

Analysis of Landscape Plant Diversity: A Case Study in the Yuanbo Garden

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Abstract

The diversity of park plants and the application status of landscape plants reflect a region's species diversity as well as the achievements in urban environmental planning and park construction. This study investigated the landscape plant diversity and plant communities in the Yuanbo Garden of Songming Vocational Education Park in Kunming through field surveys. The results show that the garden contains 31 species from 31 genera and 22 families, including 10 tree species (9 families, 10 genera), 9 shrub species (7 families, 9 genera), and 12 herbaceous species (9 families, 12 genera). Herbaceous plants are the most abundant, followed by trees and shrubs, indicating rich plant diversity. Native Yunnan species account for 30% of the total, maintaining stable ecological niches and providing habitats for local biodiversity; naturalized alien species comprise 17%, posing low threats and often coexisting with native species; controlled introduced species represent 20%. Nevertheless, ecological risks from high-risk alien species require attention.

Keywords

Yuanbo Garden; Landscape Plant Diversity; Species; Risk.

1. Introduction

Urban parks, as vital components of urban ecosystems, play crucial roles in improving urban environments, enhancing residents' quality of life, protecting biodiversity, elevating ecological services, and optimizing landscape aesthetics^[1-2]. Due to their diverse species and low maintenance costs, landscape plants are widely used in park design. Research on their diversity holds significant potential value for disciplines related to green space construction and landscape design^[3-5]. Thus, plant surveys in parks have garnered sustained attention.

The Yuanbo Garden (also named Chunhua Garden), located in Songming Yanglin Vocational Education Park, Kunming, was established in 2013. As the earliest park in the vocational education zone, it serves as a large comprehensive theme park integrating recreation, tourism, and science education, functioning as a "backyard garden" for nearby students and residents. To date, no study has investigated tree diversity in this garden. This research aims to provide references for green space construction and plant landscaping around university areas.

2. Survey Methodology

2.1 Study Area

The Yuanbo Garden (102°59'42"–103°00'01"E, 25°13'57"–25°14'18"N) is situated in Songming Vocational Education Park, Kunming, Yunnan Province. The terrain features gentle slopes with mostly flat platforms, creating strong landscape layering. The climate is subtropical plateau monsoon with mild seasons, abundant sunshine, an annual average temperature of 14°C, and annual precipitation of 1,000 mm. Soil type is red earth.

2.2 Plant Diversity Survey Methods

2.2.1 Comprehensive Census

A full-coverage census was conducted across the entire garden using systematic recording and field surveys to document plant applications.

2.2.2 Literature Review

Species identification and ecological classifications were verified against Flora Yunnanica, Flora Reipublicae Popularis Sinicae, and related literature^[6].

2.3 Data Processing

Scientific names were cross-checked via the Chinese Virtual Herbarium (CVH) and further validated using the 'plantlist' package in R. Duplicates were removed to obtain standardized species, genus, and family names. Orders and classes were confirmed via the Catalogue of Life (CoL).

Genus distribution patterns followed Wu Zhengyi's Areal-types of Seed Plant Genera.

3. Results and Analysis

3.1 Basic Composition of Garden Plants

Table 1. List of woody plants in the park

Species	Golden Privet	Family	Genus	Type
Yunnan Camellia	<i>Camellia reticulata</i> Lindl.	Theaceae	Camellia	Evergreen tree
Yunnan Nanmu	<i>Machilus yunnanensis</i> Lec.	Lauraceae	Machilus	Evergreen tree
Yunnan Pine	<i>Pinus yunnanensis</i> Franch.	Pinaceae	Pinus	Evergreen tree
Deodar Cedar	<i>Cedrus deodara</i> (Roxb.) G. Don	Pinaceae	Cedrus	Evergreen tree
Ginkgo	<i>Ginkgo biloba</i> L.	Ginkgoaceae	Ginkgo	Deciduous tree
Yunnan Cherry	<i>Cerasus cerasoides</i> Buch.-Ham. ex D. Don	Rosaceae	Cerasus	Deciduous tree
Yunnan Hackberry	<i>Celtis kunmingensis</i> Roxb.	Ulmaceae	Celtis	Deciduous tree
Weeping Willow	<i>Salix babylonica</i> L.	Salicaceae	Salix	Deciduous tree
Jacaranda	<i>Jacaranda mimosifolia</i> D. Don	Bignoniaceae	Jacaranda	Deciduous tree
Chinese Pistache	<i>Pistacia chinensis</i> Bunge.	Anacardiaceae	Pistacia	Deciduous tree
Chinese Photinia	<i>Photinia</i> × <i>fraseri</i>	Rosaceae	Photinia	Evergreen shrub
Chinese Rose	<i>Rosa chinensis</i> Jacq.	Rosaceae	Rosa	Evergreen shrub
Rhododendron	<i>Rhododendron simsii</i> Planch.	Ericaceae	Rhododendro	Evergreen shrub
Heavenly Bamboo	<i>Nandina domestica</i> Thunb.	Berberidaceae	Nandina	Evergreen shrub
Lvy	<i>Hedera nepalensis</i> K. Koch var. <i>sinensis</i> (Tobl.) Rehd.	Araliaceae	Hedera	Evergreen shrub
Bougainvillea	<i>Bougainvillea spectabilis</i> Willd.	Nyctaginaceae	Bougainvillea	Evergreen shrub
Blueberry	<i>Vaccinium</i> spp.	Ericaceae	Vaccinium	Deciduous shrub
Golden Privet	<i>Ligustrum</i> × <i>vicaryi</i>	Oleaceae	Ligustrum	Deciduous shrub
Lavender	<i>Lavandula angustifolia</i>	Lamiaceae	Lavandula	Dwarf shrub

The garden hosts 31 species from 31 genera and 22 families (Tables 1–3). As the backbone material of the plant landscape, trees play a leading role in the landscape and function of the park. There are no more than 10 types of trees in the park, accounting for 32.26% of all species. Most of the trees are common species in Yunnan, such as Yunnan pine, Yunnan camellia, and Yunnan cherry blossom.

There are 9 kinds of shrubs in the park, accounting for 29.03% of all plant species. Among them, common ones such as Chinese Photinia, Chinese Rose and rhododendron play a connecting role in the vertical structure of the community, which is of great significance for improving the structure of the plant community and enriching plant diversity.

Table 2. List of herbaceous plants in the park

Species	Golden Privet	Family	Genus	Type
Strawberry	<i>Fragaria × ananassa</i>	Rosaceae	Fragaria	Perennial herb
Orchid	<i>Cymbidium spp.</i>	Orchidaceae	Cymbidium	Perennial herb
Tulip	<i>Tulipa gesneriana</i>	Liliaceae	Tulipa	Perennial herb
Common Reed	<i>Phragmites australis</i>	Poaceae	Phragmites	Perennial graminoid
Yellow Iris	<i>Acorus calamus</i>	Iridaceae	Iris	Perennial helophytic herb
Chrysanthemum	<i>Chrysanthemum morifolium</i>	Asteraceae	Chrysanthemum	Perennial herb
Sunflower	<i>Helianthus annuus</i>	Asteraceae	Helianthus	Perennial herb
Lotus	<i>Nelumbo nucifera</i>	Nelumbonaceae	Nelumbo	Perennial aquatic herb
Tomato	<i>Solanum lycopersicum</i>	Solanaceae	Lycopersicon	Annual herb
Ornamental Pepper	<i>Capsicum annuum</i>	Solanaceae	Capsicum	Annual herb
Water Lily	<i>Nymphaea spp.</i>	Nymphaeaceae	Nymphaea	Perennial aquatic herb
Four-o'clock Flower	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Mirabilis	Perennial herb

Table 3. basic composition of plant species in Yuanbo Lake

Plant type	Family	Genus	Species	Proportion of species to total species %
Tree	9	10	10	32.26
Shrub	7	9	9	29.03
Herb	9	12	12	38.71
Aquatic plant	2	3	3	9.68
Vine	2	2	2	6.45

Herbaceous plants have high ornamental value in landscaping due to the diversity of their forms and colors. There are 12 kinds of herbs in the park, accounting for 38.71% of all plant species, there are more species than trees and shrubs. Common ones include sunflower, four o'clock, chrysanthemum, etc., which play a significant role in enhancing the ornamental value of the plants in the park.

There are three kinds of aquatic plants, accounting for a relatively low proportion. They are mainly water lilies, lotus flowers and yellow calamus, which are mainly distributed in the park ponds. In the later stage of park management and landscape creation, it is suggested to appropriately increase the types of aquatic plants to enrich the diversity of the aquatic environment.

Climbing plants include bougainvillea and ivy, which are mainly used for vertical greening and play a beautifying role in the environment. The climbing plants in the park are a bit monotonous, mainly clinging to the flower trellises. It is suggested to appropriately increase the types of climbing plants, such as spathiphylla and honeysuckle, to create a flower corridor tunnel with seasonal changes.

3.2 The Groups and Distribution

Among the garden plants in the Yuanbo Garden, the species of the Rosaceae family are the most numerous, namely Photinia, Rosa, Strawberry and cherry. The remaining two species each of the Pinaceae, Compositae, Nymphaeaceae, Ericaceae and Jasminaceae families. From the perspective of the distribution of garden plant species, there are 9 species distributed worldwide or across continents, 10 species naturally distributed in China, 7 species introduced and cultivated from abroad, and 3 species endemic to Yunnan. The wild individuals of *Camellia yunnanensis*, *Camellia yunnanensis* and *Camellia yunnanensis* are only found in Yunnan and are included in the "Red List of China's Biodiversity".

3.3 Seasonal Landscape Design

The spring theme of the Yuanbo Garden is a sea of flowers. In the park, Yunnan cherry blossoms are in full bloom, and the new leaves of Yunnan magnolia are sprouting, presenting a beautiful scene of pink flower clouds and copper-red new leaves. In addition, relatively low-growing purple jasmine and rhododendrons are in full bloom, creating a romantic atmosphere of a colorful flower carpet. In summer, lotus and water lilies are in full bloom in the pond, and jacaranda trees are in full bloom. In autumn, the golden leaves of ginkgo and the orange-red leaves of *Copa chinensis* interweave, the red fruits of *Nandina domestica* hang on the branches, and chrysanthemums; In winter, cedars and Yunnan pines serve as evergreen skeletons, while bougainvillea is developed for frost resistance. With the change of seasons, the scenery of the Yuanbo Garden alternates.

3.4 Ecological Risk Assessment of Alien Species

Among the garden plants in the Yuanbo Garden, the native species mainly include Yunnan *Camellia*, Yunnan *Nanmu*, Yunnan cherry blossom, Yunnan *Magnolia*, Yunnan pine, *Coptis chinensis*, *Rhododendron*, *Nandina domestica* and ivy, accounting for 30%. Their ecological niches are stable, providing habitats for native organisms. The naturalized alien species mainly include weeping willow, lotus, rose, chrysanthemum and lavender, accounting for 17%. They pose a relatively low threat and mostly coexist with native species. The controllable introduced species are jacaranda, cedar, golden privet, red-leaf photinia and four o four, accounting for 20%. Among them, four o four is an invasive species and potential threats need to be controlled. Acidosis caused by flower drop in jacaranda can inhibit the germination of herbaceous plants. It is recommended to plant shade-tolerant ferns under the trees. In addition, cases where bougainvillea aerial roots attach to rock fissures and secrete organic acids, accelerating soil erosion in rocky desertification mountainous areas, have also been reported, which requires attention. The roots and stems of *gladiolus* reproduce rapidly and are prone to form single groups, which also requires attention when compressing the habitats of other species.

4. Conclusion

As the earliest park in Songming Vocational Education Park, the Yuanbo Garden fulfills recreational needs while serving as an urban ecological node. There are a total of 31 species of plants belonging to 31 genera and 22 families in the park garden, including 10 species of trees belonging to 10 genera and 9 families, 9 species of shrubs belonging to 9 genera and 9 families, and 12 species of herbs belonging to 12 genera and 9 families. Herbaceous plants are the most numerous, followed by trees and shrubs, with a rich variety of plant species.

Plant diversity is one of the important elements determining the diversity of garden landscapes. Through the analysis and investigation of species diversity in the Yuanbo Garden, it was found that based on the differences in the adaptability of plants to the environment, three-dimensional planting of trees, shrubs and herbaceous plants, as well as horizontal configuration of xerophytes, wetland

plants and aquatic plants, can form a stable ecosystem and landscape. In terms of the functional zoning of the park, different functions correspond to different plant combinations. The distribution of trees is relatively concentrated and the area is large, while the distribution of ornamental plants is relatively small. The types of aquatic plants are also limited, and the pond landscapes are relatively simple. Therefore, the plant cultivation space should be planned more reasonably to create more distinctive landscapes and attract more residents and students to visit here. The ecological threats to plants also need to be taken seriously.

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