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LETTER TO THE EDITOR

# Quantitative Analysis of Vegetation Distribution Structure in Wetland Ecological Garden Based on Phytocoenology

Luo Zhuo*
School of Information Engineering, Gansu Forestry Technological College, Tianshui 741020, China
*Email: lzthl8@163.com

Wetland has strong material production function, which is rich in animal and plant resources. In view of the high error in the quantitative study of vegetation distribution structure in traditional wetland ecological gardens, a quantitative analysis of vegetation distribution structure in wetland ecological gardens based on phytocoenology was proposed. The connotation of phytocoenology was expounded. Based on the theory of phytocoenology, the classification of wetland ecological garden vegetation was divided into two categories: wet vegetation and aquatic vegetation. Based on the vector data of wetland vegetation extracted by Ouickbirc satellite combined with field survey, a quantitative evaluation model of wetland ecological garden vegetation distribution structure was constructed according to the theory of phytocoenology. The experimental results show that the proposed method has low quantization error, which lays a foundation for the further development of research in this field.

Phytocoenology; Wetland; Ecological garden; Vegetation Distribution Structure; quantitative

## 1 INTRODUCTION

As the wetland ecosystem is an important transitional system, it has the reputation of the kidney of the earth, which not only provides a habitat for many wetland organisms, but also plays an important role in the regulation of natural climate. Wetland plants can significantly reduce the concentration of ammonia, nitrogen, organic matter, phosphorus and other nutrients in water by self-absorption, thus playing the role of purifying sewage. As a carrier of wetland system, it also provides a living and activity place for microorganisms to purify water quality, which has been widely used in the treatment of urban sewage, eutrophic water, river ecological regulation and industrial and agricultural wastewater treatment. Wetland plant applications require a large number of wetland plants. Therefore, understanding the vegetation resources of wetland ecological gardens and strengthening the study of wetland vegetation are of great significance for the development and utilization of wetland vegetation and its applications. The community structure of wetland ecological garden vegetation reflects the three-dimensional spatial configuration of wetland vegetation and is the basis for studying the ecological benefits of wetland gardens. The use of limited land area and the selection of better greening structures can effectively improve the environmental benefits of wetland ecological gardens. The vegetation of wetland ecological garden is the most important part of wetland ecosystem, which can best reflect the type of wetland function in garden landscape, so as to choose the vegetation of wetland ecological garden as the research object. The vegetation of wetland ecological garden has the characteristics of complex structure type and diverse tree species, so it is necessary to quantitatively analyze its vegetation distribution.

Xinping Yuan, Yi Liu published an article in the journal Ekoloji (Issue 107, 2019) entitled “Analysis of Vegetation

Landscape Adjacency Characteristics based on Rural Wetland Ecosystem", which provides an in-depth analysis of the adjacent features of vegetation landscapes in rural wetland ecosystem. The relative abundance, relative height and relative coverage of the vegetation landscape were calculated using the relative coverage and relative density measurements. The vegetation landscape type and its characteristics were analyzed by using computing software of the landscape. On this basis, the relationship between vegetation composition and spatial configuration was obtained by using the index analysis method of vegetation landscape structure. According to the four indicators of adjacent length, percentage of adjacent length, number of adjacent sides, ratio of adjacent sides and number of patches, the analysis method of adjacent features of vegetation landscape is adopted. The adjacent characteristics of vegetation landscape and wetland in rural wetland ecosystem and the development and construction land were analyzed. The stress degree function of vegetation landscape was constructed by using the analysis method of wetland ecological security.

In reference, a research method for spatial distribution of vegetation in Tianmushan Nature Reserve based on RS and GIS was proposed. Using RS and GIS technology as tools, the TM remote sensing image of Tianmushan Nature Reserve was processed and classified to obtain the vegetation distribution map of the area. Based on the spatial analysis function of GIS, the spatial distribution of vegetation types in Tianmushan Nature Reserve was studied, and one of the vegetation types was studied. The results quantitatively describe the elevation, slope direction and slope distribution of each vegetation type in the nature reserve, and give scientific statistical results. The spatial distribution of vegetation types in the study area is summarized, and the qualitative understanding of the spatial distribution law of vegetation types is converted into quantitative description. The theoretical explanation is given in combination with the actual situation, which provides a scientific basis for the planning, management and protection of nature reserves. However, the method is too simple and there is a problem that the quantitative analysis error is large. In reference, a method for quantitative estimation of forest vegetation based on grey correlation analysis was proposed (Biswas et al. 2017). By using the grey relational analysis method, the state of the natural communities of five different recovery times is analyzed by establishing the reference system. The results show that the method can accurately identify the position and state of different natural restoration communities in succession (Shirazi and Iqbal 2017). However, as an effective and accurate recognition model based on the similarity between the reference system and the series of data, the grey relational analysis method has less application in vegetation research, and the actual application effect is not good.

Therefore, a quantitative analysis method for the distribution structure of wetland ecological garden vegetation based on phytocoenology was proposed.

## 2 IDEA DESCRIPTION

### 2.1Phytocoenology connotation

As we all know, all kinds of plants living on the surface of the earth, whether cultivated or wild, are not piled up in disorder, but interact in a certain habitat, grow regularly together, and have certain conditions with the environment. Interrelationships form a unity, that is, phytocoenology, such as forests, grasslands, and farmland. Therefore, plant communities are not a simple sum of some plants and their individuals, nor an organism or a pseudo-organism, nor a social unit, but a system with its own special nature. It is a product of long-term natural selection and historical development. Phytobiology, also known as geobotany, mainly studies the relationship between plant communities and their environment, and the relationship between plants in plant communities. It clarifies the basic laws of the formation, species composition, structure, ecology, dynamics, classification and geographical distribution of plant communities (Hou et al. 2016). The objects of phytocoenology are plant communities and vegetation consisting of plant communities. Phytocoenology reveals the basic laws of phytocoenology structure, ecology, auxiliary,

classification and distribution on the earth, so as to parameterize and apply these laws, give full play to human subjective initiative to control, utilize, simulate, transform or create Plant communities, thereby protecting and transforming the natural environment, preventing environmental pollution, maintaining ecological balance, creating an excellent ecological environment, and improving the productivity of plant communities, in order to meet the needs of human beings, serving socialist and communist construction (Hunter and Lechner 2018).

**2.2 Wetland vegetation type**

Based on the theory of phytocoenology, the vegetation of wetland ecological garden was divided into five vegetation groups, 11 vegetation types and 68 groups. Among them, five vegetation groups were coniferous forest wetland vegetation type, broad-leaved forest wetland vegetation type group, shrub wetland vegetation type group, grassland wetland vegetation type group and shallow water plant wetland vegetation type group (Just et al. 2016). The vegetation types of the 11 wetlands include warm coniferous forest type, deciduous broad-leaved forest type, evergreen broad-leaved forest type, bamboo forest type, deciduous broad-leaved shrub type, sedge type, grass type, miscellaneous grass type, floating type, floating leaf type and submerged watertype.68 species of the group are the metasequoia group, the wetland pine group, the mulberry group, the mulberry group, the weeping willow group, and the Fengyang group. This paper mainly divides the vegetation of wetland ecological garden into two categories: wet vegetation and aquatic vegetation.

**2.2.1Wet vegetation**

Wet vegetation refers to plant types that are suitable for growth in wetland revetments, marsh wetlands or waterfront areas, where the plant base is not often submerged by water bodies, but the soil moisture content is saturated or adaptable to high water content (Liu et al. 2016). This kind of vegetation is aquatic when it is full of water, and it is terrestrial when it is out of water. It has strong adaptability to the water level environment, but it is not suitable for long-term flooding environment growth.

**2.2.2 Aquatic vegetation**

Aquatic vegetation refers to plants in which some or all of the plants can only live in a water environment. Aquatic vegetation plays a multi-faceted role in water purification. As one of the primary producers in aquatic ecosystems, submerged vegetation can regulate the material circulation speed of aquatic ecosystems, increase water biodiversity, control algae, and increase water bodies, stability and effectively improve water quality. According to the morphological characteristics and ecological habits of aquatic vegetation, it can be divided into four types: submerged, floating, floating and water.

**2.2 Data information extraction**

Using Ouickbirc satellite data (spatial resolution 0.61 m), supported by RS software ERDAS IMAGINE8.7 and GIS software MapInfo7.0, combined with field survey, we extracted wetland vegetation vector data and analyzed the landscape pattern in the study area. The field survey data includes all open-ground wetland vegetation distribution structural factors in the study area and are numbered separately.

**2.3 Quantitative model of vegetation distribution**

Phytocoenology is a population of plants that are formed under certain habitat conditions. In a phytocoenology, there is a certain relationship between vegetation, and between vegetation and environment, and a unique internal environment or plant environment community is formed. The distribution of wetland vegetation has certain regularity, so it can distribute its wetland. Quantitative analysis is carried out, in which the wetland biomass calculation formula is as follows:

$$p_c = \sum_{i=1}^{n} p_i \tag{1}$$

Where $p_c$ represents the wetland biomass, $p_i$ is the vegetation biomass of each type of wetland, i is the wetland vegetation group.

On this basis, the structural indicators of wetland vegetation are analyzed, and the calculation formula is as follows:

$$p_r = \mu \sum_{i=1}^{n} p_c + \frac{p_{\max}}{p_{\min}} \tag{2}$$

Where $p_r$ is the structural index of wetland vegetation, $p_{\max}$ is the maximum biomass of wetland vegetation, $p_{\min}$ is the minimum biomass of wetland vegetation, and $\mu$ is the index weight.

According to the theory of phytocoenology, a quantitative evaluation model for vegetation distribution structure of wetland ecological garden was constructed:

$$K = \frac{1}{2} \sum_{i=1}^{n} I p_r + m_i (x_i^2 + z_i^2) \tag{3}$$

In Equation (3), $I$ represents the quantitative index, $m_i$ represents the vegetation distribution parameter of the wetland ecological garden, and $x_i$ and $z_i$ respectively represent the starting position and ending position of the quantized area.

According to the above analysis, the quantitative analysis of vegetation distribution structure of wetland ecological garden based on phytocoenology was completed.

**3 RESULTS**

The quantified effect of the distribution structure of wetland ecological garden vegetation based on phytocoenology should be verified in the experiment, so the quantitative error experiment was carried out. The experimental operating system is Windows 10, the CPU is Core i3-7100Ge, the memory is 4GB DDR4-2400, and the display is 7680x5120HDMI2. The experimental results show that the proposed method has a quantization error of less than 1%, which verifies the comprehensive effectiveness of the proposed method.

**4 DISCUSSION**

In addition to providing industrial raw materials, food, ornamental flowers, and medicinal materials directly to humans, wetland plants also play a key role in wetland ecosystems. Wetland plants play an important role in the sewage treatment system, and cooperate with microorganisms, substrates, water bodies and animals to make the whole wetland ecosystem work in balance and play a good purification function. Therefore, this paper proposes a method for quantifying the vegetation distribution structure of wetland ecological garden based on phytocoenology, which is a very good supplement to the research content of Xinping Yuan et al. The experimental results show that the quantization error of the proposed method is low. The reason is that the vegetation vector data of each wetland is extracted by Ouickbirc satellite combined with field investigation. According to the theory of phytocoenology, a quantitative evaluation model of wetland ecological garden vegetation distribution structure is constructed, which

can reduce the quantization error and improve the quantization accuracy.

## 5CONCLUSION

Wetland vegetation is an important foundation for the construction of wetland ecological gardens. Most of the wetland vegetation used in the construction process is excavated from the natural environment, especially the submerged vegetation, which not only destroys the ecological environment of its origin, but also has a low survival rate, resulting in great waste of resources. The blind introduction of exotic species (including artificial introduction of abnormal factors) is liable to bring adverse effects on native wetland organisms. In this paper, a quantitative analysis of vegetation distribution structure of wetland ecological garden based on phytocoenology is proposed. The experimental results show that the proposed method has a low quantitative error, which indicates that the method has a high quantitative accuracy for the vegetation distribution structure of wetland ecological garden. The vegetation of the wetland ecological garden has a strong earthy atmosphere, and the wildness is natural and varied. It is of great significance to the localization of the landscape culture and the richness of the wetland plant diversity. Therefore, it is worthy of full use. On the basis of the vegetation survey of the wetland ecological garden, combined with the local landscape and water purification needs, it could screen and establish the wetland plant industrialization development base and take the road of sustainable development.

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