Plant Diversity Analysis of Wild Abies Chensiensis Community in Quanbao Mountain

Guowei Liu[1], Guoge Yang[2,*], Chao Liang[1], Yali Liu[3]
[1]Henan Forestry Resources Monitoring Institute, Zhengzhou, Henan, China
[2]Henan Yellow River Guesthouse, Zhengzhou, Henan, China
[3]Henan Forestry Ecological Construction and Development Center, Zhengzhou, Henan, China
**Corresponding Author.*

Abstract: Abies chensiensis Tiegh. is a large evergreen tree belonging to the Abies genus in the Pinaceae family. It is a species endemic to China and a second-class protected wild plant. It is also a vulnerable (VU) plant under the International Union for Conservation of Nature (IUCN). The species diversity of wild Abies chensiensis community in Quanbao Mountain of Henan Province was studied by sample plot survey method. The results showed that there were some differences in species richness index, diversity index and evenness index of the community, which were obviously affected by community type and community structure, and the more complex the community structure was. The greater the species richness index and diversity index, the smaller the evenness index; there are some differences among the species diversity indexes of different life forms of Abies chensiensis community. However, the difference is not necessarily statistically significant.

Keywords: Funiu Mountain; Quanbao Mountain; Qinling Fir; Community; Diversity

1. Introduction

Abies chensiensis Tiegh.is an evergreen tree of Abies in Pinaceae. The leaves are arranged in two or nearly two rows on the branches, in strips. The cone is cylindrical or oval cylindrical, the seed is longer than the seed wing, and the inverted triangle is oval [1,2]. It is an endemic and second-class protected wild plant species in China (2021) [3]. It is a Vulnerable (VU) plant of the World Conservation Union (IUCN) and a Vulnerable plant of the ' Chinese Plant Red Book ' (Book 1). [4] Abies chensiensis is mainly distributed in the alpine and subalpine areas of Qinling Mountains, showing obvious island-like distribution [5]. Due to the harshness of the habitat, the population growth is extremely slow, the individual development is poor, the self-renewal ability is poor, and the population in most areas is declining [6]. At present, the endangered status of Abies chensiensis is worrying, and the research reports on Abies chensiensis are also very limited, and most of them are limited to forest cultivation, the principles and methods for the preservation of genetic resources of Abies chensiensis, the countermeasures for protection and development, and the construction and management of seed orchards [7-10]. However, most of them are macroscopic descriptions, and the research is not deep enough. Abies qinlingensis plays an important role in maintaining ecological balance and biodiversity in high altitude areas. Quanbao Mountain in the eastern section of Qinling Mountains is one of the distribution points of wild Abies chensiensis in Henan Province, and it is also the easternmost distribution of this species. It is of great significance to study the diversity of its plant community for the effective protection of Abies chensiensis.

2. Materials and Methods

2.1 Overview of the Study Area

The whole Baoshan is located in the southwest of Xinghua Township, Luoning County, on the northern slope of Xiong 'er Mountain, a branch of Qinling Mountains. It is 125 kilometers away from Luoyang City, 16.8 kilometers long from east to west, about 9 kilometers wide from north to south, and the main peak is 2130.2 meters above sea level. The area is 4105 hectares. The forest coverage is 98.4 %, and the annual average temperature is 10

degrees. Baoshan is rich in woody plants, rare plants and wildlife resources, including 72 families, 155 genera and 436 species of woody plants.

2.2 Sample Survey Methods

The typical sampling method was used to set up 20m × 20m survey plots 15 plots were mechanically arranged in the four corners and the center of each plot. Five 2m × 2m shrub plots and five 1m × 1m herb plots were used to record the main project habitats: including topography, soil, altitude, slope direction, slope position, human disturbance degree and so on. Community characteristics: Record the name, number, height, DBH and crown width of trees; shrub name, height, coverage, base diameter; species, quantity, coverage and height of herbs, etc.

2.3 Diversity Analysis

Margalef richness index (Ma) was used to analyze species richness, Shannon-Wiener index (H') was used to analyze species diversity in different regions of the community, Pielou evenness index (J) was used to reflect individual differences of community species, and Simpson index (D) was used to analyze the ecological dominance of each plot [11-15].

3 Results and Analysis

3.1 Analysis of Plant Components in Wild Community of Abies Chensiensis

Abies qinlingensis community is a warm temperate coniferous and broad-leaved mixed forest. Different plant species in the community are the basic unit of the community construction and one of the most basic characteristics of the plant community. According to the survey results, there are 115 species belonging to 72 genera and 37 families in the A.chensiensis community. Among them, there were 29 species of Asteraceae, 18 species of Rosaceae, 15 species of Leguminosae, 10 species of Liliaceae and 9 species of Gramineae, accounting for 25.2 %, 15.7 %, 13.0 %, 8.7 % and 7.8 % respectively. There were 7 species of Rubus, 6 species of Saussurea, and 4 species of Lespedeza, accounting for 6.1 %, 5.2 %, and 3.5 %. The results are shown in Table 1.

In terms of life form, herbaceous plants were the most abundant in the community, with a total of 75 species, accounting for 65.2 % of the total plant species. Compositae plants are the most abundant in herbaceous plants, accounting for more than 25 %, and shrub resources are relatively abundant in woody plants, accounting for 15.7 %. The distribution of Abies qinlingensis is relatively high, more than 2000 meters, relatively remote, inconvenient transportation, less human activities, and relatively abundant plant resources. Due to the high altitude, there are not many tall trees, and some tree species are in a dwarf state. Therefore, A.chensiensis belongs to the upper layer and has a greater risk of lightning strikes.

Table 1. Differences in Plant Life Forms of Abies Chensiensis Community

life form	species number	Proportion (%)
arbor	14	12.2
shrub	18	15.7
fujimoto	8	6.9
herb	75	65.2

3.2 Analysis of Community Overall Species Diversity

The overall species diversity of plant population is a comprehensive concept, which reflects the number and species of plant species in a certain area or ecosystem, as well as the interaction and distribution between them. The overall species diversity of plant populations is an important basis for the stability of ecosystems and is of great significance for maintaining ecological balance, protecting biodiversity, and human survival and development. Through the sample survey, the average value of each sample was taken to calculate the community structure characteristics. The results are shown in Table 2.

It can be seen from Table 2 that different plant community structures are different. Compared with low altitude areas, the canopy density of trees is significantly reduced. The canopy density of trees below 1000 meters in the whole Baoshan is more than 0.8, and the composition of tree species is also significantly less, which is mainly affected by high altitude meteorological factors. The difference of total coverage is mainly determined by the ecological and biological characteristics of the species, such as the reproduction mode and shade tolerance of fine root Polygonatum

sibiricum. Although Veratrum nigrum and Phlomis rotundifolia are dominant species in high altitude areas, it is difficult to form large pure species populations.

Table 2. Structural Characteristics of Abies Qinlingensis Community

N	*cenotype*	total coverdegree			
		community	arbor	Tsukunito	herb
1	*A.chensiensis+ P.armandi+L.tangutica+P.gracile*	98	0.5	26	95
2	*A.chensiensis+ A.oliverianum +Z.dielsii +M. henryi*	90	0.6	38	88
3	*A.chensiensis+ C. cordata +C. foveolatus +P. umbrosa*	85	0.5	51	80
4	*A.chensiensis+ A. pictum +S. koehneana +C. macrophylla*	95	0.5	36	92
5	*A.chensiensis+ S. caprea +C. montana +P. zanlanscianense*	87	0.6	35	81
6	*A.chensiensis+ P. conadenia +S. chinensis +V. nigrum*	88	0.3	33	72

3.3 Species Diversity of Different Types in the Community

The diversity of different life-form species in plant communities is an extremely important and complex aspect of ecosystems. Plant communities are composed of a variety of plants with different life forms. These plants are divided into different types according to their growth habits, morphological characteristics and ecological adaptability. Through in-depth study of its composition, structure and functional characteristics, as well as influencing factors and conservation management measures, we can better understand and protect this valuable natural resource. Based on the structural characteristics of Abies chensiensis community in Quanbao Mountain, the species diversity characteristics of tree layer, shrub layer and herb layer were mainly discussed. The warm temperate forest shows that the biomass and space occupied by the body are the largest in the tree layer.

The results of calculation and test in Table 3 show that, in general, the species richness index of herb layer and shrub layer of all community types in the relationship between species richness and life form is higher than that of tree layer. This is because there are many forest gaps formed by sparse trees, and the shade of shrubs and herbs is reduced, resulting in an increase in shrub and herb species. The overall trend of species richness index is that the shrub layer is larger, the herb layer is second, and the tree layer is smaller. The difference t-test results also showed that there were significant differences between the species richness indexes of trees and herbs. The species richness indexes of shrub-herb and tree-shrub were not significantly different. The inter-community variation analysis of species richness of different life forms showed that the species richness index of shrub layer had the largest variation among community types, followed by the species richness index of tree layer, and the species richness index of herb layer had the smallest variation.

Table 3. Species Diversity of Different Life Forms in Abies Chensiensis Community

index	species diversity						community difference					
	tree-shrub		tree-grass		shrub--grass		tree		shurb		grass	
	t	P	t	P	t	P	A	CV	A	CV	A	CV
Ma	-2.210	0.995	-2.745	0.019*	0.992	0.341	3.240	0.410	6.984	0.600	4.925	0.201
H’	-1.499	0.204	-2.411	0.098	0.441	0.702	1.001	0.403	1.499	0.507	1.407	0.110
J	0.039	0.917	-0.591	0.532	-0.341	0.698	0.821	0.033	0.810	0.221	0.864	0.099
D	0.311	0.699	1.187	0.240	0.901	0.411	1.009	0.201	1.064	0.112	1.000	0.049

* means significant difference; a: community average planting; CV: Coefficient of variation

From the results of the difference t test, it can also be seen that the relationship between species diversity and life form is that the diversity index is not significantly different in the tree layer-shrub layer, tree layer-herb layer, and shrub layer-herb layer. Analysis of the variation of species diversity among communities of different life forms showed that the variation of species evenness index in shrub layer was larger than that in tree layer and herb layer.

There was no obvious regularity in the distribution of species evenness index of different life forms among community types in A.chensiensis community in Quanbao Mountain. The inter-community variation analysis of species evenness of different life forms showed that the species evenness index

of shrub layer had the largest variation among community types, followed by the species evenness index of tree layer, and the species evenness index of herb layer had the smallest variation.

4. Conclusion and Discussion

4.1 Relationship between Species Richness and Life Form

The relationship between species richness and life form in all community types, the species richness index of herb layer and shrub layer were higher than that of tree layer. This is because there are many gaps formed by sparse trees, and the shade of shrubs and herbs is reduced, resulting in an increase in shrub and herb species.

4.2 Species Richness Index

The overall trend of species richness index is that the shrub layer is larger, the herb layer is second, and the tree layer is smaller. The difference t-test results also showed that there was a significant difference in species richness index between trees and herbs, and there was no significant difference in species richness index between shrubs-herbs and trees-shrubs.

4.3 Inter Community Variation of Species Richness in Different Life Forms

Variation analysis of species richness among communities with different life forms showed that the shrub layer species richness index had the largest variation among community types, followed by the tree layer species richness index, and the herb layer species richness index had the smallest variation.

4.4 Discuss

The abnormal characteristics of species diversity and community stability of A.chensiensis community are related to the characteristics of A.chensiensis community itself. In recent years, the death of A. qinlingensis in many places is mainly due to the great changes in light, water, heat and other conditions in the community, resulting in strong changes in species composition and community structure in the community. In addition, the excessive intensity of human disturbance and the inherent biological characteristics of the species also affect the species diversity and community stability of the A.chensiensis community.

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