Review

The Aesthetic Value of World Heritage Karst: A Literature Review and Implication for Huangguoshu Scenic Area Outstanding Universal Value

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Abstract: With the development of aesthetic value research, more and more disciplines, institutions, and researchers have joined in, taking the research development in a quantitative direction. At present, karst is not only a popular type of “world natural heritage site”, but also a hotspot in the research of landscape aesthetics. However, no comprehensive literature review covers the aesthetic value of World Heritage karst sites. To fill this gap, the study systematically reviewed 190 articles retrieved from the Web of Science, the China Knowledge Resource Integrated, and Google Scholar databases. First, the study conducted a quantitative analysis of the annual number, content, countries, and themes of published literature. Secondly, the study summarized the landscape evaluation, aesthetic value, and protection of World Heritage karst sites and related theories and put forward the key scientific issues to be solved, as well as the direction of future research.

Keywords: aesthetic value; world heritage karst; landscape; criteria vii; Huangguoshu scenic area

1. Introduction

World Heritage (WH) is the designation for places on Earth that are of outstanding universal value (OUV) to humanity and, as such, have been inscribed on the World Heritage List to be protected for future generations to appreciate and enjoy [1]. World Heritage is the highest level of nature conservation, it is recognized by humankind as an irreplaceable treasure nowadays and is crucial to the conservation of biodiversity and global ecological security [2]. As of October 2022, 182 States Parties have acceded to the Convention Concerning the Protection of the World Cultural and Natural Heritage (hereinafter referred to as the Convention). With the advancement of society and the increasing impact of human activities on nature and ecology, an increasing number of researchers have begun to investigate the value of WH sites. The convention considers that the UOV means cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity [3], and the World Heritage should have it. It is important for the present and the future. As a result, WH sites must be carefully guarded [4]. In the Operational Guidelines for the Implementation of the WH Convention [3], the WH Committee has established 10 criteria for distinguishing and judging whether a property is of OUV or not. Six of these criteria apply to cultural heritage (i, ii, iii, iv, v, and vi) and four to natural heritage (vii, viii, ix, and x) (Table 1).

The WH List was established in 1978 and, as of June 2022, 167 States Parties have joined the list. There are a total of 1154 WH sites globally. The process of the inscription is broadly divided into the stages of preparation of nominations, upstream process, preliminary assessment, and participation in the nomination process, where the IUCN plays...
an important role in the inscription of natural World Heritage properties. The specific role of IUCN in relation to the Convention includes evaluation of properties nominated for inscription on the WH List, monitoring the state of conservation of NWH properties, reviewing requests for International Assistance submitted by States Parties, and providing input and support for capacity-building activities [3].

Table 1. Assessment criteria for Outstanding Universal Value [3].

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<tr>
<td>(i)</td>
<td>Represent a masterpiece of human creative genius;</td>
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<td>(ii)</td>
<td>Exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;</td>
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<td>(iii)</td>
<td>Bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;</td>
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<td>(iv)</td>
<td>Be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage or significant stages in human history;</td>
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<td>(v)</td>
<td>Be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;</td>
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<td>(vi)</td>
<td>Be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria);</td>
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<tr>
<td>(vii)</td>
<td>Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;</td>
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<tr>
<td>(viii)</td>
<td>Be outstanding examples representing major stages of earth’s history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;</td>
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<tr>
<td>(ix)</td>
<td>Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;</td>
</tr>
<tr>
<td>(x)</td>
<td>Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.</td>
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Geological/geomorphological heritage sites are an essential part of the Natural World Heritage (NWH). The excitement of geologically interesting and impressive landscapes, together with historical and cultural values, thus increases the geotouristic potential of sites [5,6]. They are often nominated by the combination of criteria vii and viii [7]. They are distinguished from other types of heritage by their scenic value [8]. On the WH list, 168 properties are inscribed based on criterion vii, of which 26 are karst related, including 25 natural heritage properties and 1 mixed heritage property (Figure 1). Despite the karst desertification, many karst sites are still listed because of their unique geological features and natural beauty.

Against the background of karst desertification in karst areas of the world, the Huangguoshu Scenic Area preserves aesthetic, tourist, and scientific values, and was listed on the WH Tentative List in 2019. So, it is necessary to declare, manage, and display the value of the WH to study the aesthetic value and protection of the Huangguoshu Scenic Area.

This study analyses the research available on the aesthetic value of World Heritage Karst (WHK) sites and classifies the articles according to the annual distribution, the content of the studies, and the type of literature. It identifies and summarizes seven key scientific problems when studying the aesthetic value of WHK sites and offers effective research methods with reference to the characteristics of the Huangguoshu Scenic Area.
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2. Data Collection

To identify relevant studies, a search was conducted in the China Knowledge Resource Integrated (CNKI) database, Web of Science, Google scholar, and the websites of UNESCO and the International Union for Conservation of Nature (IUCN) for articles, theses, conferences, and WH application text. In the CNKI database and the Web of Science databases, ‘topic’ was used as the search item, and ‘World Natural Heritage Karst’, and ‘World Heritage Karst’ were used as the search words for the first search. Among the results, ‘natural beauty’, ‘aesthetic’, ‘aesthetic value’, ‘beauty’, and ‘aesthetic importance’ were used as the search words for the second search. The search time range was the maximum time range of the database. Finally, the retrieved Chinese and English literature was manually screened according to the research content of this article. In the search for ‘karst’ and ‘criteria vii’ on the UNESCO World Heritage Centre website, 26 applications for WH sites were obtained.

Through the above search and selection, there are 190 pieces of Chinese and English literature related to the aesthetic value of World Heritage Karst: 116 pieces of non-Chinese literature and 74 pieces of Chinese literature, including 112 literature journals, 20 master’s dissertations, 1 doctoral dissertation, 32 conference papers, and 26 WH application texts.

3. An Overview of the Aesthetic Value of World Heritage Karst

3.1. Annual Distribution of the Literature

As shown in Figure 2, the published research on the aesthetic value of WHK sites can be traced back to early 1978, with a generally increasing research trend. The existing research can be divided into three stages, namely, the start-up, slow development, and rapid growth stages. The slow development stage occurred from 1978 to 2004, and the annual number of pieces of literature during this period was no more than three, indicating the aesthetic value of WHK began to attract attention. The slow development stage, from 2005 to 2013, was a stage during which a fluctuating increase in relevant research occurred. In the rapid growth stage, from 2013 to 2021, the amount of related research has shown a stable and fluctuating growth trend, with a great leap especially in 2014 and after 2019.
literature and 74 pieces of Chinese literature, including 112 literature journals, 20 master's dissertations, 1 doctoral dissertation, 32 conference papers, and 26 WH application texts.

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![Figure 2. Annual distribution of literature on the aesthetic value of WHK until 2021.](image)

3.2. Content Distribution of the Literature

The content of the aesthetic value of WHK is shown in Figure 3. According to the research content, all the literature consulted is classified and summarized according to the landscape type, landscape structure, landscape characteristics, landscape evaluation, landscape aesthetic value, landscape protection and development, and other relevant research. It involves the analysis of the types of landscape of WHK sites, the evaluation methods of landscape aesthetics, the construction of the aesthetic value evaluation system, and the adjustment of protection and management measures for different heritage sites. Between them, landscape evaluation (28%) and landscape protection and utilization (30%) account for nearly 60%, which shows that it is a research hotspot of the aesthetic value of WHK. The proportion of karst landscape types (4%), landscape structure (5%), landscape characteristics (10%), and other research literature is small, as existing research focuses on the evolution and formation of karst landforms, while relatively little research is based on the karst landscape. Many researchers have used information from theoretical research on landscape types, characteristics, and structures to research the aesthetic value of karst landscapes, to make a nomination for criteria vii.

3.3. Country Distribution of the Literature

The country distribution of the aesthetic value of WHK is illustrated in Figure 4. Among them, 69 have studied China’s heritage sites, mainly involving five provinces, municipalities, and autonomous regions. Among them, Guizhou has 34 relevant pieces of literature, followed by Guangxi, Chongqing, Sichuan, and Yunnan. There are few studies on the aesthetic value of WHK abroad, and a few studies have been carried out in Canada, Croatia, Italy, Australia, Brazil, etc. In general, the distribution of the study areas...
corresponds to the global distribution of WHK sites, but the distribution is concentrated in a few countries and regions, and the current studies lag the WHK declaration process.

![Figure 3. Distribution of research contents in studies on the aesthetic value of WHK.](image)

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![Figure 4. Regional distribution of research on the aesthetic value of WHK.](image)

Figure 4. Regional distribution of research on the aesthetic value of WHK.
3.4. Themes and Topics

To supplement the analysis results, visual technology is used for word frequency analysis. Word clouds, also known as ‘content clouds’ [9], are useful analytical tools that provide a concise yet interesting way to summarize the content of websites or text documents [10], enabling a combination of qualitative research analysis, content, and visualization [9]. Word clouds can present common terms related to the aesthetic value of WH karst in a visual and tangible form (Figure 5). In the word cloud, ‘karst landscape’ and ‘criteria vii’ are clearly the most used words in the study of the aesthetic value of WHK. In addition, several terms related to ‘World Heritage’ are also used with high frequency (e.g., ‘World Heritage’, ‘natural beauty’, ‘heritage site’, ‘aesthetic value’, ‘UNESCO’, and ‘tourism’).

Figure 5. The aesthetic value of WHK: word cloud visualization.

4. Main Progress and Landmark Achievements

4.1. Theoretical Research

The term ‘landscape’ was born in medieval Europe to mean beautiful scenery and was widely used in social and natural disciplines. It was originally a geographic term with the meaning of ‘surface area’, but the focus gradually shifted to the relationship between nature and humans. At the beginning of the nineteenth century, Alexander von Humboldt, the founder of modern geography, introduced landscape to geography, defining it as ‘the general character of an area of the earth’, broadening the perspective of researchers and creating a trend that integrated social, aesthetic, economic, and environmental elements to analyze landscape [11]. In 1939, the father of landscape ecology, Troll, defined landscape as ‘the whole of nature and the space of human existence’ [12]. In 1949, the Russian geographer Vadim Mikhailovich Solntsev defined landscape as being composed of elements such as strata, soil, vegetation, animals, sunlight, water, etc., based on geography, with a combination of elements that are connected and constrained and produce regularity [13]. In the Council of Europe Landscape Convention, the landscape is defined as ‘A perceivable area whose characteristics are the result of the interaction of natural and human elements’ [14]. Landscape type is the foundation of landscape structure and characteristics research, and a prerequisite for landscape evaluation, value studies, conservation, and management. In the studies on the aesthetic value of WHK, the classification of karst landscapes is mainly based on the landscape features, geomorphological forms, and types of tourism resources. By summing up the landscape type and structure, the researchers analyzed the aesthetic characteristics of the landscape and proved its aesthetic importance to make the nomination for WH. For example, Yuan (1994) divided karst landscapes into three types: mountain,
water, and cave landscapes [15]. Liu (2006) combined the method of ‘Classification of
karst tourism resources in China’ proposed by Chen (2004) with the geological genesis
and landscape development of karst and classified the landscape of Guilin into four types:
rocky, cave, canyon, and water landscapes [16,17]. UNESCO (2014) showed that Guilin
karst had a rich variety of landscape types, such as peaks, forests, and clusters, which was
the symbolic karst landscape of peak forests and clusters in the world [18]. For WHK,
some researchers also studied formal aesthetic characteristics such as visual images, colors,
lines, dynamics, and statics associated with natural landscapes [19]. Different classification
criteria can lead to differences in results. However, current research does not cover all
landscape types. Due to the diversity of landscape combinations, technological limitations,
and differences in research purposes, there is an overlap in classification methods and the
inapplicability of some regions, making their general use difficult.

Topography is the foundation and frame of the landscape and the background of the
harmonious beauty of man and earth. The karst landscape consists of different spatial
units with distinct visual features and functional relationships with ecological, aesthetic,
economic, and cultural values [20]. Its beauty mainly comes from natural beauty without
artificial participation. Under the combined action of geomorphology, soil, hydroclimatic
conditions, and biological activities, it produces various landscape types and features,
showing the surface landscape with various forms. It is necessary to study the landscape
structure to show the aesthetic characteristics of individual or combinations of landscapes,
which help us to understand the landscape’s aesthetic value at multiple levels, from macro
to micro. For example, some researchers have discussed the single and combined forms of
natural landscapes [21,22] or their spatial distribution characteristics [23]; some researchers
have divided the karst landscape into spaces to determine whether its aesthetic value is
affected [21,24]; some researchers have studied the relationship between landscape
patterns and aesthetic characters using the principles of landscape ecology [25,26]. By
analyzing the landscape pattern, it is possible to determine the impact of land use patterns
on aesthetic values and to adjust the landscape land types, which has a positive significance
for protecting the fragile ecological environment of karst sites [27].

The karst areas have good geomorphological formations and ecological environments.
Huangguoshu Scenic Area has developed rich landscape types, and its landscape units
show obvious flat and vertical characteristics in different geomorphic parts and elevations,
and the combination of each landscape unit and the complex has regularity in space and
seasonal changes in time (Figure 6). Although there is a lack of research on the combination
of landscape pattern and aesthetic value, it is of great significance for the division and
planning of landscape units in the Huangguoshu Scenic Area and has an important guiding
role in the study of the aesthetic value of the differences between the individual and
combined landscapes reflected in different landscape levels.

4.2. Evaluation Methods

Karst landscape evaluation integrates theories from multiple disciplines such as geog-
raphy, aesthetics, and ecology to make relevant evaluations of the surface and subsurface
landscapes of karst areas. Yuan et al. (1994) argue that the evaluation of the karst area
should be based mainly on the quality of the natural environment and the conditions for
development [15]. Karst landscape evaluation is a qualitative and quantitative assessment
of the quality of the aesthetic environment consisting of the atmosphere, hydrosphere,
lithosphere, and biosphere.
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Figure 6. Landscape combination characteristics of the Huangguoshu Scenic Area. (Photo by Mengzhou Wang and Xin Wang).

4.2. Evaluation Methods

Karst landscape evaluation integrates theories from multiple disciplines such as geography, aesthetics, and ecology to make relevant evaluations of the surface and subsurface landscapes of karst areas. Yuan et al. (1994) argue that the evaluation of the karst area began to emerge and then developed rapidly, and the number of countries and disciplines involved also grew rapidly, among which the insights and propositions of geographers, landscape planning and management experts, forest science experts, ecologists, psychologists, and behavioral experts, who have evaluated landscape resources from the perspective of their different disciplinary backgrounds and developed various types of analytical models, have played a positive role in the research field of landscape evaluation [28]. Experts in western countries have established many mathematical models for quantitative visual analysis based on psychological and behavioral preferences to evaluate landscapes from the perspective of visual aesthetics in a comprehensive and single-factor evaluation [29]. In the mid-1960s, landscape evaluation was mainly oriented toward visual aesthetics, evaluating landscapes through biological characteristics such as biodiversity, integrity, and sustain-
ability, combined with human value judgments and preferences [30]. T.L. Saaty (1970) proposed the analytic hierarchical process of quantitative relationships [31]. In the 1990s, some studies evaluated landscape aesthetics by adding computer-constructed landscape models, and much exploration was done in terms of the underlying theory and landscape aesthetics [32,33]. For more than 30 years, the expert school has gradually dominated in countries such as the U.S. and the U.K. In the 21st century, many experts have made a breakthrough in evaluating the aesthetic value of landscapes such as forest landscapes, coastal cultural heritage, road landscapes, and coastal natural tourism resources [34–36]. The researchers finally confirm that the widely used landscape evaluation methods include four schools: expert, psychophysical, cognitive, and experimental paradigm, after studying the evaluation methods of their predecessors. The theoretical methods of the four schools are different and have their own advantages and limitations, of which the expert school is the most widely used theory in recent years before quantitative evaluation (Table 2). Most studies have used the global frameworks approach recommended by UNESCO to evaluate the aesthetic value of natural landscapes [37–39]. This means comparing the nominated natural site with similar sites around the world for aesthetic value and aesthetic importance and selecting “The Best of the Best” around the world [40]. It is worth noting that the analogy approach, when applied, proposes to extend the scope of the analogy to the whole world, requiring a global standard of proof and involving the comparison and analysis of measurable indicators, such as landscape values, wherever possible [41]. The South China Karst was nominated for NWH in 2007 based on criteria vii and viii and eventually included in the WH List, adopting the analogy approach in the aesthetic value evaluation, conducting a comprehensive global comparative analysis, and receiving widespread attention within the international karst community, providing a standard model for similar nominated sites [42]. But these methods use qualitative description rather than the quantitative evaluation of landscape by measurable indicators. This has been attempted by scholars who have used the scenic beauty estimation (SBE) method [24,43], the semantic differential (SD) method [44], and the analytic hierarchy process (AHP) [45], etc. to quantify landscapes based on psychological methods.

Table 2. Comparison of landscape evaluation of four schools [46].

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<th>Content</th>
<th>Advantages and Limitations</th>
<th>Applications</th>
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<tr>
<td>Expert paradigm</td>
<td>Aesthetic evaluation and classification, aesthetic landscape sensitivity measurement, visual impact assessment (VIA), visual absorptivity (VAC) measurement, visual resource management, etc.</td>
<td>The practicality of large-scale land-use planning and forest landscape resource management is outstanding, and it is easy to produce objective and comparable evaluation results. However, the evaluation scale is too coarse and the complete description of the aesthetic characteristics of the landscape is controversial</td>
<td>Topographical maps, photographs, computers, expert site assessments, and public surveys.</td>
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<td>Psychophysical paradigm</td>
<td>Measure aesthetic elements from photographs, predict aesthetic preference variables and study the relationship between aesthetic landscape object elements and aesthetic values based on aesthetic features reflecting changes in grade quality (individual evaluation). Photographs are commonly used to assess, grade, compare and predict the degree of the aesthetic beauty of a landscape in relation to adjacent areas (SBE).</td>
<td>Attention is paid to the perceptual connection between the subject and object of landscape evaluation, acknowledging that landscapes can be evaluated quantitatively and that people are generally consistent in their aesthetics of landscapes. However, this approach over-considers objectivity, photographic evaluation lacks a sense of reality and the spatiality of the site and is mostly an immediate evaluation of the perception of the landscape, lacking cultural influences.</td>
<td>Photographs and PowerPoint shows are used to represent the field environment, mostly for predictive management of forests, urban green spaces, rivers, highways, and recreational landscapes.</td>
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Table 2. Cont.

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<tr>
<td>Cognitive paradigm</td>
<td>Individual evaluation: consisting of 'like-dislike, the tendency-avoidance, experience/emotion/evocation' Model group evaluation: observation-shelter theory; evaluation of landscape by the ease of interpretation and solvability criteria (ease of interpretation consists of consistency and clarity; solvability consists of planar complexity and spatial mystery); evaluation of topography and landscape openness.</td>
<td>Emphasis is placed on immersive spatial experience, linking the subject and object of the landscape through the medium of information, and uncovering long-lived landscape preference control factors. However, it is limited to tests of human naturalness, basic survival needs, and physiological responses, and lacks sociocultural evaluation and aesthetic analysis, as well as subjective perception-objective landscape links, making its application difficult.</td>
<td>Photographs, topographic maps as a tool, mostly used for forest landscape assessment, and examples of computer translation of landscape information already exist.</td>
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<td>Experimental paradigm</td>
<td>A study of artistic works by literary artists and their personal experiences of the landscape; the aesthetic history of the landscape, the meaning of the landscape and its transformation in society; the description of the landscape, the geography of the landscape, and the historical landscape.</td>
<td>Enriching the identifiable factors that influence the perception of the landscape, is no longer limited to the object elements of the landscape. However, the over-reliance on the artist’s individuality makes perception unpredictable, making it difficult to draw universally agreed patterns and lacking practical value for landscape planning and management.</td>
<td>Textual descriptive landscape evaluation and organization of garden mood sequences.</td>
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With the development of technology, the study of landscape evaluation has taken a new direction, and the addition of new technologies such as Geographic Information Systems (GIS), three dimension (3D), virtual reality (VR) [47], and tourism websites has improved the investigation and extraction of landscape elements [48]. Karst landscape is a specific heritage, where the surface and underground are part of a single landscape. Novakovic (2014) carried out a general analysis of the Skocjan caves using 3D technology [49]. However, studies for WHK sites are lacking, and they can learn from the research direction and methods of other regions. For example, Yang established a comprehensive evaluation system combining expert opinion with public opinion, taking WH criteria, ecological environment, and viewing experience as indicators; based on GIS, the indicators were selected as corresponding layers, and the weights of decision makers were combined to give the final evaluation [50]. An evaluation was conducted on Xinjiang Tianshan Bayanbulak, and the evaluation result shows that the aesthetic value of the site gradually decreases from inside to outside, which is consistent with the actual condition. Julie Vercelloni used VR to assess the aesthetic value of coral reefs, and compared to traditional evaluation methods, VR can show the landscape elements more objectively without subjective factors interfering with the judgment [51]. Karst landscape evaluation is a complex system project with a large spatial scale and many influencing factors, which makes it difficult to select evaluation factors and develop an index system. However, it is still feasible to establish an evaluation system for the aesthetic value of the karst landscape. The above study provides a reference for the study of the landscape aesthetics of the Huangguoshu Scenic Area. The Huangguoshu Scenic Area is a famous landscape developed on the karst landform, and the landscape types are mainly geological landscapes and waterscapes. A combination of SD and SBE methods can be chosen to evaluate the landscape, using questionnaires to investigate and express the subjective feelings in the data. When selecting evaluation indicators, one can focus on the characteristics of the geomorphology and water, such as geomorphological peculiarity, topographic variation, volume variation, water feature morphological diversity, and landscape levels. This is coupled with the diversity of species, seasonal changes, and color changes in other landscapes, such as plants. In addition to these, someone’s overall feelings, such as psychological comfort, landscape attractiveness,
etc., should be considered to make a comprehensive judgment on the aesthetic value of the landscape.

4.3. Aesthetic Importance and Natural Beauty

With the further study of aesthetic value, the qualitative research has been a breakthrough. The multi-disciplinary, multi-angle aesthetic value study involves the study of various natural landscapes. At present, karst is not only a popular type of “world natural heritage”, but also the hotspot of landscape aesthetic value in the world’s academic circles. In 1978, Nahanni National Park was the first site to join the WH List with criteria vii and has grown to include 26 karst sites today. The karst landscape, due to its uniqueness, presents the world with superlative natural phenomena and natural beauty, with a unique aesthetic value that meets the OUV of WH. Sweeting points out that ‘the karsts of the south and southwest of China consist mainly of the sword, cone, and tower karsts, which constitute some of the most remarkable landscapes in the world [18]. In 2003, Purnululu National Park was added to the WH List. Its dramatically sculptured structures, unrivaled in their scale, extent, grandeur, and diversity of forms anywhere in the world, undergo remarkable seasonal variation in appearance, including striking color transition following rain [52]. During their visits to Shibing, Williams, Wood, and other experts praised the outstanding geomorphological landscape and aesthetic value of the Shibing dolomite karst during their visits to Shibing [18,53]. Chen et al. (2004) suggested that Xiaozhai Tiankeng has aesthetic value and scientific value; it is a precious karst landscape with scarcity, typicality, systematicity, and non-renewability and it has the conditions to become WH [54]. In 2006, he pointed out that Wulong Karst combines karst landscapes such as canyons, caves, natural bridge groups, and tiankeng, which have the most distinctive natural beauty and exceptional aesthetic value in the southern karst region of China [37,55]. Du et al. (2009) concluded that the Libo Karst cone peaks have the formal aesthetics of neatness, symmetry, and stability; the combination of karst peak cluster depression and peak cluster valley is complete, rich, and typical in form, which meets the criteria vii of the WH [56]. Li et al. (2010) suggested that Shibing Karst has the characteristics of being “deep, beautiful, and strange’ in terms of natural beauty, reaching the state of aesthetic importance and meeting criteria vii [44]. Deng (2011) conducted a landscape characterization and evaluation of Jiuzhaigou NH, which is dominated by water landscapes such as plateau lake groups, calcium waterfalls, and calcium beach flows, and the distribution of water landscapes is particularly concentrated, with excellent aesthetic, scientific, and tourist values [57]. Jon et al. (2021) deal with the cave formation process, the features of speleothems and other karst features in Songam Cave, which indicate that Songam Cave is a geoheritage of high conservative significance because of its geological and aesthetical value [58].

4.4. Protection and Development of Karst Landscape

The harmonious development of nature and humanity is the idea of the NWH [59]. WH is a precious tourism resource, and its development and investment should be based on resource protection. WH is a symbol of honor and wealth for a country or region. Whether the heritage can be well protected and managed is a symbol of the responsibility, obligation, and ability of a contracting party. The Convention’s goal is to preserve the heritage’s ‘authenticity’ and ‘integrity.’ The Operation Guide for the Implementation of the World Heritage Convention (hereinafter referred to as the Operation Guide) stipulates that authenticity and integrity are very important protection principles, and any nominated sites applying for inclusion in the WH List must have outstanding universal value. ‘Authenticity and integrity’ are the fundamental guarantees to reflect the two important missions of WH: inheriting human civilization and reflecting the evolutionary history of nature. It plays an important guiding role in heritage protection. These two principles are not only the yardstick to measure the value of heritage, but also the key to protecting heritage [60]. Authenticity is mainly reflected in cultural heritage, while integrity is mainly reflected in natural heritage. In 2004, the Operation Guide adjusted the protection principle, believing
that authenticity and integrity are mutually unified and should be considered uniform. For natural heritage, authenticity is the basis of integrity, and integrity is the reinforcement of authenticity. The most advanced form of nature conservation is “preservation”, not “conservation” [61]. Therefore, the principle of integrity is the key to the application and protection of natural heritage.

The unique and spectacular landscape of karst geomorphology is a valuable natural resource of tourism and has aesthetic values on its own; contributions of geographers to the introduction, conservation, research, and development of the karst environment should be emphasized [62]. From the aspect of environmental protection, the karst landscape is fragile, and non-renewable, which is very different from other resources. Historically, karst landscapes have attracted visitors due to their natural beauty, but during sightseeing, the beauty of the landscape has been damaged due to the irreversible effects of various factors. Leopold (1966) realized that for natural aesthetics to support environmentalism, it must be consistent with environmental values [63,64]. In 1967, John Krutilla (1967) proposed the need to protect rare landscapes and to strictly control their use under renewable terms, especially regarding the concepts of ‘uniqueness’, ‘authenticity’, ‘indeterminacy’, and ‘irreversibility’ for comfort resources [65]. Ronald Hepburn (1993) proposed environmentalism, arguing that we should shift from paying for natural aesthetic experiences to appreciating ‘true nature,’ abandoning the human-centeredness of traditional aesthetic thought [66]. By knowing the process of landscape evolution and understanding the beauty of the landscape in depth, we can protect the aesthetic value of the landscape better. Given current trends in nature conservation internationally, and a shift in value systems from an exclusive focus on scientific values to a greater emphasis on connecting people and nature, consideration should be given to the evaluation of the additional values of the site [67]. These wider values are fundamental in terms of gaining wider public recognition and support for geoconservation and advancing the integration of geoconservation within nature conservation, protected area planning and management, and broader environmental strategies and policies [68]. Wu (2010) considered that analyzing the components of aesthetic psychology in karst cave adventure can be conducive to karst cave adventure tourism [69]. Kamarudin (2015) concluded that OUV is applicable to become the foundation of conservation education for the local community in Malaysia by adapting the 10 OUVs based on the authenticity and characteristic of Malaysia [70]. Based on these premises, Veronica, etc., (2022) have developed the inventory and quantitative assessment of seven geosites, aimed to enhance the geotouristic potential of this sector of the northern Apennines and propose a different reading and interpretation of the territorial values, to increase the local tourist attraction by enhancing the geotourism proposal [71]. Over time, WH sites have become established as important tourist destinations, and UNESCO’s policy toward WH sites is no longer just about conservation, but now also includes sustainable tourism [72]. According to the present development and protection of karst sites, most sites have unreasonable landscape development planning, inadequate tourism facilities, weak management, and imperfect protection mechanisms [73]. Blindly imitating and learning from other landscapes without reflecting on local characteristics [74] results in a serious waste of resources [75]. Poor infrastructure and subsequent management lead to a worse tourist experience and a shorter life cycle of the scenic spot; the lack of popular science leads to tourists being unaware of the fragility of karst and can inadvertently cause damage to the environment [76].

In fact, reasonable development projects can promote the demonstration of heritage values, but unreasonable development projects can pose a threat to heritage values. As a result, development projects at heritage sites are of great concern. The judging of whether a project can be carried out in and around a WH site is whether and to what extent it will have a negative impact on the outstanding universal values of the WH site. In 2003, Purnululu National Park analyzed the impact of human traffic on the site in its nomination, monitoring the impact of the site by building airstrips and airways to disperse visitors, ensuring public safety, and keeping noise within tolerable limits [52]. For the conservation
and management of the series of heritage sites, the South China Karst has combined the general requirements and principles of conservation and management of the NWH sites around the world when formulating the conservation management plan and proposed measures and action plans for the different values and challenges of each site separately, finally building the overall management framework [18]. Xiao et al. (2020) used GIS to carry out an impact evaluation of the glass bridge in Zhangjiajie Grand Canyon in the NWH of Wulingyuan [27].

WH monitoring is an important tool for protection and risk prevention, providing data support and trend analysis for heritage protection and providing a scientific basis for heritage management decisions. Pretty (2011) offered a global model based on multi-model general circulation model ensembles, vulnerability, and Human Influence, producing the World Heritage Vulnerability Index, a measure of relative risk among properties [77]. Xiong et al. (2012) are based on the principles of ‘protection-oriented, scientific development, and sustainable use,’ and the protection concept of ‘protection-oriented in the core area, combined treatment and development in the buffer zone, and combined prevention and control in the upper watershed area,’ three types of measures, including protective construction, development, and infrastructure construction, have been adopted in the Libo NWH Site of the South China Karst [78]. Liu (2018) used the pressure-state-response model as the basis for classifying the value of heritage sites to build the monitoring and assessment index system of the Shibing NWH Site, evaluate the current situation of its protection and management, and propose an alert feedback mechanism to establish a monitoring and assessment system applicable to the Shibing Karst [79].

As a key scenic area in China, the Huangguoshu Scenic Area attracts many tourists from around the world with its water landscape, such as the Great Falls, the waterfall group, and the river valley landscape, combined with the local national features and the comfortable climatic conditions. Tourism activities at heritage sites are inevitable, so it is necessary to study WH sites in the context of tourism activities [80]. This could be achieved by setting indicators for the aesthetic value of the landscape of the Huangguoshu Scenic Area and its characteristics, establishing conservation objectives based on landscape types and characteristics, and constructing a ‘value-carrier and its characteristics-conservation objectives’ protection and management mechanism, and providing targeted development and conservation measures for WH sites with criteria vii.

5. Discussion

Due to the diversity of landscape elements, the complexity of landscape patterns, the limitations of technology, and the different purposes of research, the final landscape types and evaluation systems are different. Some classification methods do not include all landscape types, some classification methods are not universal due to their special study area, and some classification methods have overlapping results, so it is difficult to use them comprehensively. So far, there has not been a recognized, standardized, and universal landscape classification system. It is necessary to establish an integrated evaluation model that combines the attributes, structures, and levels of the natural landscape. Ha and Yang (2019) established a generic system combining subjectivity and objectivity with expert and public opinions. In this system, the NWH site criteria, ecological environment, and viewing experience were used as established indicators. Furthermore, the Bayinbuluk area of Tianshan Mountain in Xinjiang was used as an example to verify the rationality of the model [81]. In addition, UNESCO (2011) advocates the need to use quantitative methods to explain superlative characteristics as much as possible [82]. Moreover, the IUCN recommends the further development of qualitative research methods and further research on suitable methods and principles based on the existing methods for aesthetic value recognition that have been utilized in countries around the world. From the above studies, karst landscape characteristics are mostly studied based on geomorphological and evolutionary processes, but the landscape features such as fragility and non-renewability are not studied from the perspective of landscape aesthetics. Traditional aesthetic factor
extraction and aesthetic feature recognition are mainly conducted through data analysis and photo scoring. With the continuous development of Remote Sensing, Geography Information Systems, Global Positioning Systems, 3D, and other technologies, it is possible to conduct landscape analysis on the data of the research area, making the evaluation more accurate and objective [83]. In addition, the development of technologies can also promote the monitoring and protection of heritage sites. However, in the existing study on the Huangguoshu landscape, new technology is mostly used to monitor vegetation coverage and the transformation of landscape patterns [84–86]. In general, the key attributes can be explained intuitively through mapping. Moreover, new technologies can broaden the channels through which preference data can be collected and have broad application prospects.

Karst landscape is a popular type of NWH, and its aesthetic value attracts researchers from all over the world to study it. However, due to different subjective factors such as cultural background, knowledge systems, and personal experience, researchers will form different evaluation criteria when evaluating karst landscape, and qualitative descriptions of different styles will penetrate the evaluation, which has a negative impact on the recognition of the aesthetic value of the landscape. The main characteristic of the Huangguoshu Scenic Area’s environment is the dual nature of the surficial and underground spaces. As the landscape is complex and diverse, it is necessary to further refine the characteristic lists created for the same type of landscape and provide more detailed and objective descriptions of the single and combined landscape forms, as well as their importance in similar landscapes.

By analyzing the texts of the inscriptions of criteria vii for heritage sites, it was found that when States Parties apply for heritage sites with criteria vii, the part of ‘superlative natural phenomena’ can usually be measured and evaluated objectively; for ‘exceptional natural beauty and aesthetic importance’ was pointed out to be more difficult to evaluate, and the evaluation is a much more subjective description. When evaluating the aesthetic value of the Huangguoshu landscape, it should adopt a combination of qualitative and quantitative approaches. Xu (2018) contends that separate assessment schemes for expert and public opinions, with separate weights assigned, can be developed to comprehensively evaluate the aesthetic value of the nominated site’s landscape [87].

In the application of criterion vii, the global comparison framework is used to identify other sites with similar values. For many properties nominated by criteria vii, the comparison of qualitative evaluations based on aesthetic values remains challenging. Different perspectives and preferences of experts and the public lead to different evaluation results. From the perspective of the States parties, different social and cultural backgrounds may lead to deviations in the translation of criteria vii. This method’s guiding role in writing the re-inscription text is still limited, and it is still difficult to explain the aesthetic value of the heritage site objectively and fully by only referring to the ‘analogy method’ [88].

The Huangguoshu Scenic Area is in the karst plateau canyon area, with diverse spatial structures and complex landscape types. So, we need to summarize the list of the same type of landscape, combine various perspectives from experts and the public, assign weights, and build a comparative framework of the same type to carry out the study.

At present, most of the karst landscape types are divided based on geomorphology, tourism resources, and spatial distribution, and combined with actual cases. On this basis, aesthetic landscape research is carried out, resulting in the description of the heritage sites in the application for WH being more focused on geomorphological features, evolutionary processes, etc. As to the aesthetic value, most of them are simply described by photos, drawings, and documents, and little research is conducted from the perspective of the landscape.

Because of the scarcity, typicality, systematicity, and non-renewable nature of the karst landscape [54], the landscape value is especially outstanding, and a systematic theoretical system is extremely important for the study of the karst landscape. A correct understanding of the landscape value system can clarify the questions of ‘why and what to protect; why and what to use’ [89]. Now, the Huangguoshu Scenic Area is listed in the Tentative List. When studying landscape protection, a protection scheme should be
formulated in combination with the value of the landscape contained in the criteria met by the specific type of Huangguoshu Scenic Area. Additionally, the Convention stipulates that state parties have five responsibilities regarding WH, including the identification, protection, preservation, exhibition, and inheritance of WH by future generations. There is no doubt that WH research is not only focused on protection but is also motivated by sharing WH with all of humanity so that people can learn about and share the value of WH sites together [27]. Further, Carlson and Lintott (2008) explain how a focus on natural beauty is an important motivator for environmental protection [90].

6. Conclusions and Future Research

In this paper, we performed a systematic literature review by analyzing 190 articles retrieved from the Web of Science, CNKI, and Google Scholar. The main conclusions are as follows: (1) research on the aesthetic value of WHK is generally increasing; (2) among the WH studies related to landscape type, landscape structure, landscape characteristics, landscape evaluation, landscape aesthetic value, landscape protection and development, the study of the aesthetic value of WHK is most common and is focused on the aesthetic value of WHK; (3) research on the aesthetic value of WHK is primarily conducted in China; and (4) the word cloud reveals that the most frequently used words are associated with karst landscape and criteria vii. After additional studies, this paper proposed seven key scientific issues that remain to be addressed. These seven issues are hot research topics worthy of in-depth exploration in the future.

This literature review has summarized several key scientific issues, and the future directions of the aesthetic value at WHK sites can be developed based on the following aspects: how to choose the landscape classification system of karst sites; how to build a comprehensive evaluation model of aesthetic value that is suitable for WHK sites; how to quantify the aesthetic value of WHK sites; how to select the objective evaluation subject of karst landscape; how to formulate the protection and management measures of the aesthetic value of WHK sites; how to objectively describe the aesthetic value of WHK sites; and the application of new technology to the aesthetic value of WHK sites. These issues need further research. In addition, some areas are not only WH sites, such as World Geoparks, Scenic Spots, and Nature Reserves. In this case, how to coordinate all levels of protected areas of overlap and determine the reasonable aesthetic value of the protection management system is another issue to consider. Future research may consider interdisciplinary knowledge of related fields. In addition, relevant information needs to be obtained not only from the literature, but also from UNESCO, IUCN, and other institutions to obtain the latest policy information.

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References


9. Cidell, J. Content Clouds as Exploratory Qualitative Data Analysis. Area 2010, 42, 514–523. [CrossRef]


68. Gordon, J.E.; Crofts, R.; Díaz-Martínez, E.; Woo, K.S. Enhancing the role of geoconservation in protected area management and nature conservation. Geoheritage 2018, 10, 191–203. [CrossRef]


71. Guerra, V.; Lazzari, M. Geoheritage Assessment and Potential Geotouristic Enhancement in Mountain Environments: A Test-Site in the Northern Apennines (Italy). Geoheritage 2022, 14, 1–20. [CrossRef]

72. Lyck, L. World Heritage as Tourism Destination Drivers. Tour Leis. 2015, 203–222. [CrossRef]


75. Liu, C.L. Study on Landscape Characteristics and Landscape Coordination of Shilin Scenic Spots in Yunnan Province. Master’s Dissertation, Kunming University of Science and Technology, Kunming, China, 2017.


77. Perry, J. World Heritage hot spots: A global model identifies the 16 natural heritage properties on the World Heritage List most at risk from climate change. Int. J. Herit. Stud. 2011, 17, 426–441. [CrossRef]


