT (2018) Assessment of aesthetic quality on soil and water conservation engineering using the scenic beauty estimation method. *Water (Switzerland)* 10(4). <https://doi.org/10.3390/w10040407>
- Richards DR, Tunçer B (2018) Using image recognition to automate assessment of cultural ecosystem services from social media photographs. *Ecosyst Serv* 31:318–325. <https://doi.org/10.1016/j.ecoser.2017.09.004>
- Ros-Candeira A, Moreno-Llorca R, Alcaraz-Segura D, Bonet-García FJ, Vaz AS (2020) Social media photo content for Sierra Nevada: a dataset to support the assessment of cultural

- ecosystem services in protected areas. *Nat Conserv* 38:1–12. <https://doi.org/10.3897/natureconservation.38.38325>
- Scott MJ, Canter DV (1997) Picture or place? A multiple sorting study of landscape. *J Environ Psychol* 17:263–281. <https://doi.org/10.1006/jevp.1997.0068>
- Shafer EL Jr, Brush RO (1977) How to measure preferences for photographs of natural landscapes. *Landsc Plan* 4:237–256
- Smardon RC (2016) Visual impact assessment: where have we come from and where are we going? *J Environ Prot* 07(10):1333–1341. <https://doi.org/10.4236/jep.2016.710116>
- Steiner F (2009) The living landscape: an ecological approach to landscape planning. *J Am Plan Assoc* 75(4). <https://doi.org/10.1080/01944360903169717>
- Stepchenkova S, Zhan F (2013) Visual destination images of Peru: comparative content analysis of DMO and user-generated photography. *Tour Manag* 36:590–601. <https://doi.org/10.1016/j.tourman.2012.08.006>
- Svobodova K, Sklenicka P, Vojar J (2015) How does the representation rate of features in a landscape affect visual preferences? A case study from a post-mining landscape. *Int J Min Reclam Environ* 29(4):266–276. <https://doi.org/10.1080/17480930.2013.873258>
- Swanwick C, LUC (2002) Landscape character assessment. In *The countryside agency, Scottish natural heritage*. <https://www.nature.scot>. Accessed 2 Jul 2021
- Tenerelli P, Demšar U, Luque S (2016) Crowdsourcing indicators for cultural ecosystem services: a geographically weighted approach for mountain landscapes. *Ecol Indic* 64(September 2018):237–248. <https://doi.org/10.1016/j.ecolind.2015.12.042>
- Tieskens KF, Van Zanten BT, Schulp CJE, Verburg PH (2018) Aesthetic appreciation of the cultural landscape through social media: an analysis of revealed preference in the Dutch river landscape. *Landsc Urban Plan* 177:128–137. <https://doi.org/10.1016/j.landurbplan.2018.05.002>
- Tveit M, Ode Å, Fry G (2006) Key concepts in a framework for analysing visual landscape character. *Landsc Res* 31(3):229–255. <https://doi.org/10.1080/01426390600783269>
- U.S. Department of the Interior (n.d.) The Pinelands Scenic Study
- van der Ploeg MJ, Baartman JEM, Robinson DA (2018) Biophysical landscape interactions: bridging disciplines and scale with connectivity. *Land Degrad Dev* 29(4):1167–1175. <https://doi.org/10.1002/ldr.2820>
- van Zanten BT, Verburg PH, Scholte SSK, Tieskens KF (2016) Using choice modeling to map aesthetic values at a landscape scale: lessons from a Dutch case study. *Ecol Econ* 130:221–231. <https://doi.org/10.1016/j.ecolecon.2016.07.008>
- Wang Z, Jin Y, Liu Y, Li D, Zhang B (2018) Comparing social media data and survey data in assessing the attractiveness of Beijing Olympic Forest Park. *Sustainability (switzerland)* 10(2):1–18. <https://doi.org/10.3390/su10020382>
- Wartmann FM, Frick J, Kienast F, Hunziker M (2021) Factors influencing visual landscape quality perceived by the public Results from a national survey. *Landsc Urban Plan* 208:104024. <https://doi.org/10.1016/j.landurbplan.2020.104024>
- Wood SA, Guerry AD, Silver JM, and Lacayo M (2013) Using social media to quantify nature-based tourism and recreation. *Sci Rep* 3. <https://doi.org/10.1038/srep02976>
- Zube EH, Sell JL, Tylor JG (1982) Landscape perception: research, application and theory. *Landsc Plan* 9:1–33. [https://doi.org/10.1016/0304-3924\(82\)90009-0](https://doi.org/10.1016/0304-3924(82)90009-0)

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.