Assessment of Vegetation Impact and Environmental Management in Nature Reserves Considering AHP

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Abstract: The construction of China's nature reserves has experienced more than 60 years of development, and played a very important role in protecting biodiversity, protecting natural heritage and natural landscape, promoting the construction of ecological civilization and the construction of a beautiful China. In this paper, AHP (Analytical Hierarchy Process) method was used to comprehensively evaluate the vegetation in the study area. In the comprehensive evaluation of natural reserves, it has the characteristics of multiple objectives and complexity, and the level of the evaluation index system is also relatively complex. The combination of subjective and objective weighting method was adopted. In the evaluation, the analytic hierarchy process was adopted. The analytic hierarchy process is easier to implement, and is suitable for more fuzzy evaluation and comparison. In this paper, the analytic hierarchy process was used to evaluate the wild medicinal plants. It was found that the Class III medicinal plants accounted for 22.2%, and the Class IV medicinal plants accounted for 21.2%. In this paper, wild medicinal plants were divided into four levels, which laid a foundation for their protection and rational use.

1. Introduction

In the natural ecosystem, vegetation is not only an indispensable part, but also a major component of the terrestrial ecosystem. It provides people with an environment for survival and rich natural resources. In order to make everyone aware of the importance and urgency of protecting wild ornamental plants, everyone needs to make aware of it. The loss of biodiversity is a major factor in the current deterioration of the ecological environment. It makes people realize that the loss of species has brought great harm to the present and even the future. In this way, people can

abandon some immediate interests and take the initiative to devote themselves to the cause of which the achievements are in the contemporary era and the benefits are in the future.

In human production and life, the function of ecosystem is the basis for human survival. It can be said that in the process of human survival, the various services provided by the ecosystem make the environmental conditions for human survival maintain and stabilize. Sun S believed that the network of national nature reserves constituted the core element of the Chinese government's strategy to protect the country's huge biodiversity and its diverse ecosystems [1]. Shi H believed that potential natural vegetation was the final stage of vegetation succession, and played a key role in ecological restoration, natural reserve design, and agricultural and animal husbandry development [2]. Prach J re-sampled 156 quasi-permanent plots sampled from 1950s to 1970s, covering the entire range of forest vegetation in the region. He compared the species richness and community composition of understory plants during the survey period, and tested the temporal variation of vegetation spatial heterogeneity [3]. Mingyan W U believed that Gongyaluo Nature Reserve was an important carbon storage area in western Sichuan, which was of great significance to the scientific management of forest resources and the maintenance of forest ecological environment in the nature reserve [4]. Their research did not explore the content of environmental management.

In this paper, the comprehensive evaluation of wild plants and wild medicinal materials was carried out by AHP based on their resource value, potential and biological characteristics. Then, according to the characteristics of each constraint layer index, the standard layer index was selected. Through comprehensive evaluation, it can better reflect its application prospects in the region. This paper has made further screening and research on the selection of evaluation index, which is of great significance for further mining and utilization of wild plant resources.

2. Vegetation Impact Methods in Nature Reserves

2.1. AHP

AHP can effectively reduce the impact of subjective judgment inconsistency on evaluation results, and is suitable for comprehensive evaluation of multiple indicators. The specific operation process is as follows. The subsystem layer and the indicator layer are scored in pairs according to their importance, and the judgment matrix is constructed. The maximum eigenvalue and eigenvector are calculated. The compatibility check is performed once. CR value less than 1 is qualified, otherwise it needs to be modified. The feature vector points are normalized to obtain the weighted vector. Then, the weighted number of the index layer is multiplied by the weighted average of the index layer to obtain the final weighting coefficient.

In this paper, the environmental management adopts the weighted calculation method to convert the degree of membership into a score of S:

$$S = v_1 + v_2 + v_3 + v_4 \tag{1}$$

According to the principle of minimum deviation, the weighted linear combination coefficient is calculated to determine the optimization model of environmental management portfolio weighting:

$$W = W_1 + W_2 + W_3 + W_4 \tag{2}$$

According to the characteristics of plant resources development and utilization, the analytic hierarchy process is adopted to divide it into four levels: target level, constraint level, standard level and the lowest level, and a comprehensive evaluation model based on the analytic hierarchy process is constructed.

(1) Target layer

In the reserve, under the premise of ensuring that the ecological environment is not damaged and gradually improved, scientific and efficient development and utilization of medicinal plant resources is carried out in accordance with natural laws.

(2) Constraint layer

There are various factors that restrict and restrict the development and utilization of wild medicinal resources in the Reserve. Here, only three factors that have strong constraints on the target layer are listed as the constraint layer. The reasons for selection are as follows:

1) Resource value: It is a special value of a resource. Its quality is directly related to its appeal to the public.

2) Resource development and utilization potential: Within the scope of the Reserve, the development and utilization of resources should be based on protection and guided by reality. The exploitability of resources determines its exploitability.

3) Ecological characteristics: It emphasizes the characteristics of resources and the spatial distribution of resources. Ecological characteristics greatly affect the development and utilization of resources.

(3) Standard layer

On this basis, taking the medicinal materials in the reserve as an example, the comprehensive evaluation is carried out respectively. Based on this, combined with practical experience, the development and utilization level is divided into different levels.

(4) Bottom

It is a wild medicinal plant species to be evaluated.

2.2. Vegetation in Nature Reserves

For the villagers in the surrounding villages of the Reserve, the traditional economic source is to collect herbs. The herdsmen living nearby mainly derive their income from animal husbandry. In peacetime, they dig wild herbs, pick wild fruits, and sell them to subsidize their daily life. However, residents in the region are highly dependent on the wild plants in the region in terms of economy and life, resulting in unreasonable development of the already fragile ecological environment in the region. From the standpoint of the Nature Reserve Administration and relevant departments, it is necessary to consider how to achieve sustainable use of resources, promote economic development and achieve sustainable and harmonious development of ecological environment, ecological benefits and social benefits on the premise of protecting biodiversity and maintaining ecosystem stability [5]. The exploration idea of this article is shown in Figure 1.

Based on the score of the comprehensive evaluation value, the wild ornamental plants are ranked and divided into several grades. Through the comprehensive evaluation of wild ornamental plants, it can not only recommend wild ornamental plants with high scores for landscaping, but also provide a scientific theoretical basis for the protection and utilization of wild ornamental plant resources. The ranking is as follows:

$$X = \sum(P \times W) \tag{3}$$

Environmental protection measures:

In terms of protection awareness, a series of education for the managers of the nature reserve can be carried out, and some experts and scholars are invited to give lectures in the nature reserve, mainly on the identification of wild ornamental plants, the value of development and utilization, the laws and regulations of the nature reserve and the relevant management requirements. This not only improves their management and professional ability, but also makes them more conscious in maintaining laws and regulations [6].
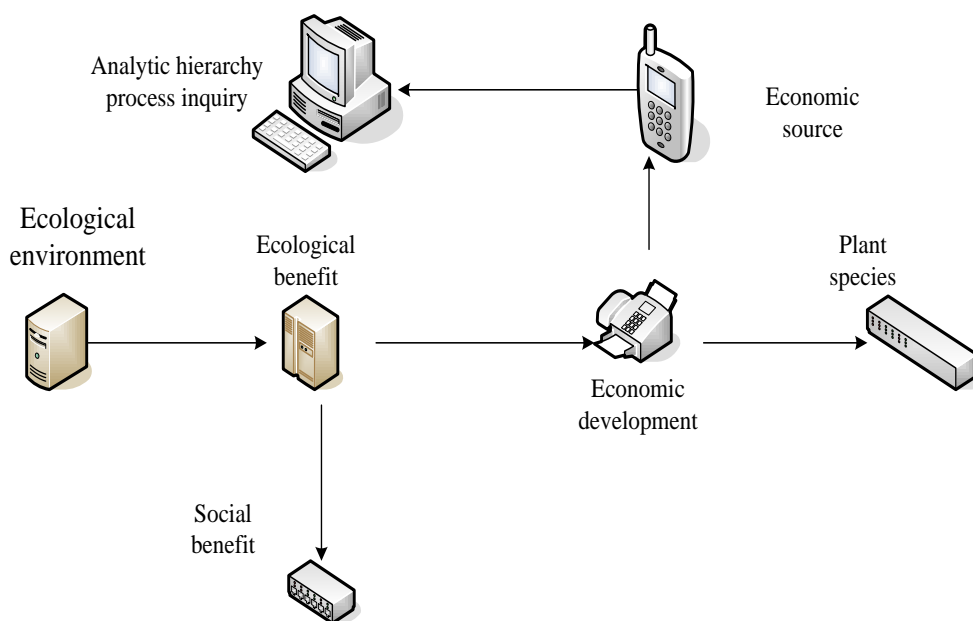
Figure 1. Research ideas of this article

It is necessary to strengthen the protection of nature reserves, increase international exchanges and cooperation, actively learn from the advanced business models and technologies of other countries, and constantly improve China's ecological environment.

According to the local actual situation, the natural resources should be reasonably developed to maximize their benefits. The resource advantages of the established nature reserves should be maximized without causing any damage to the natural resources and ecological environment. At the same time, it can also encourage the surrounding residents to participate in the production activities beneficial to natural protection, thus developing industries beneficial to natural protection, and promoting their economic development, so that they can get tangible benefits in the cause of natural protection [7-8].

It is prohibited to carry out polluting projects in protected areas or key areas of biodiversity. For resource development and economic construction projects, biodiversity and its ecological assessment system must be implemented in advance and corresponding protection measures must be implemented [9].

The development of ecotourism has been carried out. In ecotourism, ornamental plants play a very important role, and many species have high ornamental value in branches, leaves, flowers, fruits, etc. On this basis, combined with the rich characteristics of China's garden greening resources, the countermeasures for the development of China's garden greening resources are put forward.

The key drivers of vegetation dynamics are related to vegetation type and time [10-11]. Although there are some reasons for the decline of a living creature, such as its weak regeneration ability, its natural decline is a long time compared with man-made deforestation and habitat destruction. Because of their high ornamental value, some ornamental plants are often over-exploited, resulting in a rapid decline in their number.

3. Environmental Management Evaluation Experiment

(1) At present, the evaluation methods of nature reserves can be roughly divided into two categories. One is subjective, the other is objective. Subjective evaluation is greatly affected by

subjective factors, and the results of objective evaluation are easily inconsistent with reality. Therefore, this paper adopts a subjective and objective evaluation method, combining subjective information with objective calculation.

(2) In the comprehensive evaluation of nature reserves, there are multiple objectives and complex characteristics, and the hierarchy of the evaluation index system is also relatively complex. In the evaluation, the combination of subjective and objective weighting can be used. In the evaluation, the AHP method can be used. The AHP method is relatively easy to implement, and is suitable for relatively fuzzy evaluation and comparison.

(3) The process of weight error reduction is divided into two stages. In the first stage, Spearman correlation is used to test the consistency of subjective and objective weights to reduce the weight deviation; in the second stage, according to the principle of minimizing the deviation, the weights assigned are linearized and fused to determine the optimal weights.

4. Vegetation in the Reserve

According to the edible parts, the wild vegetables in the reserve are divided into six categories: root vegetables, seedling vegetables, stem and leaf vegetables, fruit vegetables, cauliflower, and sprout vegetables. The proportion of wild vegetables in different regions is shown in Table 1. Root vegetables accounts for 19.8%. Due to the altitude, the vegetation development in the study area is the best. Through the promotion of ecological protection management regulations and the implementation of the common development model of ecology and people's livelihood, important ecological projects such as natural forest protection and mine ecological restoration should be carried out continuously in these areas. The restoration of ecological environment should be organically combined with human management, and suitable areas should be selected to carry out afforestation, afforestation in closed mountains, afforestation in barren mountains, so as to improve the structure of vegetation, and improve the development quality of the ecological environment.

Table 1. Proportion of wild vegetables in different regions

Different sampling area	Root vegetable(%)	Seedlings and vegetables(%)	Stem and leaf vegetables(%)	Fruits and vegetables(%)	Cauliflower(%)
1	28.4	29.3	11.3	22.6	7.8
2	23.4	32.3	23.3	10.6	11.8
3	29.4	28.3	22.3	12.6	9.8
4	29.4	30.3	16.3	17.6	8.8
5	-0.6	31.3	13.3	21.6	8.8
6	15.4	29.3	25.3	4.6	9.8
7	15.4	28.3	28.3	18.6	16.8
8	20.4	27.3	19.3	21.6	10.8
9	16.4	26.3	7.3	7.6	8.8
10	20.4	30.3	18.3	22.6	16.8

Mesophytes account for about 30.4% of the total plants in the study area. However, because there are many lakes in the reserve, there are also many aquatic vegetation and wet vegetation in the reserve, accounting for 30.0% and 17.2% respectively. The geographical location of the study area determines that the main desert plant type in the area is drought type, accounting for 22.4% of the total species. Therefore, the biodiversity of the study area is very high. The vegetation diversity of the study area is shown in Figure 2. The proportion of mesophyte and aquatic vegetation is shown in Figure 2 (a). Wet vegetation and dry vegetation is shown in Figure 2 (b).
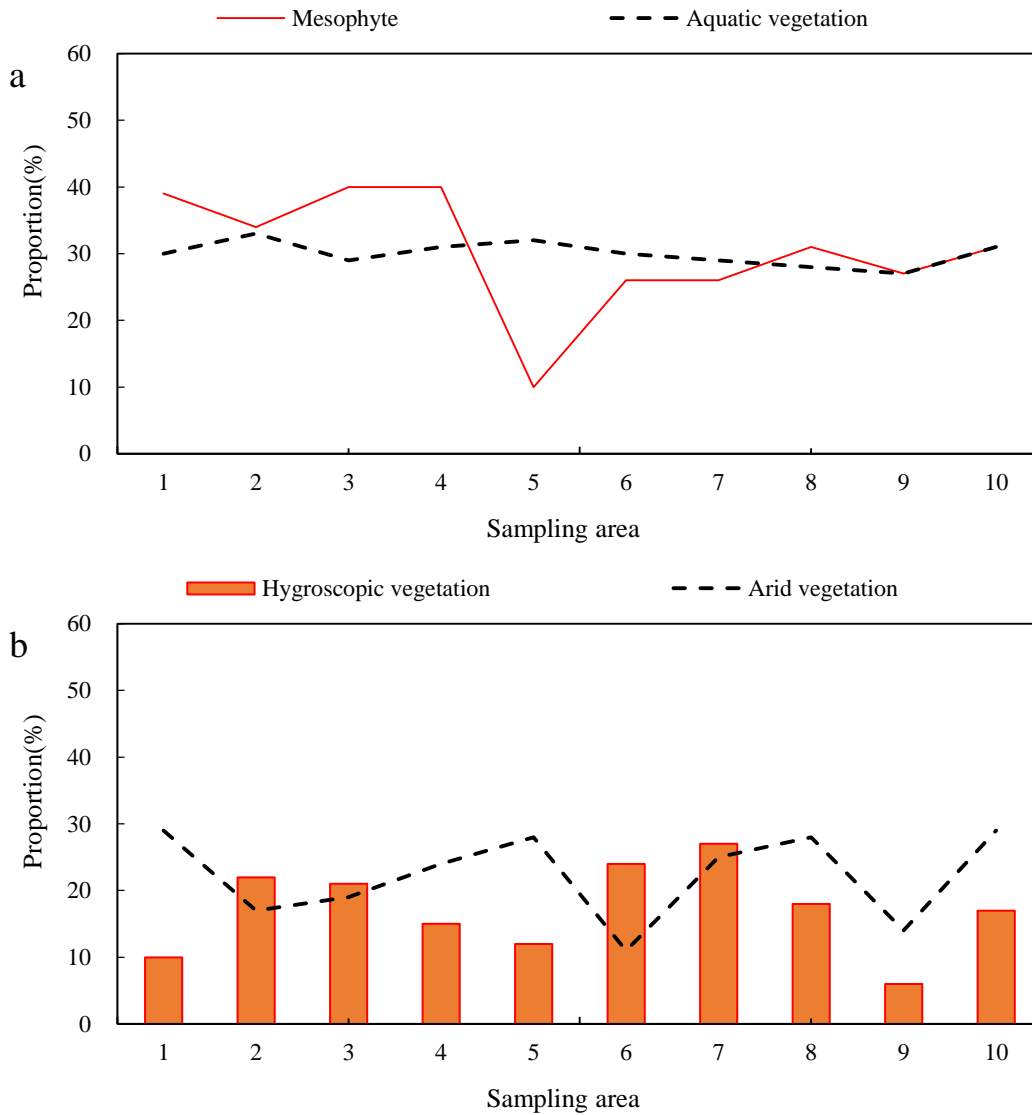
Figure 2. Vegetation diversity in the study area

The plant resources in this area are investigated in the field. In order to improve the scientificity, accuracy and comprehensiveness of plant resource survey, the project plans to carry out detailed field survey from the survey area as the starting point to the end point along different landforms, different slope directions, different elevations, different ponds, rivers, roadside, sunny slopes, shady slopes and other different habitats. During the field investigation, the ferns, gymnosperms and angiosperms within 60 m along the line are investigated and photographed. Areas with rich vegetation, complete vegetation and unique habitat are selected for field sampling. In addition to taking digital photos to record the growth status and quantity of trees, a survey of plants such as single tree ruler is also carried out.

Extremely endangered species account for 26.4%, endangered species 26%, vulnerable species 15.2%, near-endangered species 19.2%, and safe species 13.2%. It is necessary to strengthen the protection of key protected plants, especially to strictly control the use of Class I and II protected plants. The types of endangered species of plants in the reserve are shown in Figure 3. Extremely endangered, endangered species are shown in Figure 3 (a). Vulnerable, near-dangerous and safe species are shown in Figure 3 (b).

On the basis of scientific and reasonable evaluation, the plant resources should be effectively developed and utilized. At present, in the study of plant resources, this method is only used for the evaluation of ornamental and aromatic plant resources, and its evaluation indicators are selected from three aspects of resource characteristics, resource potential and ecological characteristics. From the evaluation results, this method can better reflect the development and utilization value of plant resources in this area. In addition, the analytic hierarchy process is a relatively mature method and also a relatively common method. When selecting the ecological function evaluation of the reserve, the biological characteristics of the reserve itself, the stability of wild animals and plants on the overall ecological environment and the impact on society are often considered.
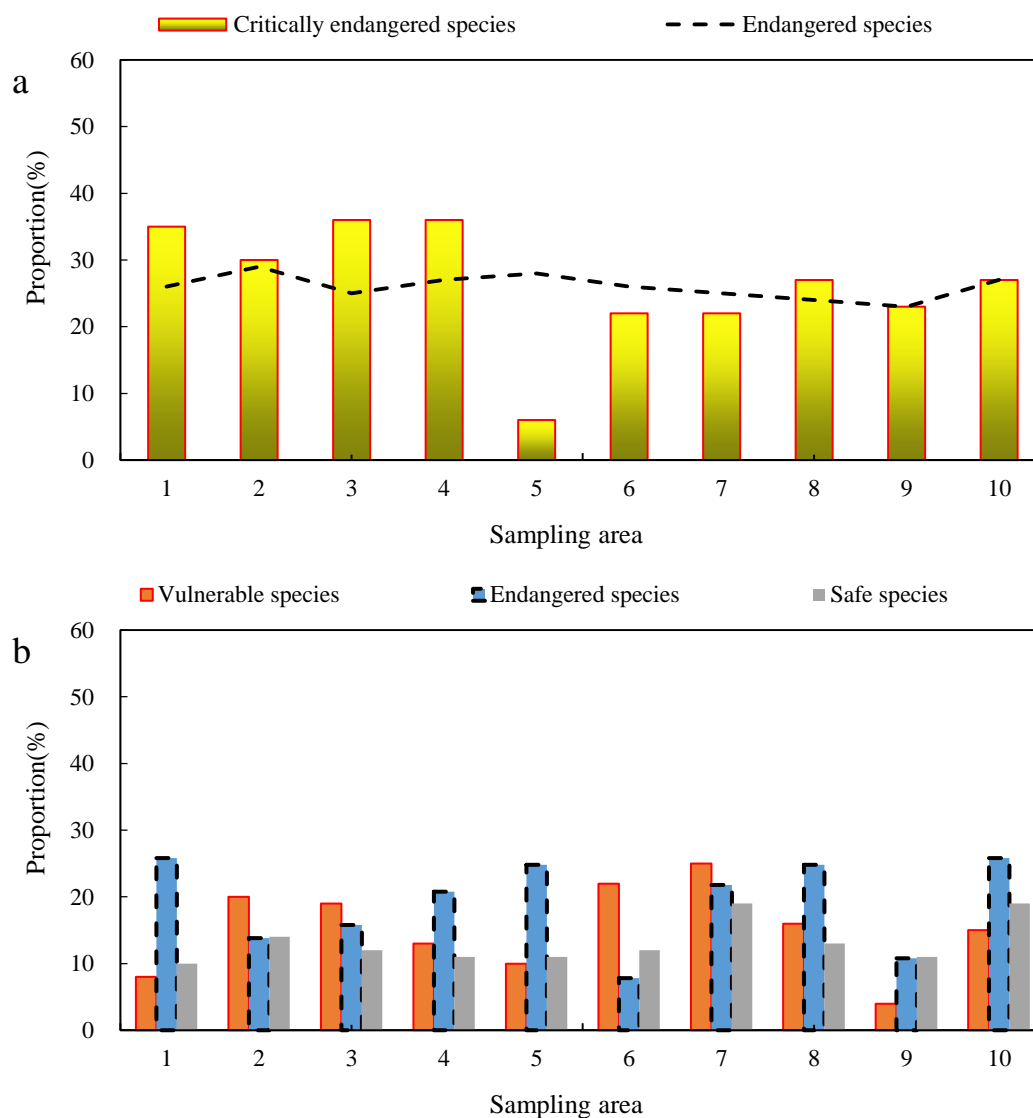

Figure 3. Types of endangered species of plants in the reserve

The analytic hierarchy process is used to evaluate the wild medicinal plants. The Class I medicinal plants accounts for 29.4%, and the Class II medicinal plants accounts for 27.2%. The Class III medicinal plants accounts for 22.2%, and the Class IV medicinal plants accounts for 21.2%. Medicinal plants are not allowed to be used in the reserve, but wild medicinal materials with high medicinal value and good market prospects can be screened in the experimental area and further developed on this basis. The proportion of Class I - II medicinal plants is shown in Figure 4

(a), and that of Class III - IV medicinal plants is shown in Figure 4 (b).

Compared with the rich medicinal plant resources in the region, the research on the active components of most medicinal plants is relatively weak, and the research on the types, contents and characteristics of the active components is relatively weak. Qualitative study of its active ingredients is of great significance for its development and utilization. Although there is no record of this genus at present, the emergence of this species has shown its genetic diversity and ecological significance. At the same time, it is necessary to pay attention to these wild plants from multiple perspectives and explore their potential as soon as possible. The taxonomic study of plant resources in this area shows that there are many kinds of plant resources in this area. During the development and utilization of plant resources in the Reserve, the growth and development of plants with fruits and seeds as economic purposes should be concerned, and corresponding measures should be taken to promote the fruiting of plants and improve the utilization rate of plants based on the regeneration cycle of plant resources. For the resources with plant vegetative organs as the main economic use, the maximum yield can be achieved by regulating their ecological factors.
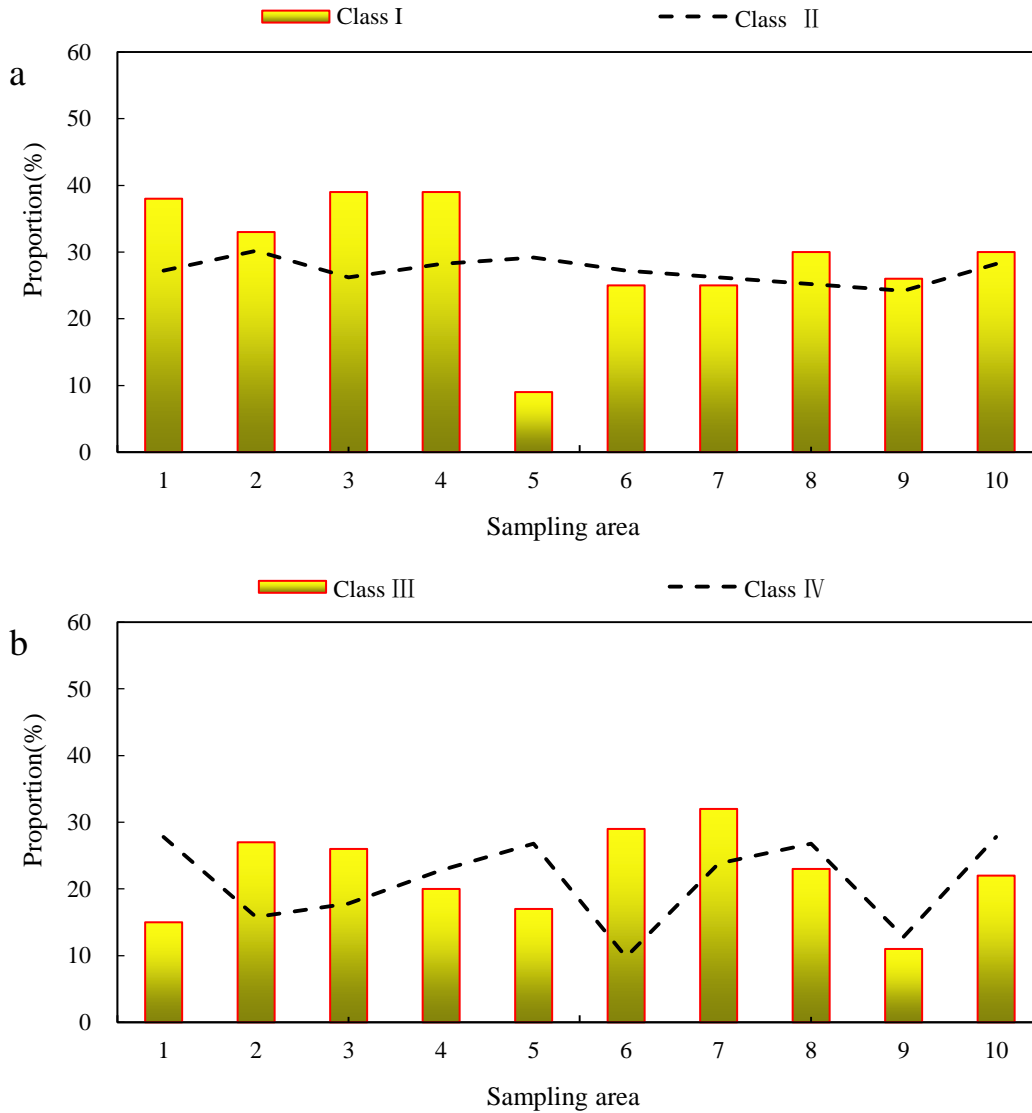

Figure 4. Proportion of medicinal plants of different grades

5. Conclusion

The comprehensive evaluation of natural reserves is a multi-objective and complex system. In the process of evaluation, the weighting method combining subjective and objective should be adopted, so as to make the evaluation results more reasonable. In the way of comprehensive calculation, the grading results of the AHP assessment are easier to analyze the differences and changes between various indicators and systems, and can also be better used in the comprehensive assessment of natural reserves. The index system method used in this paper is mainly the component analysis method. If different evaluation methods are used in the assessment of ecological vulnerability and multi-scene simulation, it is possible to calculate the weight of and get different evaluation results. Therefore, future research should select index factors more scientifically and comprehensively, and establish index system suitable for the subjects.

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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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