

Evaluation and Optimization of Nature Reserve Interpretation System Based on Genetic Algorithm

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Keywords: Nature Reserve, Genetic Algorithm, Interpretation System, Satisfaction Analysis Model Method, Evaluation and Optimization

Abstract: As an important part of tourism services, the interpretation system has received extensive attention in recent years. However, in addition to Taiwan, China's research on interpretation is still in its infancy. Compared with other countries, there are obvious limitations in research participation, research objects, research content and research methods. This paper aimed to study how to evaluate and optimize the interpretation system of nature reserves based on Genetic Algorithm (GA) and Satisfaction Performance Analysis (IPA). Through a questionnaire survey of tourists, this experiment found that 44.89% of tourists were satisfied with the environmental interpretation system of Z Nature Reserve, and only 2.27% of tourists were not satisfied. It can be seen from the data that tourists were highly satisfied with the environmental interpretation system of Z Nature Reserve. Environmental interpretation is an effective way to carry out environmental education and develop ecotourism. It involves environmental protection, education, tourism, management and other fields. It can play an important role in better understanding the relationship between environment and development, environment and human survival.

1. Introduction

The interpretation system in the nature reserve is a necessary means to carry out public education and implement ecotourism, which is of great significance to the management, construction and development of the nature reserve. The nature protection interpretation system collects and arranges the interpretation information, and transmits the value and protection information of the resources in the nature reserve to tourists, so that tourists can better understand and appreciate the natural landscape, thus forming reasonable tourism motivation, and finally achieving the goal of sustainable development of the nature reserve. The planning of the nature protection interpretation system should meet the needs of tourists, be based on scientific design, be consistent with the actual needs

and technical level, and ensure that the information can be clearly and effectively transmitted to tourists.

With the continuous development of society, the research on nature reserves has gradually increased. Gritsan Yuriy I. found that in the current survey, a chain method was developed to evaluate the landscape diversity of the “Dneperoorirsky” nature reserve. In the complex and diverse landscape, the traditional concept of linking as a group of residual, transit and cumulative locations cannot cover the most important environmental gradient model [1]. Kujirakwinja D. used mapping methods of community resources developed from best practices to help communities determine the boundaries of protected areas, and then pilot participatory zoning to determine settlements, agriculture, hunting, non-wood forest product collection and protected areas [2]. Mo R. R. reported two new species of Amphioxidae and Amphioxus from the Daming Mountain National Nature Reserve in the central part of Guangxi Zhuang Autonomous Region in southern China, namely, the double-handle soft-shelled turtle and the double-horn soft-shelled turtle [3]. Xu ZengRang investigated and analyzed the Qiangtang National Nature Reserve by taking the coordination of land multi-functional conflicts in the nature reserve as an example [4]. Although these studies have promoted the research of nature reserves to some extent, they have not been combined with the actual situation.

This paper first analyzed the interpretation method of nature reserves based on GA, and studied it from three aspects: the status quo of the interpretation system of nature reserves, the introduction of GA, and the construction of the interpretation system of nature reserves. Secondly, this paper conducted a questionnaire survey and analysis on tourists, and probed into many aspects. Finally, some suggestions for the optimization of the interpretation system of the nature reserve were given.

2. GA-based Interpretation Method of Nature Reserves

2.1. Current Situation of Nature Protection Interpretation System

A perfect environmental interpretation system can allow tourists to have a deeper understanding of the internal essence of the landscape while enjoying the external form of the landscape, thus generating positive environmental protection concepts and behaviors. In tourism development and environmental protection of tourism destinations, the role of environmental interpretation cannot be measured. The nature reserve is an eco-tourism scenic spot with rich natural resources and high representativeness [5-6]. The two central functions of nature reserves are to promote ecological education and nature conservation [7]. Therefore, the establishment of ecological environment assessment system is of great significance to the development of China’s nature reserves. Therefore, for the nature reserve, the establishment of its interpretation system must take the perspective of environmental interpretation as the starting point, and pay attention to environmental education and natural protection. Only in this way can the tourism in the nature reserve be experiential, educational and protective [8-9].

At present, China’s research on the construction of environmental interpretation system is basically based on the theory and experience of other countries, either the traditional mass tourism interpretation system as the main body, or the planning and design of a single interpretation media. Moreover, these works are carried out based on cases, and lack a set of systematic and universally followed theories and methods for the construction of environmental interpretation systems that highlight the role of environmental education and protection.

At present, there are still problems in China’s nature conservation interpretation system, mainly in the following aspects, as shown in Figure 1.

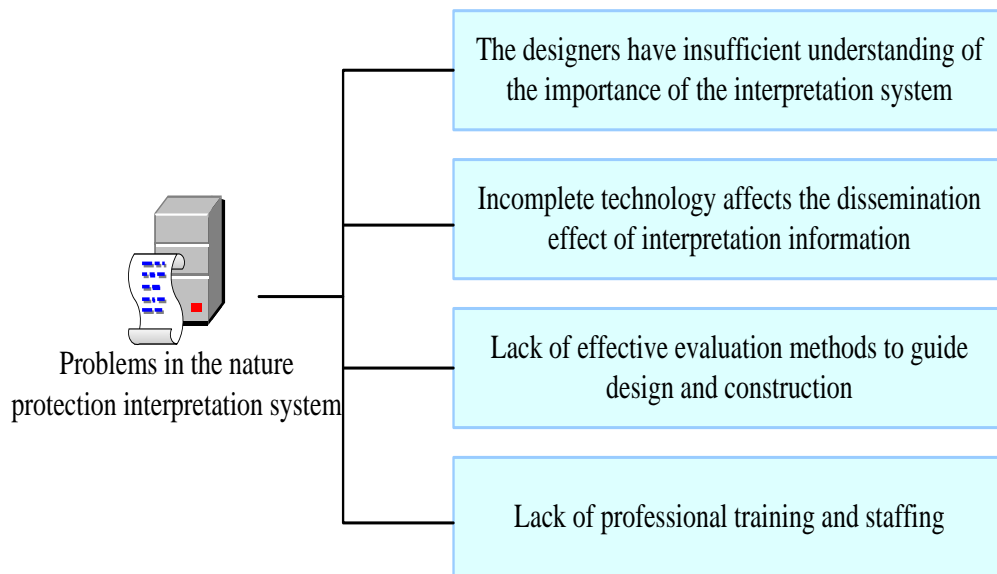


Figure 1. Problems in the nature protection interpretation system

It can be seen from Figure 1 that the problems of the nature protection interpretation system are: The designers have insufficient understanding of the importance of the interpretation system; Incomplete technology affects the dissemination effect of interpretation information; There is lack of effective evaluation methods to guide the design and construction work; There is lack of professional training and inadequate staffing.

How to improve the quality of the nature protection interpretation system through effective design is an urgent problem to be solved. Natural reserves play an important role in China's ecological environment. How to make full use of their natural resources for ecotourism has become a research hotspot [10].

2.2. GA Introduction

GA is an adaptive heuristic search algorithm based on the theory of natural biological evolution. Its essence is an efficient and parallelizable global search mode [11-12]. In recent years, GA has been widely used to solve optimal problems.

GA starts from a set of feasible solutions of the problem to be solved. It can be considered as a population composed of a specific number of individuals, which are encoded by genes [13-14]. On this basis, through the random selection of some individuals in the population, they are gradually evolved, and finally the optimal solution is obtained. Before each generation starts to evolve, the fitness of all individuals in the population is first counted, and then some species in the population are randomly selected according to a certain fitness. They are hybridized and mutated, and finally a new population is obtained. Through multiple genetic operations, the population with poor fitness is eliminated to obtain a better population. Finally, after several iterations, the near-optimal results can be obtained.

In classical GA, a possible solution in the solution space of the problem is converted into a fixed sequence. Adaptive function is a function to evaluate the advantages and disadvantages of each possible solution in the group [15]. The main control parameters are population size, maximum operation algebra, population crossover probability, population mutation probability, etc. When the algorithm is terminated depends on the specific situation.

The basic steps of GA are shown in Figure 2.

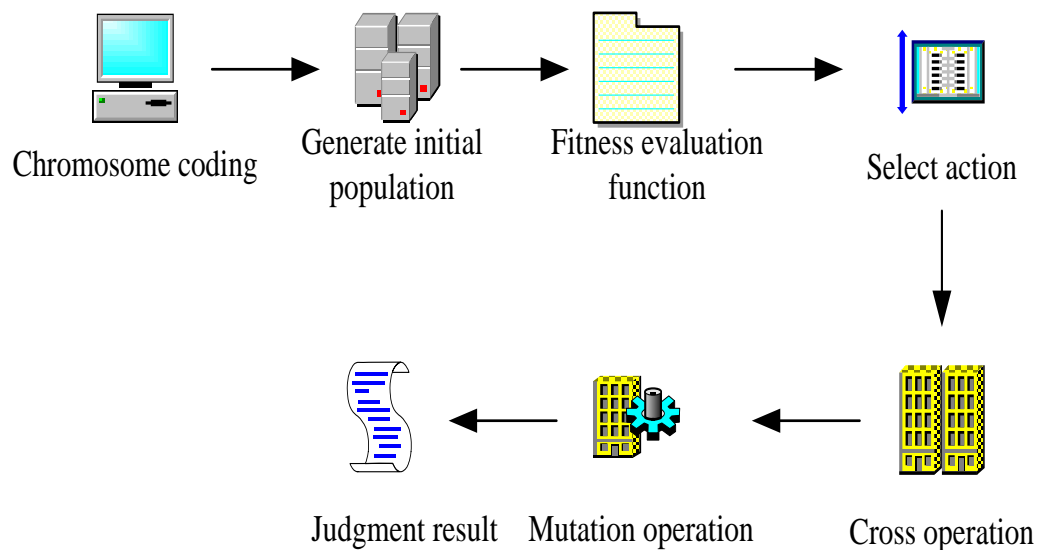


Figure 2. GA basic steps

Chromosome coding: Because GA cannot use the solution data of the real problem to be solved, it must be encoded and expressed as a string.

Generate initial population: Since this method starts from a possible solution set of a real problem, it needs to prepare a certain number of possible solution sets for post-order operation. In this initial group, everyone is composed of a fixed, randomly generated string.

Fitness evaluation function: On this basis, a GA-based genetic optimization method is proposed, which applies genetic optimization method to genetic optimization.

Selection operation: The purpose of this selection is to select the best individual from the current population and make it possible to become the father of the next iteration.

Cross-operation: Cross-operation refers to selecting a certain number of individuals from the contemporary group according to the specified crossover probability and making two pairs of pairs. Then, select a gene node and exchange the gene strings between the selected nodes to generate two new individuals.

Mutation operation: Mutation operation refers to the random selection of a certain number of individuals from a population with a certain probability to transform the content of a certain gene.

Judgment result: In this method, there are usually two termination conditions. One is to obtain the algebra of the whole iteration, and the other is to obtain the optimal solution. It is determined that the current population meets the termination conditions. If not, it enters the fitness evaluation function and continue to evolve. When the above requirements are met, the method is terminated and the best result is output.

The application of GA to the evaluation and optimization of the interpretation system of nature reserves is a good evaluation method.

2.3. Construction of Interpretation System of Nature Reserves

According to the importance of the environmental interpretation audience in Z Nature Reserve to each index, the tourists are investigated, and the score of their importance is used as the basis for the index weight. On this basis, an evaluation method based on fuzzy clustering analysis is proposed, and the evaluation results are analyzed.

Weight determination formula of each evaluation index:

$$\bar{w}_o = \frac{\sum_{o=1}^n S_o}{\sum_{o=1}^m S_o} \quad (1)$$

\bar{w}_o is the weight of the o single indicator. S_o is the important value of the o index. n is the sample size of this survey, and m is the number of indicators.

Criteria layer weight determination formula:

$$C_k = \frac{\bar{S}_k}{\sum (\bar{S}_1 + \bar{S}_2 + \bar{S}_3 + \bar{S}_4 + \bar{S}_5 + \bar{S}_6)} \quad (2)$$

C_k is the weight of the k-th criterion layer, and \bar{S}_k is the average of the important values of the k-th criterion layer. $\sum (\bar{S}_1 + \bar{S}_2 + \bar{S}_3 + \bar{S}_4 + \bar{S}_5 + \bar{S}_6)$ is the sum of the average values of the importance of each criterion layer.

According to the multi-level characteristics of the evaluation model, the multi-objective linear weighting function method is used to evaluate the environmental interpretation system of the Z protection zone. The calculation is as Formula (3):

$$A = \sum_{k=1}^n (\sum_{o=1}^m Q_o \bar{w}_o) C_k \quad (3)$$

In the formula, A is the total score, and Q_o is the score of the o single indicator. The scores of tourists are counted, and the arithmetic mean of their satisfaction is taken as the single score of the evaluation index.

According to the above evaluation model, the environmental interpretation system score of Z Nature Reserve can be obtained.

3. Evaluation and Optimization Experiment of Interpretation System in Nature Reserves

3.1. Tourist Questionnaire

A total of 182 questionnaires were distributed to tourists in this questionnaire, and 176 questionnaires were collected and valid. This paper analyzes this.

Figure 3 shows the relevant data survey of the number of visitors.

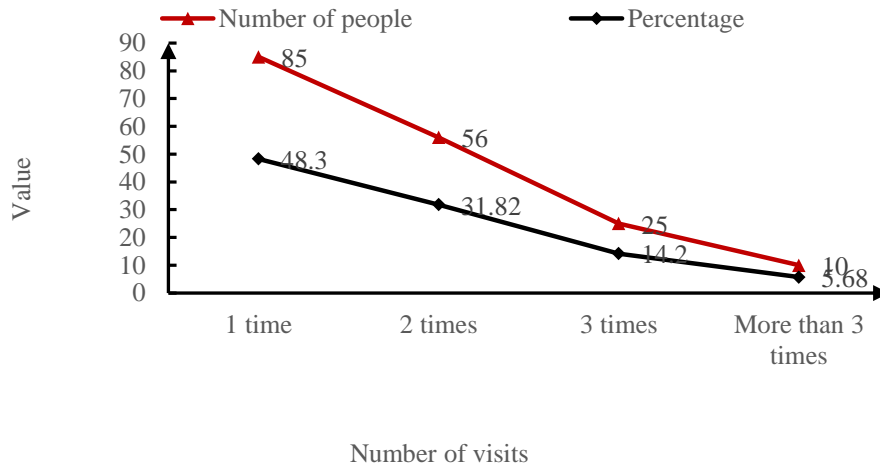


Figure 3. Visits

It can be seen from Figure 3 that 85 tourists visited Z Nature Reserve once, accounting for 48.30%. There were 56 tourists twice, accounting for 31.82%. There were 25 tourists for 3 times, accounting for 14.20%. There were 10 tourists more than 3 times, accounting for 5.68%.

Table 1 shows the relevant data survey of tourists' travel purposes.

Table 1. Purpose of travel

Purpose of travel	Number of people	Percentage
Natural sightseeing	39	22.16%
Leisure vacation	73	41.48%
Exercise	19	10.80%
Enhance the feelings of relatives and friends	36	20.45%
Other	9	5.11%

It can be seen from Table 1 that 39 tourists went out for natural sightseeing, accounting for 22.16%. There were 73 tourists traveling for leisure and vacation, accounting for 41.48%. There were 19 tourists traveling for the purpose of exercising, accounting for 10.80%. There were 36 tourists traveling for the purpose of enhancing the relationship between relatives and friends, accounting for 20.45%.

Figure 4 shows the relevant data survey of tourists' satisfaction with the environmental interpretation system in Z Nature Reserve.

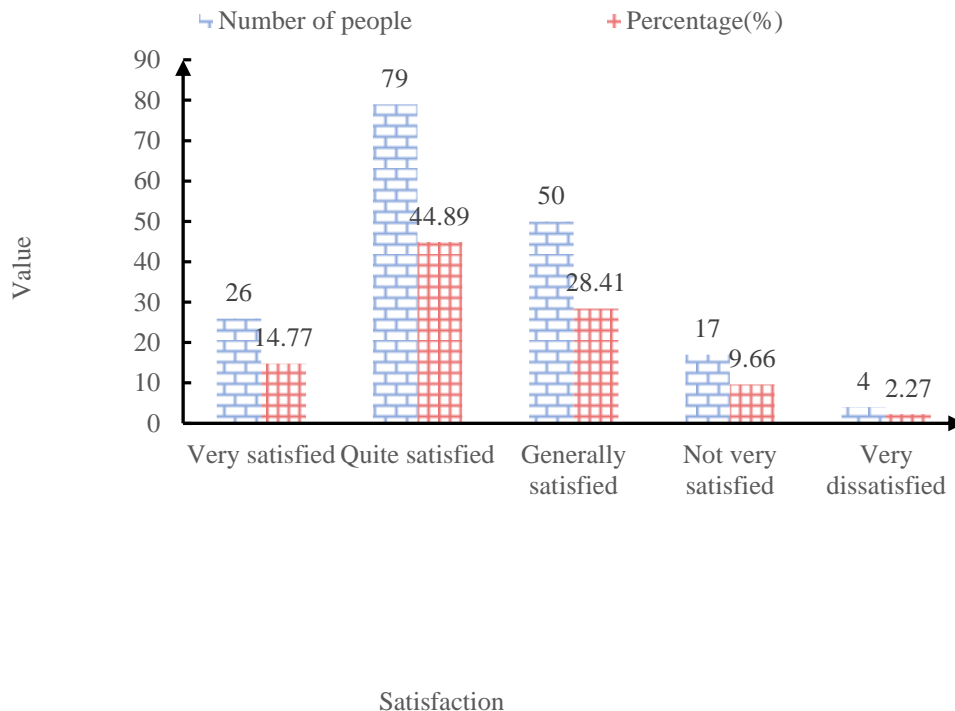


Figure 4. Satisfaction survey

It can be seen from Figure 4 that 26 tourists were very satisfied with the environmental interpretation system of Z Nature Reserve, accounting for 14.77%. 79 tourists were satisfied, accounting for 44.89%. 50 tourists were generally satisfied, accounting for 28.41%. 17 tourists were dissatisfied, accounting for 9.66%. Four tourists were very dissatisfied, accounting for 2.27%.

3.2. Comprehensive Score of Environmental Interpretation System Assessment

In the reserve, the interpreter's explanation is very simple. However, the commentator can't answer the random questions posed by tourists well, and their knowledge reserve is incomplete. Moreover, their service attitude is also relatively indifferent, and their Mandarin needs further improvement. In the process of explanation, they put aside the introduction of scenic spots and the interpretation of cultural legends more than the transmission of the concept of environmental protection. Therefore, the resources and protection characteristics of nature reserves cannot be expressed.

In the reserve, there are enough warning and fire prevention signs, and some scenic spots have explanation signs. However, there are very few kinds of explanation boards, and some explanation boards are old and obscure, so the reserve needs to update and supplement them. During the investigation, it is also found that most of the commentary boards in the reserve were made of metal, which is a little out of place compared with the surrounding green forest environment and can not be well integrated with the reserve. It can be improved in the future, which can greatly improve the quality of the environmental interpretation system of the whole reserve.

Most of the multimedia facilities in the reserve are video and audio playback devices, which are very convenient to use and the content played is also very attractive. However, they are more inclined to entertainment functions, while the development of educational functions is not sufficient. Therefore, while ensuring the perfection of other indicators, the reserve can add multimedia education equipment to provide richer interpretation services for tourists.

The portable publications and brochures in the reserve can be obtained from tourist centers, souvenir stores and other places, but tourists do not make much use of them. Therefore, if conditions permit, the Reserve can produce more exquisite and distinctive publications to satisfy some tourists' desire for their collection.

The tourist center of scenic spot Z is located far away from the main entrance, which is inconvenient for tourists to enter. Although there are some functions such as tourism consultation and leisure in the scenic spot, the equipment is relatively backward. In addition to the tourist center, a forest museum has also been built in the Z Nature Reserve, as a supplement to the tourist center, providing tourists with certain explanations and services.

It is necessary to pay attention to improving the type and frequency of participatory activities in the reserve. At the same time, it is necessary to show the protection characteristics of the reserve to make it more educational.

The comprehensive score of environmental interpretation system assessment is shown in Table 2.

Table 2. Comprehensive score of environmental interpretation system assessment

Type	Score
Narrator	7.28
Explanation Board	7.12
Multimedia facilities	8.08
Portable publications	6.85
Tourist Centre	7.09
Participatory activities	7.31

It can be seen from Table 2 that the commentator score was 7.28 points, the commentary board score was 7.12 points, the multimedia facilities score was 8.08 points, the portable publications score was 6.85 points, the tourist center score was 7.09 points, and the participating activities score was 7.31 points.

3.3. Suggestions on the Optimization of Interpretation System in Nature Reserves

Environmental awareness has been established to actively participate in environmental protection. At present, China's understanding of this issue is still in its infancy. Especially for the interpretation work in the reserve, its educational significance has not received enough attention. In order to maximize the management efficiency of the environmental interpretation system in the nature reserve and realize the coordinated and sustainable development of environmental education, resource utilization and ecological protection, combined with the previous evaluation results of the IPA analysis model of the environmental interpretation system in the Z nature reserve, suggestions are put forward to optimize and improve it from the following aspects, as shown in Figure 5.

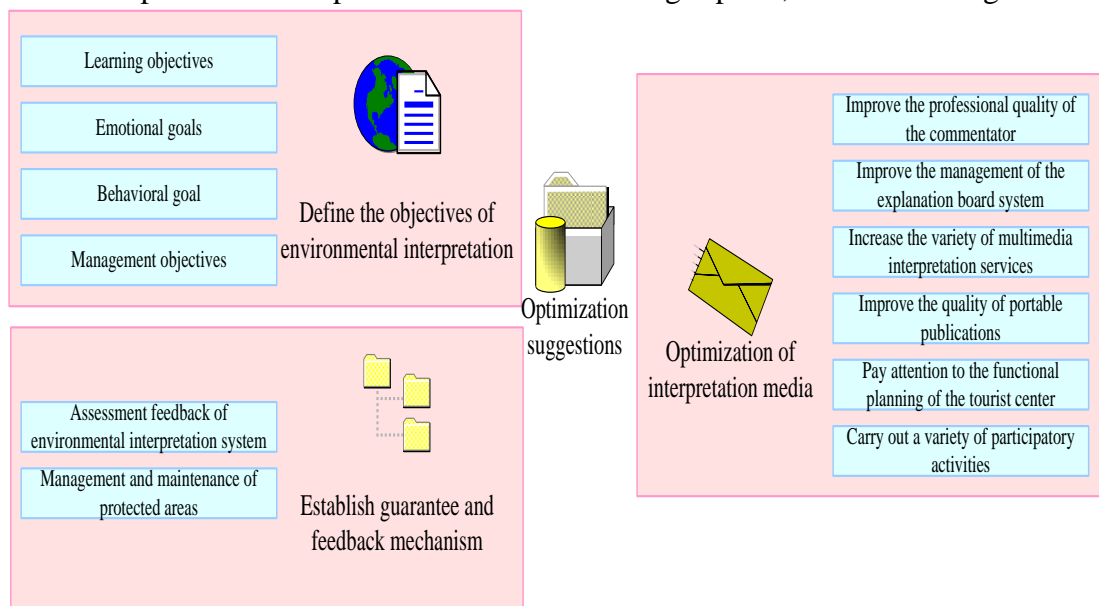


Figure 5. Optimization suggestions

(1) Definition of the objectives of environmental interpretation

In the reserve, the purpose of ecological interpretation should be established and the educational function of the ecological interpretation system should be improved. It comprehensively displays the scientific knowledge, ecological value and historical and cultural value contained in the Z Nature Reserve.

Learning objectives: In the process of interpretation, the most important thing is to satisfy the curiosity and curiosity of visitors. There are many kinds of plants in Z Nature Reserve, and there is a lot of scientific knowledge in the forest ecological landscape. The natural succession of primitive forest communities is of great significance for understanding the formation of surface topography and the evolution of ecological environment. An image, vivid environmental interpretation and interactive and participatory interpretation activities is used to stimulate tourists' interest in learning. Let them explore the mysteries of nature to have more understanding of relevant popular science knowledge and historical and cultural heritage, so as to learn more environmental knowledge and environmental protection skills, and get a better tour experience.

Emotional goal: Correct environmental protection attitude is the prerequisite for tourists to produce positive environmental protection behavior. The environmental interpretation media, methods and content design of the nature reserve should allow tourists to have a feeling of caring for and respecting nature, thus stimulating tourists' concern and sense of responsibility for the environment. The environmental interpretation of the nature reserve should show the beauty of

nature and the charm of humanity in a comprehensive and in-depth way, and at the same time make tourists realize that the ecological environment is closely related to the survival and development of human beings. Therefore, it is urgent to protect the environment. In addition, high-quality, personalized and distinctive environmental interpretation also contributes to the external publicity and promotion of Z Nature Reserve.

Behavioral objectives: The educational role of environmental interpretation is fully played, and guided in a positive way on the premise of arousing the emotional resonance of tourists, so that tourists can get a satisfactory tourism experience, and can also willingly take some environment-related actions, such as resisting uncivilized tourism behaviors such as littering, scribbling, trampling and climbing. People can better change their behavior through their daily habits and behaviors.

Management objectives: Interpretation services are used to increase the breadth and depth of Z Nature Reserve. Reasonable guide route guidance and warm tour tips greatly help to reduce the congestion and other bad behaviors of tourists, thus creating a well-ordered tourism environment. Through the feedback of relevant information, as well as the feedback of tourists' opinions and suggestions, the further development of the environmental interpretation system of China's nature reserves is promoted.

(2) Optimization of interpretation media

Strengthening the professional quality of interpreters: Interpreters are an indispensable part of the interpretation process. Based on their rich professional knowledge and skilled interpretation skills, they carry out two-way and active information transmission to tourists, and their most prominent feature is dynamic communication. Through field research, it is found that due to the lack of professional knowledge on ecological protection and environmental education in the nature reserve, many interpreters can not accurately convey their sensitivity and significance to the nature reserve to tourists, resulting in tourists unwilling or unwilling to take corresponding protection measures, which seriously affected the ecotourism and sustainable development of the nature reserve.

Improving the management of the explanation board system: The explanation board can easily, quickly, clearly and intuitively transmit pictures and text information to tourists, and can effectively guide tourists to form positive tourism behaviors. It is an important part of the environmental interpretation system in the nature reserve, and is also the most widely used interpretation medium in the Z nature reserve at present. As far as the protection status of China's national forest parks is concerned, there are problems such as the lack of unified standards for the protection signs, small quantity, unreasonable layout, and poor maintenance, which need to be further improved.

Increasing the types of multimedia interpretation services: Multimedia guided tour is a way to introduce the relevant contents of the reserve to tourists with sound and image as the carrier. It is more attractive to tourists with its diversified ways of expression and rich interpretation. In the environmental interpretation system of Z Nature Reserve, the content of multimedia interpretation is not only profound and attractive, but also difficult to operate. However, it is very necessary to expand the types of multimedia devices, such as the development of portable voice announcer, so that tourists can carry it around, improve the website of the reserve, and build a real-time shared interpretation network.

Improving the quality of portable publications: In terms of portable publications and other promotional products, Z Nature Reserve can produce high-quality audio-visual CDs or online videos, as well as foldouts and postcards associated with them, and publish a detailed introduction and species atlas of Z Nature Reserve. The education and service functions of portable publications and promotional products are combined. While delivering the explanation information, it can also turn it into a special tourist souvenir, thus improving the collection value of the publication.

Paying attention to the functional planning of the tourist center: The tourist center in the Z Nature Reserve is relatively remote and difficult to use. However, due to its difficulty in relocation, it should be optimized to make it a multi-functional area integrating “consultation, recreation and interpretation”.

Carrying out a variety of participatory activities: The participation of Z Nature Reserve can be divided into permanent and seasonal. The content of participatory activities is relatively simple, and the theme does not reflect the characteristics of the reserve. Z Nature Reserve should also continue to carry out attractive participatory activities, strengthen its planning, and increase its interactivity, its environmental protection education role, and its experience for tourists.

(3) Establishment of guarantee and feedback mechanism

Assessment feedback of environmental interpretation system: The environmental interpretation system aims at providing services for tourists. Therefore, it is necessary to establish a matching and effective evaluation, supervision and control mechanism, and combine the evaluation opinions of experts, interpretation providers - Z Nature Reserve, tourists, travel agencies and other aspects. Opinions mailbox, questionnaire survey, field observation, interview and communication, network survey and other ways are used to understand the use of the environmental interpretation system, satisfaction, opinions and suggestions and other feedback information. The management personnel of the No. Z Nature Reserve classifies and sorts the information received, corrects and updates it in real time, and gives corresponding feedback. Through the formation of a virtuous and interactive virtuous cycle mechanism, the ecological interpretation system of the nature reserve is further improved.

Management and maintenance of the reserve: The establishment of a complete environmental interpretation system of the reserve is an important guarantee to ensure its normal operation and effective interpretation. The management committee of Z region should fully undertake all the work of the interpretation system, including hiring professionals from forestry, ecology, tourism, protected areas and other fields to form the construction team of the interpretation system. The normal operation of the Z-type environmental interpretation system is ensured through the reasonable allocation of tourism economic benefits, the welfare guarantee system of the community, the establishment of a work team, and the zoning and subsection management of the interpretation equipment.

4. Conclusion

In the design process, the interpretation system should fully consider the needs of tourists, strengthen the investigation of tourists, and take it as an important basis for the design scheme. At the same time, attention should be paid to the display form of the interpretation system, which can enrich the transmission of interpretation information through physical display, multimedia display and other means. Efficient communication technology should be adopted to realize the timely dissemination of information through multimedia software, live broadcast platform, etc. In addition, the number of tourists and time distribution should also be considered to optimize the interpretation system. Attention should be paid to the later maintenance of the interpretation system. On the one hand, the interpretation system can be regularly maintained and updated. On the other hand, elements such as local folk characteristics and cultural values can be integrated into the interpretation system, and the expression forms of interpretation information can be enriched. At the same time, it is necessary to pay attention to the training of volunteers and ensure that volunteers fully understand and are familiar with the content of the narrator.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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