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To cite this article: Tianqi Yang *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **446** 032094

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Impact of Garden Plant Resources Allocation on Ecological Landscape in Cold Cities

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Abstract. This paper analyzes the distribution of plant resources in the test plots, and aims to optimize the allocation of plants and improve the follow-up construction plan for the cold land ecological park. We provide basis and reference for plant species selection and diversification in the construction of cold land urban Greenland plant landscape, and further improve the urban environment. Taking Jiamusi City as an example, the plant species, ecological distribution and utilization of plant resources in Jiamusi City Park were investigated and investigated by sample method and field investigation method. The data were analyzed by the analytic hierarchy process, and the ornamental value of the regional plants was analyzed. According to the survey, there are 41 species of plants in the park in Jiamusi City, belonging to 15 families and 35 genera. Their use involves three aspects, such as edible medicinal, and has high application value. As a typical cold city, Jiamusi proposes to consider the concept of ecological balance and sustainable development while considering the ornamental nature of plant resources, to play a role in supporting the image of the city.

1. Introduction

The cold city is the high-dimensional zone north of 40 north latitude. Its biggest feature is the seasonal phase change of four seasons, but it is generally influenced by the natural geographical environment, especially the climatic factors. Cold-weather cities are more demanding for plant species due to their cold temperature conditions[1]. Plants are the most basic and important elements of urban green space. Their species composition, seasonal landscape changes and planting methods determine the landscape effects and style characteristics of garden green spaces and even the entire city[2]. The landscape construction of northern garden plants often only pays attention to the landscape effects of spring, summer, and autumn, ignoring the ornamental nature of winter plant landscapes[3]. The northern winter viewing period is also the longest in the four seasons, which has caused people to face and endure the boring winter in the middle of the year. Therefore, the role of seasonal landscapes of garden plants in the landscaping of cold cities is receiving more and more attention[4]. The urban landscape reflects the characteristics of a city. It is an environmental art space formed by elements such as buildings, gardens, streets, squares, parks and urban pieces[5]. They are historical products of economic society and human civilization to a certain extent and at a certain stage[6-7]. Urban landscapes are characterized by locality, historicity and complexity, and the ecological garden



landscape is a very complex practical application system[8]. To improve the quality of plant landscapes in cold urban areas, domestic researchers have conducted extensive explorations of cold and urban plant landscapes from different angles and different levels, and with the rapid development of urban greening construction, some cold urban green areas are applied [9]. There are more and more plant species, but there are few studies related to Jiamusi City as a typical cold city. To this end, this paper conducts a comprehensive and systematic survey of plant species in Jiamusi City Park, which is intended to provide basis and reference for plant species selection and diversification in the construction of cold land urban Greenland plant landscape, and further improve the urban environment. Through practice and management, the cold urban environment can be "gradually changed" in space, and have the "time beauty" in the delay process.

2. Research Overview

2.1 Research methods

Field survey methods and sample methods were used. In the field survey, the district survey method and the line survey method were mainly used. According to the district planning of Jiamusi City, the park plant resources in Qianjin District, Xiangyang District, Dongfeng District, and suburbs were investigated. In the field survey, specimens were collected and recorded. Plants in each of the four areas were set up with 50 50m×50m samples to record the plant species, quantity and, habitat. We identify plant species and distribution ranges, and classify plant species.

2.2 Data processing and statistics

In this paper, the analytic hierarchy process is used to evaluate the ornamental value of plant resources. According to the ornamental value and ecological value of plants, the evaluation index system of plant resources for garden landscape is formulated. Different weights in the model are determined based on the different importance in the criteria layer. The ornamental value of the plant is determined by a consistency test. Establish a mathematical model of hierarchical analysis to obtain:

The normalized feature vector corresponding to the feature value n (ie, the sum of the components is 1) is a weight vector, which represents the weight of the factors to the upper factor. The normalized feature vector of A can be used as the weight vector.

When $CR < 0.1$, it proves that the ornamental resources of plant resources in the region meet the requirements. Where, CI represents the magnitude of the influence of a factor, RI represents the random consistency indicator, and CR represents the consistency ratio.

Table 1. Jiamusi City Plant Resource Evaluation Analysis Model Model

A Target layer	B Criteria layer	C standard floor
Evaluation and Analysis of Plant Resources in Jiamusi City	B1 Ornamental value	C1 Fruit value
		C2 Leaf value
		C3 Flower value
	B2 Ecological value	C4 Soil and water conservation capacity
		C5 Developed and utilized
	B3 Value	

3. Results and Analysis

3.1 Plant resource analysis and ornamental statistics

In this paper, by using the sampling method and the inductive summarization method, the plant resources of Jiamusi City were summarized and analyzed. The results showed that there were 41 species of plants in the park in Jiamusi City, belonging to 15 families and 35 genera. Among them, the proportions of *compositae* were 35%, and that of *Pinaceae* was less. The number of evergreen plants is the most ornamental, while the number of fruit species is less (In Fig 1-2).

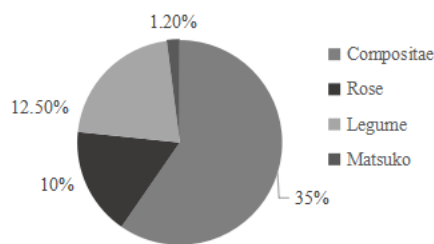


Figure 1. Statistics on main resources of plant resources in Jiamusi City

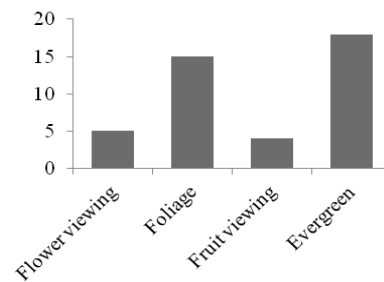


Figure 2. Ornamental statistics of plant resources in Jiamusi City

3.2 Statistics and analysis of arbor plant resources

The arbor plants are widely distributed in the test plots, and the number is more than 32% of the total population. The statistical results show that in the research area, the families with more arbor plants are: *Rosaceae* and *Pinaceae*, accounting for 5.16% and 3.53% of the total plants, respectively. Among all the arbor plant resources, angiosperms account for the vast majority. Some of them have high edible value, garden ornamental value, such as flower buds and flower red. Most of the trees have strong cold resistance, and the golden leaf mites have good adaptability to the soil, and can grow normally under the condition where the sandy soil water content is as low as 7%. The good application of arbor plants is conducive to the creation of a good city card effect, and the research of arbor species is difficult to meet the needs of urban construction.

3.3 Statistics and analysis of shrub plant resources

Table 2. Classification of plant resources arbor plants in Jiamusi City

Plant type	distributed	Abundance	use
<i>Malus asiatica</i> Nakai	hillside	++	edible
<i>Sorbus pohuashanensis</i>	Forest edge	+	Medicinal
<i>Fraxinus mandshurica</i> Rupr	hillside	+	Greening
<i>Pinus sylvestris</i> var. <i>Mongolica</i> Litv.	hillside	+	Greening
<i>Ulmus pumila</i> L	Forest edge	+	Greening
<i>Salix babylonica</i> L.	Forest edge	+++	Greening
<i>Picea asperata</i> Mast	Forest edge	+++	Greening

Note: “+”: there is distribution, the quantity is small, “++”: richness, “+++”: rich distribution, and the quantity is large.

The distribution of shrub plants is mainly concentrated in the sunny area of the research area, and the population accounts for 36% of the total number of plants. The species of shrub plants are complex and lack representative. Among them, clove is widely used in the plant resource allocation of the research area because of its special aroma and flower colour. *Amorpha Sinensis* has a cold-tolerant climate due to its cold weather, and its light requirements are not high. It accounts for a maximum of 35% of the total number of shrubs. Red Swiss Wood has a very high economic value, but the number is small. Each plant has its unique shape, colour, charm, style and other characteristics, to display and create different plant landscapes in different environments, to achieve different seasons in spring, summer, autumn, and winter, and have an ornamental significance. Cold winter cities are difficult to survive due to winter grasses. It is not suitable to create plant landscapes with large areas of lawns, highlighting the importance of shrub plants. The species of shrubs in the study area are mostly foliage, and there are fewer flowering plants, which affects the landscape of the city.

Table 3. Classification of plant resources shrub plants in Jiamusi City

Plant type	distributed	Abundance	use
<i>Viburnum sargentii</i>	hillside	+	Edible Greening
<i>Ligustrum obtusifolium</i> Sieb. et Zucc.	hillside	+	Greening
<i>Amygdalus triloba</i>	Forest edge	+	Greening
<i>Syzygium aromaticum</i> (L.) Merr. & L. M. Perry	Forest edge	+++	Greening
<i>Sambucus williamsii</i> Hance.	bush	+	Greening
<i>Swida alba</i> Opiz.	Forest edge	++	Medicinal
<i>Forsythia suspensa</i>	bush	++	Medicinal
<i>Amorpha fruticosa</i> Linn.	bush	+	Medicinal

Note: “+” means there is distribution, the quantity is small, “++” means richness, “+++” means rich distribution, and the quantity is large.

3.4 Statistics and analysis of herbaceous resources

Herbs are widely distributed and are mostly wild herbs. Among them, the number of medicinal plants is the largest, accounting for 87% of the total number of herbaceous plants. The herbaceous plants in Jiamusi City are mostly Composite, with 14 species. Herbaceous plants are indispensable plant materials for landscaping. They are various in varieties, different in shape and different in ornamental characteristics. Wild ornamental plants growing under forests and forest margins have a certain tolerance to negative, which can meet the needs of gardening. The demand for landscaping can also enrich the greening and beautification of dense shelters, viaducts, and shady surfaces of buildings, such as shades, semi-shadows or wet environments. It is an indispensable greening plant with both ornamental and ecological functions. In urban gardens, rationally planting wild ornamental herbaceous plants is a way to reflect the landscape of the region, highlight the natural landscape, and achieve conservation-oriented landscaping. Jiamusi City can use the wild herbs in this city, which not only puts in less manpower and material resources, but also achieves the best landscape effect.

Table 4. Jiamusi City Plant Resources Herbs Classification Table

Plant type	distributed	Abundance	use
<i>Iris ensata</i> Thunb.	bush	++	Medicinal
<i>Saxifraga rufescens</i> var. <i>flabellifolia</i>	understory	++	Medicinal
<i>Crepis tectorum</i> Linn.	understory	+	Medicinal
<i>Selaginella nipponica</i>	bush	+	Medicinal
<i>Phaenosparganthes globosa</i> Munro ex Benth.	understory	+	Medicinal
<i>Parthenocissus quinquefolia</i> (L.) Planch.	understory	+	Greening
<i>Trifolium repens</i> L.	understory	+	Medicinal
<i>Hosta ensata</i> F. Maekawa	understory	++	Medicinal
<i>Picris hieracioides</i> L.	bush	++	Medicinal
<i>Scorzonera austriaca</i> Willd.	bush	+	Greening
<i>Lagedium sibiricum</i> (L.) Sojak	understory	+++	Medicinal
<i>Inula linearifolia</i> Turcz.	understory	+	Greening
<i>Artemisia carvifolia</i> Buch.-Ham. Hort. Beng.	understory	+++	Medicinal
<i>Kummerowia striata</i> (Thunb.) Schindl.	bush	+	Medicinal
<i>Heteropappus hispidus</i> (Thunb.) Less.	bush	+++	Medicinal Edible
<i>Phragmites communis</i> (Cav.) Trin. ex Steud.	bush	+++	Greening
<i>Artemisia japonica</i> Thunb.	understory	+	Medicinal
<i>Echinochloa caudata</i> Roshev.	understory	+	Medicinal
<i>Vicia amoena</i> Fisch. ex DC.	understory	+	Medicinal
<i>Geum aleppicum</i>	bush	++	Medicinal
<i>Agrimonia pilosa</i> Ldb.	bush	+	Medicinal

<i>Glycyrrhiza pallidiflora</i> Maxim.	bush	+	Edible Medicinal
<i>Kalimeris lautureana</i> (Debx.) Kitam.	understory	+	Edible Medicinal
<i>Artemisia scoparia</i> Waldst. et Kit.	bush	+	Edible
<i>Xanthium sibiricum</i> Patr. ex Widder	understory	+++	Medicinal
<i>Pterocypselia indica</i> (L.) Shih	understory	+	Edible Medicinal

Note: “+” means there is distribution, the quantity is small, “++” means richness, “+++” means rich distribution, and the quantity is large.

4. Conclusions and discussion

4.1 Discussion on Optimization of Plant Resources in Coldland Ecological Park

In recent years, countries all over the world have paid more attention to the construction of ecological cities. Domestically, they have also increased their efforts to invest in the construction of ecological green landscapes and rationally allocated plant landscapes. On the one hand, it can achieve a harmonious state between man and the natural environment. The modern society advocates harmony between man and nature. Therefore, the planning of urban parks must be in harmony with the ecological environment, in line with the ecological balance principle of the natural environment, and comprehensive utilization of ecology and landscape design should be adopted; use as much of the renewable resources within the base as possible. Minimize the destruction of the existing natural environment (rivers, lakes, topography, etc.), combine urban planning and architectural layout with natural topography and natural environments such as forests and lakes; ensure the diversity of ecosystems, land, and time. Build a multi-level artificial plant community by comprehensive, scientific and rational allocation of landscape plants with high ecological benefits. Therefore, a good plant resource allocation design is conducive to the creation of a good reputation in the city, resulting in a good business card effect in a larger area.

4.2 Conclusion

From the horizontal distribution point of view, there are many kinds of plants in the forward and sunny areas, and spruce and clove are the main dominant species. From the vertical distribution, the arbor layer is the uppermost layer, followed by the shrub layer and the herb layer. *Forsythia suspensa* and *Syzygium aromaticum* are dominant species in the shrub layer, and *Artemisia annua* L. and *Phragmites communis* are the main dominant species in the herb. From the perspective of ornamental effect, the main dominant species such as spruce and reed are leafy plants, and there are few species of flower viewing, and it is appropriate to consider increasing the flowering plants. With the continuous acceleration of urban construction and the rapid development of the global economy, the contradiction between people, cities and the ecological environment is increasing. As one of the main contents of urban construction, urban parks must meet the leisure needs of urban residents, provide rest, tour, exercise, and communication functions, and give full play to ecological benefits to promote urban social, economic, and cultural development. The allocation of resources in cold cities is limited by many factors. It is necessary to comprehensively apply multidisciplinary knowledge and technology such as meteorology, soil science, ecology, botany, and landscape science to allocate plant resources more complicated. Through field investigations on the existing plant resources in Jiamusi City, it is found that there are not many types of shrubs in Jiamusi City, and they are limited by the environment. If the area of available green land is small, it will inevitably lead to a relative reduction of plant species in certain areas. Due to the natural factors of the cold zone city, the construction process of the ecological park has been slowed down. The planning and design of eco-parks in cold-strewn cities should follow the corresponding principles, and the division of internal patterns and functional areas should be more scientific and reasonable, to better exert the ecological effects of urban ecological parks, and protect and improve the local ecological environment. The construction of the ecological park should fully consider the multi-layer greening of the plant resources, and rationally adjust the

plant species to achieve the best construction effect with the least resources. Plant ecological resources should also take into account the seasonal changes and different ornamental effects of different plants.

Acknowledgement

Heilongjiang Provincial Department of Education Basic Research Project, China, (2018-KYYWF-0936); China Scientific and technological innovation projects in Heilongjiang Province, college students: 201910222007.

References

- [1] Körner, C. (2006) Significance of temperature in plant life. *J. Sci. Plant growth and climate change*, 2: 48-69.
- [2] Chen, B., Adimo, O. A., & Bao, Z. (2009) Assessment of aesthetic quality and multiple functions of urban green space from the users' perspective: The case of Hangzhou Flower Garden, China. *J. Sci. Landscape and Urban Planning*, 93: 76-82.
- [3] Thompson, J. W., & Sorvig, K. (2007) Sustainable landscape construction: a guide to green building outdoors. Island Press. New England.
- [4] Franco, J. A., Martínez-Sánchez, J. J., Fernández, J. A., & Bañón, S. (2006) Selection and nursery production of ornamental plants for landscaping and xerogardening in semi-arid environments. *J. Sci. The Journal of Horticultural Science and Biotechnology*, 81: 3-17.
- [5] Thompson, C. W. (2002) Urban open space in the 21st century. *J. Sci. Landscape and urban planning*, 60: 59-72.
- [6] White, L. A. (2016) The evolution of culture: the development of civilization to the fall of Rome. Routledge. New York.
- [7] Wood, E. M. (1981) The separation of the economic and political in capitalism. *J. Sci. New Left Review*, 127: 66-74.
- [8] Whitehand, J. W. (2007) Conzenian urban morphology and urban landscapes. In 6th International Space Syntax Symposium. Istanbul. pp. 12-15.
- [9] Stremke, S., Van Den Dobbelsteen, A., & Koh, J. (2011) Exergy landscapes: exploration of second-law thinking towards sustainable landscape design. *J. Sci. International Journal of Exergy*, 8: 148-174.