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Sustainable Development Analysis of National Park Tourism based on Analytic Hierarchy Method

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Abstract: As an essential place for ecotourism, scientific research, and the educational environment, the national park is an essential part of the research conducted by many experts and scholars. To build an evaluation system of the sustainable development of national parks, and to deeply study the content of the sustainable development of national parks in China, to provide a new direction for the national parks in the sustainable development road of tourism. Studies have shown: 1. As the core content of national parks, the ecosystem is still the focus of experts and scholars, among which the authenticity and integrity of ecosystems account for the highest proportion. 2. According to the evaluation results of experts, it is concluded that China's national parks are currently in the basic sustainable development stage of tourism. There are more opportunities and space for the sustainable stage of future tourism development. 3. At present, China's national parks are representative of the ecosystem, the authenticity of the ecosystem reaches good coordination, and the suitability of the area and scale is moderately unbalanced. To study and explore the factors affecting the tourism sustainability of national parks and to provide a meaningful direction and reference basis for the protection and management of their formulation of policies and systems.

Keyword: National Park; Analytic hierarchy method; Sustainable Development

1.0 Introduction

In a modern society with rapid economic development, the material foundation is guaranteed, and people gradually pursue the satisfaction of the spiritual world. The transformation of social contradictions affects more tourists' choice of tourist destinations. The public tourism way of punching in has intuitive changes and more of the pursuit of spiritual and emotional tourism. The ecosystem's fairly wide natural environment has become an important tourism trend. The term "national park" first appeared in the United States, mainly for the state to protect the natural areas of intact ecosystems, providing places for ecotourism, scientific research, and the educational environment. The national park has a unique natural and cultural landscape, which is the most important resource for tourists to visit and is also an important part of the protection and development of the national park.

At present, our country is in the primary stage of the development of "national park" protection. National park tourism destinations are popular and widely distributed. Five parks were selected as the first national park list in October 2021, namely Mount Wu Yi, Hainan Tropical Rainforest, Northeast Tiger and Leopard, Giant Panda, and San Jiang Yuan National Park. The five parks cover nearly 30% of the national key protected wildlife species in inland countries. They are also the regions with the richest biodiversity, the best natural heritage, the unique landscape, and the most critical ecosystem in China's national park system. In the early stage of the pilot construction of national parks, more politicians, experts, and scholars endorsed the concept of protecting development and promoting the sustainable use of natural resources. Therefore, national parks have become an important object of concern, and their ecological diversity and species uniqueness have also become important protected tourism resources. Based on the previous scholars, this paper constructs the evaluation system by using the national park identification indicators, evaluates the development direction and importance through the questionnaire of domestic tourism experts, analyzes the development status of national parks in China, and provides reference opinions for the future development direction of national park tourism.

2.0 Literature Review

American artist George Katlin originally proposed the term national park American artist George Katlin originally proposed the term national park to protect a region from being harmed by human development and pollution. The first national park in the world was Yellowstone National Park, which the United States Congress approved in 1872. The national park in the United States is known as the "Pleasuring grounds" of the people (Robert, 2013); it is also a vital tourism resource. There are various types of national parks in China, forest parks with vegetation and comprehensive animal and plant parks. Many scholars comprehensively study the content of the sustainable development of national parks in various fields, which can be divided from the professional background and research direction of the research scholars.

Among the scholars who study the influence of tourists on national parks, Huang Li (2022) has studied the social value of national parks in the United States from the perspective of tourists and believes that natural national parks mainly take natural resources as the core with aesthetic, cultural, historical, biological diversity and other social values. At the same time, it should also have a certain information transmission and recreation (Yang, 2016). Huang et al. (2018) studied the civilized behavior of tourists in the Great Wall National Park and believed that creating a cultural atmosphere of tourist places is conducive to cultivating the emotion of tourists' local attachment, thus affecting the civilized behavior of tourists. Ou (2021) analyzes the impact of tourists' wasting food behavior on the ecological environment, and Deng (2021) studied tourist satisfaction in the National Forest Park. The development of national parks in China is relatively slow, and it is still in the early stage of development. Scholars have studied foreign national parks to provide a reference for developing national parks in China. Such scholars focus on the protection and management of national parks. Gao (2022) studied the ecological security of national parks in the United States from the perspective of environmental history, established a mature national park system, and demonstrated nature protection in other countries. Cai et al. (2022) studied the logic of the national park system in constructing ecological civilization and dealt with the problem of balanced interests in developing environmental civilization and the issue of balanced interests in developing national parks. To meet better, the relevant interests of national parks among the interest groups. For example, Optimizing the comprehensive testing system for national parks (Jiao et al. 2022), Functional zoning of the National Park (Wang et al., 2021a), Development ideas and construction path (Li, 2016), and Value accounting of ecological products (Du et al., 2023).

With the unveiling of China's first national parks list, domestic national parks research has once again become a research hotspot among experts and scholars. Researching the protection and management of national parks and ensuring the sustainable development of national parks in terms of macro policies and systems. Yang (2020) studied the legal framework of the sustainable development of national parks in China, promoted the legislation of national park protection, and had laws to follow. Xu (2015) studies the system construction and governance model of British national parks (Wang et al., 2018), starting from the system and formulating the development path and strategy of national parks], To provide reference opinions for the sustainable development of national parks in China. Building a national park evaluation

system, From the social impact (Chen et al., 2022), Ecosystem integrity (Dai et al., 2019), Effect evaluation (Tang et al., 2010), Tourism suitability evaluation (Chen et al., 2020), Entrance space quality (Wang et al., 2020), Performance management evaluation (Wu et al., 2015), The tourism development status of national parks in China is analyzed from multiple perspectives.

To sum up, domestic and foreign experts and scholars have developed various research fields on national parks. From the perspective of the management system, tourists, ecological protection, and evaluation system, they can learn from the experience of national park tourism development at home and abroad and integrate disciplinary knowledge. Based on the research of previous scholars, this paper constructs the evaluation system with the national park identification index to study the development status and development path of national parks in China.

3.0 Materials and Methodology

3.1 Build an Index System

This paper uses the AHP analysis method to construct a sustainable evaluation system, consult high-level experts and scholars and fill in expert questionnaires to explore the important direction of the sustainable tourism development of national parks. The AHP analysis method was proposed by an American operations researcher and Professor T.L.Saaty at the University of Pittsburgh at the beginning of the 1970s. This method is mainly for quantitative analysis of qualitative problems and qualitative text into numerical quantification. With the aid of national park identification indicators and the AHP analysis method, the evaluation system is constructed as follows (Table 1)

Table 1: National park evaluation layers.

Target layer	system layer	Indicator layer
National parks have sustainable developmentA1	National representativeB1	Representativeness of Ecosystem C1
		Representation of biological species C2
		The Uniqueness of natural landscape C3
	Ecological importanceB2	Ecosystem integrity C4
		Ecosystem authenticityC5
		Suitability of area scale C6
	Management feasibilityB3	Natural resource property rights C7
		Fundamentals of Conservation Management C8
		Sharing potential for all C9

3.2 Computational and analytical methods

In the index architecture diagram, the AHP analysis method usually employs either the sum product or the square root method. In this study, the influence weights of the same indices level are calculated using the sum-product method. In the expert scoring and evaluation, the Sadie 1–9 scale construction method is used for factor comparison (Table 2). The maximum eigenvalues and the corresponding eigenvectors of this matrix are calculated by comparing the two factors and constructing a same-level comparison matrix. This determines the influence degree of the index. The accounting consistency test determines the influence degree of the index

Table 2: Sadie 1-9 scale.

Comparison of Importance Indicators	Important	Very Important	More Important	Slightly Important	Equally Important	Slightly Unimportant	Comparatively Unimportant	Very Unimportant	Unimportant
Factor ai with Factor aj	9	7	5	3	1	1/3	1/5	1/7	1/9

According to the comparison degree of the index, the process of calculating and judging the hierarchy matrix is as follows:

(1) Normalization of each column of elements of the judgment matrix:

$$a'_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \quad i, j=1, 2.....n$$

(2) Normalized values of the judgment matrix summed by columns:

1. $w' = \sum_{j=1}^{n} a'_{ij}$ i =1, 2.....n

(3) The vector$w'= (w'_1, w'_2, \ldots, w'_n,)$ T is normalized as:

1. $w_i = \frac{w'_i}{\sum_{i=1}^{n} w'_i}$ i =1, 2.....n

b. The resulting $w= (w_1, w_2, \ldots, w_n)$ T is the approximation of the requested eigenvector

(4) The maximum eigenvalue of the judgment matrix was calculatedλ_{max}:

1. $\lambda_{max}=\frac{1}{n}\sum_{i=1}^{n} \frac{AW}{w_i}$

(5) To avoid contradictions, a consistency test should be conducted to judge the consistency index of evidence:

1. $CI=\frac{\lambda_{max}-n}{n-1}$

b. (n is the number of layers of the judgment matrix)

(6) Random consistency ratio calculation:

$$CR=\frac{CI}{RI}$$

The value of the RI is a fixed index relative to the multi-stage matrix. Table 3 is the control table of the random consistency index of the fixed positive and negative matrix of classes 1–15. The matrix was considered to pass the consistency test when the consistency ratio was CR < 0.1.

Table 3: Control table of the random consistency index of the fixed positive and negative matrix of classes 1–15.

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.46	1.49	1.52	1.54	1.56	1.58	1.59

4.0 Results

4.1 Expert Interview

The national park sustainable development study will invite experts in the field of tourism to conduct a questionnaire survey on the impact indicators in the tourism development process. At the same time, to determine the reliability of the expert questionnaire, experts were invited to assess their professional degree and the familiarity of the research subjects when filling in the questionnaire. A total of 23 experts were invited, including professors (4), associate professors (14), lecturers (2), senior executives of tourism enterprises (1), and deputy positions of the tourism bureau (2). According to the professional degree of the experts and the filling basis, the division criteria are as follows (Table 4):

Table 4: Professional degree of experts.

Degree and basis	large	middle	small
speculative knowledge	0.4	0.3	0.2
practical experience	0.4	0.3	0.2
Peer understanding	0.1	0.1	0.1
Personal intuition	0.1	0.1	0.1

According to experts familiar with the protection and development of national park tourism, it is divided into five levels: very familiar, more familiar, generally familiar, relatively unfamiliar, and unfamiliar. They were granted 1, 0.75, 0.5, 0.25, and 0 to determine the professional degree and rigor of the experts in filling in the questionnaire. The questionnaires of 23 experts have been recovered, indicating that the experts have high enthusiasm for academic research. After collecting the questionnaire, the degree of authority of the invited experts was determined. The judgment basis Ca is 0.8739, the familiarity CS is 0.5543, and the comprehensive authority coefficient Cr range from 0~1, Cr=（Ca + CS）/2 is 0.7141, indicating that the authority of the experts is high. The questionnaire filled out by the experts is more credible.

The expert questionnaire compares and analyzes the indicators of the national park through the AHP and uses the yaanp2.7 professional software to calculate the weights of the indicators in the national park evaluation system as shown in the following table (Table 5):

Table 5: Weightage of the indications in the national park evaluation system.

Target layer	system layer	Weight	Indicator layer	Weight
National parks have sustainable development A1	National representative B1	0.266320	Representativeness of Ecosystem C1	0.099970
			Representation of biological species C2	0.084600
			The Uniqueness of natural landscape C3	0.081750
	Ecological importance B2	0.538412	Ecosystem integrity C4	0.193018
			Ecosystem authenticityC5	0.207274
			Suitability of area scale C6	0.138120
	Management feasibility B3	0.195268	Natural resource property rights C7	0.054124
			Fundamentals of Conservation Management C8	0.072102
			Sharing potential for all C9	0.069042

The results of the research expert questionnaire showed that the ecological importance (0.5384)> national representativeness (0.2663)> management feasibility (0.1953). The ecosystem is the core content of the development and protection of national parks. The ecosystem is the core content of the development and protection of national parks. The construction of national parks in China is a landmark, guiding, and overall major innovation of China's ecological civilization. It is an essential means to protect the integrity and diversity of China's ecosystem.

In the ecosystem importance system, ecological authenticity and integrity account for a high proportion, namely 0.2072 and 0.1930, respectively. National parks are based on ecological environment, natural resources protection, and moderate tourism development to achieve development in a small range and promote an extensive range of protection. The integrity and authenticity of the national park ecosystem are the core. Sustainable tourism development must ensure that national parks do not suffer irreversible damage in the process of utilization and development or can be repaired in time from more serious and broader damage. In the national representative system layer, the usual ecosystem system (0.0999) accounts for a relatively large proportion. Not only has a complete ecosystem but its resource scarcity and resource diversity are also important to condition. Hence, the first batch of national parks in China covers 30% of the species of animals and plants in China. In the management feasibility system layer, the protection and management foundation has become an important means (0.0721) and

has a relatively high weight. Optimizing management methods and improving management skills is an important guarantee to protect national parks from damage, enhance utilization efficiency, and promote sustainable development

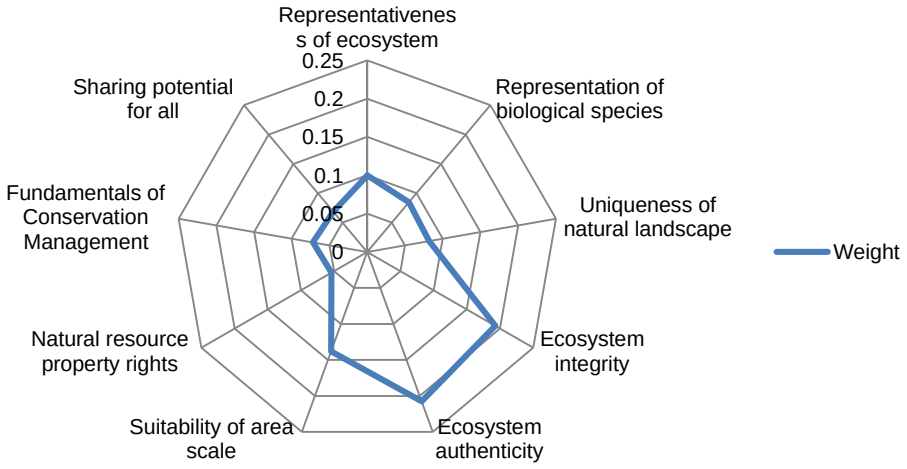

Figure 1: Metric layer weight map.

4.2 Fuzzy Comprehensive Evaluation of National Parks

According to the expert evaluation, the fuzzy comprehensive scoring method commonly used by the multi-objective linear weighted function is adopted (Yang et al., 2007), To evaluate the sustainable development degree of national parks, using the five-level scoring system method (Ge et al., 1950), The sustainable development process by adopting the percentage system is divided into five stages. The evaluation table is as follows (Table 6).

Table 6: Five-level scoring system for fuzzy comprehensive evaluation of national parks.

Integrated Assessment Value	0 to 20	20 to 40	40 to 60	60 to 80	80 to 100
Stage of development	Tourism unsustainable development stage	Tourism sustainability preparation Stage	Early stages of sustainable tourism development	Tourism basic sustainable development Stage	Tourism sustainable development Stage

Statistical calculation of expert evaluation score, construct the system layer weight judgment matrix Z, the weight value framework weight vector matrix S obtained through AHP calculation, through the following formula and take the five-level evaluation average calculation of expert comprehensive rating weight Q=Si * Zj:

$$Q = \sum_{n=1}^{l} I_n * R_n$$

In the above formula, Q is the total score value of the national park; In is the score value of an individual index factor in the index layer; Rn is the weight value under the corresponding level of the individual index. Through the fuzzy comprehensive evaluation of SPSSAU (v22.0) software, the national park expert evaluation weight set is {0.098, 0.126, 0.172, 0.231, 0.373}. Taking the five-level classification system, the comprehensive score of experts is 63.10 points after assigning different levels. According to the table of sustainable development of tourism stage, China's national parks are in the stage of essential sustainable development of tourism.

4.3 Verification of Sustainable Development Coordination of National Parks

4.3.1 The coupling coordination degree was calculated

. Using the coupled coordinated development degree correction mode (Wang et al., 2021b), it evaluates the degree of relationships more efficiently and accurately across system levels:

$$C = \sqrt{\left[1 - \frac{\sum_{i>j,j=1}^{n}\sqrt{(Y_i - Y_j)^2}}{\sum_{m=1}^{n-1} m}\right]} * \left[\prod_{i=1}^{n}\frac{Y_i}{\max(Y_i)}\right]^{\frac{1}{n-1}}$$

In the above equation, Yi is the i-th criterion layer score, Yi ∈ [0,1], and the coupling degree C ∈ [0,1]. The larger the C values, the more concentrated the criterion layers are. In contrast, the smaller the C values, the more discrete the criterion layers are. Therefore, if n = 3, Calculate the coupling and coordination degree of national representativeness(B1), ecological importance(B2), management feasibility(B3) criterion layer, assuming max(Yi) as ecological importance(B2):

$$C_B=\sqrt{\left[1-\frac{\sqrt{(Y_{B_2}-Y_{B_3})^2+(Y_{B_2}-Y_{B_1})^2+(Y_{B_3}-Y_{B_1})^2}}{5}\right]*\sqrt{\frac{Y_{B_1}}{Y_{B_2}}*\frac{Y_{B_3}}{Y_{B_2}}}}$$

The formula for calculating the degree of coordinated development D is:

$$D=\sqrt{C*T}$$

Among them, C is the coupling coordination degree, T is the total evaluation value, and D is the coordinated development degree of factors within each layer. In addition, the main division criteria are as follows (Table 7):

Table7: Main division criteria.

Coupling Coordination Degree D Value Interval	Coordination Level	Degree of Coupling Coordination
[0.0 ~ 0.1)	1	Extreme disorder
[0.1 ~ 0.2)	2	Severe disorder
[0.2 ~ 0.3)	3	Moderate disorder
[0.3 ~ 0.4)	4	Mild disorder
[0.4 ~ 0.5)	5	On the verge of disorder
[0.5 ~ 0.6)	6	Basic coordination
[0.6 ~ 0.7)	7	Primary coordination
[0.7 ~ 0.8)	8	Intermediate coordination
[0.8 ~ 0.9)	9	Good coordination
[0.9 ~ 1.0]	10	High-quality coordination n

The calculation of the coupling coordination calculation by SPSSAU (v22.0) software provides the following analysis results (Table 8):

Table 8: Coupling coordination analysis.

Item	Coupling Degree C-Value	Coordination Index T-Value	Coupling Coordination Degree D-Value	Coordination Level	Degree of Coupling Coordination
Representativeness of ecosystem	0.894	0.812	0.852	9	Good coordination
Representation of biological species	0.307	0.475	0.382	4	Mild disorder
The uniqueness of the natural landscape	0.266	0.523	0.373	4	Mild disorder
Ecosystem integrity	0.503	0.705	0.595	6	Basic coordination
Ecosystem authenticity	0.973	0.735	0.845	9	Good coordination
Suitability of area scale	0.347	0.231	0.283	3	Moderate disorder
Natural resource property rights	0.295	0.386	0.337	4	Mild disorder
Fundamentals of Conservation Management	0.846	0.736	0.789	8	Intermediate coordination
Sharing potential for all	0.548	0.541	0.544	6	Basic coordination

4.3.2 Analysis of the coupling and coordination degree of the sustainable development of national parks

The calculation results show that the representativeness of the ecosystem and the authenticity in the coupling coordination level of the national park sustainability development index layer is well blended. The coupling coordination degree value is 0.852,0.845, respectively, and the coordination level is 9. In the process of tourism development, China's national parks pay attention to the protection of the natural ecosystem and tourism resources, which makes China's national park ecosystem the characteristics of species integrity and biodiversity. The basis of protection and management is moderate coordination, and the coordination level reaches 8. Federal park protection needs a specific protection basis, and control means. Various regions have issued management measures and countermeasures for different national parks to promote the sustainable development of national parks and the protection of ecological tourism resources. The degree of coupling and coordination between ecosystem integrity and universal sharing potential is barely coordinated, with a coordination level of 6. The tourism publicity of national parks is weak, many tourists do not clear the definition and division of national parks, and their resource-sharing power is weak.

In the coupling and coordination degree results, the representativeness of biological species, the natural landscape uniqueness, and the property rights of natural resource assets were all slightly dysregulated, and the coordination level was 4. Biological species and natural

landscapes of national parks in China have their geographical characteristics in different ecological environments and locations, highlighting the features of biodiversity and the development degree of natural and geographical resources. Area size adaptation was moderate dysregulation with a coordination level of 3. In the development process of national parks, the areas available for development and utilization are highly restricted. Only part of the areas can be developed to provide more complete and effective protection of national parks. Only part of the areas can be developed to provide more comprehensive and effective protection of national parks. Meanwhile, to ensure the safety of tourists, tourists are prohibited from entering the non-development areas.

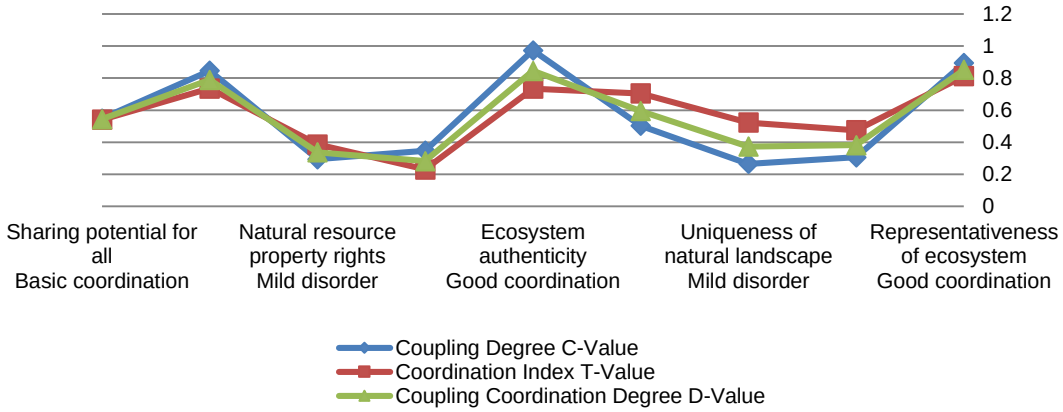

Figure 2: Degree of Coupling Coordination

Sustainable tourism in national parks is a joint development of multiple fields, structures, and levels. To intuitively analyze the trend of tolerable development degree and coordination of national parks, the statistics of the coupling degree value, coordination index value, and coupling coordination degree value of the index layer are as follows (Figure 2). It is more convenient for scholars to understand the degree of coordination and the importance of the sustainable development factors of national parks

5.0 Discussion

The authenticity and integrity of the ecosystem are still the core content of the sustainable development of national park tourism. Natural ecological resources are important tourist attractions, and tourists can enjoy and experience the most realistic environment of natural resources. Therefore, protecting the natural resources of national parks from damage provides an important guarantee for sustainable tourism development.

China's national parks have reached the basic tourism sustainability stage. Although only five of the first national parks were selected in 2021, the preliminary protection and development work still needs a solid foundation. Other national parks at home and abroad have far-reaching research theories, draw on each other's experience in national park management to develop tourism, and jointly promote t tourism development and the protection of natural resources.

Improve the publicity of national parks in the public view. The characteristics and functions of national parks are unclear in the public perception. Some tourists still equate national parks with forest parks, zoos, and even modern recreational parks. Therefore, improve the publicity of national parks, and deepen the tourists' awareness of national parks. It is conducive to protecting the ecological environment of national parks and reducing the damage to tourists in national parks.

Improve the management system for implementing the protection of national parks. The management system should be continuously optimized according to the development progress of national parks, and corresponding measures should be formulated in time. Management agencies should not rigidly abide by them. In the face of emergencies, they should focus on t tourists' life safety then reducing the damage to national parks.

Using modern scientific and technological means to optimize national parks' management methods and media. With 3S technology and real-time monitoring, it can not only implement comprehensive supervision and management of national parks but also reduce the cost of the management process. Several independent medical centers should be set up in national parks to solve medical emergencies for tourists. It can ensure the safety and health of tourists and improve the safety and experience of tourists.

Optimizing the industrial structure of tourism development in national parks is conducive to improving the utilization efficiency of natural resources, promoting ecological environment protection, and improving ecological value. Optimizing and upgrading the tourism development industry in national parks can make full use of natural resources to develop tourism and drive an industrial adjustment in surrounding areas. Optimize the development of the tourism industry, promote the coordinated development of national parks and the tourism industry, and constantly meet social development needs.

6.0 Conclusions

Integrating professional knowledge in various disciplines is conducive to improving the ability to protect national parks. It is necessary to protect the integrity of national parks' tourism resources and improve the protection capacity and means. We will integrate talents in all professional fields and use modern scientific and technological means to protect all national parks. Reduce ecosystem damage and promote the sustainable development of tourism in national parks.

It is necessary to balance the factors that influence the sustainability of national parks. The development of national park tourism is not a single development but should be comprehensive and coordinated. While protecting the tourism resources of the ecosystem, we should strengthen the publicity of environmental protection for tourists, broaden the management channels of national parks, optimize the management system, and comprehensively develop national parks.

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