Survey and Application Prospect Analysis of Spontaneous Plants in Urban Park Lawn in Hangzhou

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Abstract　The spontaneous plants in the lawn not only improve the biodiversity of the lawn, but also provide food and shelter for insects, amphibians and birds, as well as pleasant sensory experience for people. The spontaneous plants in eight different types of parks in Hangzhou were investigated in detail by field survey. A total of 89 species of 27 families of spontaneous plants were found in Hangzhou urban parks, of which Asteraceae, Fabaceae and Poaceae were the dominant families. The life forms are mainly perennial herbs, and the growth forms are mostly erect. According to the screening criteria, 20 spontaneous plants, such as *Ranunculus sieboldii*, *Taraxacum mongolicum* and *Corydalis decumbens*, were recommended for potential exploitation. According to the spontaneous plants of lawn, three application models of flower lawn, semi-natural succession of lawn and natural grassland were put forward.

Key words　Spontaneous plants of lawn, Species composition, Parks in Hangzhou, Application

1 Introduction

Urban spontaneous plants refer to plants that grow by themselves in the urban environment and are not planted by human beings, including weeds, natural regeneration seedlings, urban green space system seedlings, and so on[1]. The spontaneous plants have the functions of maintaining biodiversity, increasing carbon sequestration and organic carbon content, and restoring soil environment[2−3]. Using spontaneous plants to build low-maintenance landscape can not only increase the natural wild interest, but also save the consumption of manpower, material resources and resources. Lawn is a business card of the era of ecological civilization. Starting from natural grassland, lawn has the ecological functions of providing entertainment and leisure places for people, protecting and beautifying the environment, and is an important part of urban green space system.

Artificial lawn species are single, low and open in space, which provides favorable conditions for the invasion, growth and reproduction of spontaneous plants[4]. In the maintenance and management of lawn, considering that spontaneous plants interfere with the growth of lawn grass and affect the lawn landscape, artificial removal and the use of herbicides are often used for treatment. However, the extensive use of chemical fertilizers and pesticides in the maintenance and management of a large number of urban lawns will not only cause environmental pollution, but also reduce urban biodiversity. In this situation, research has shifted to explore turf alternatives such as grassless, flowering, and urban grasslands, which offer advantages in maintenance, aesthetics, and biodiversity[5].

Foreign studies have shown that urban residents prefer natural and diverse grasslands and wild flower meadows to monotonous lawns[6]. In the past, more attention was paid to how to maintain the ornamental landscape of artificial lawn, but less attention paid to the spontaneous plants in the lawn. Therefore, in this paper, we took the spontaneous plants of artificial lawn in Hangzhou parks as the research object, through detailed investigation, discussed the species composition and growth characteristics of the lawn spontaneous plants, and recommends the spontaneous plants that have development potential. In addition, we put forward the application mode of lawn spontaneous plants to provide theoretical basis for better application of lawn spontaneous plants in urban parks and improvement of urban biodiversity in the future.

2 Research site and methods

2.1 Survey site　We selected eight representative parks, namely, Orioles Singing in the Willows, Prince Bay, Viewing Fish at Flower Harbor, Hangzhou Botanical Garden, Hangzhou Flower Garden, Qianjiang New Town Forest Park, Reclamation Culture Park and Chengbei Sports Park.

2.2 Survey methods　In March, August and December of 2023, we carried out a detailed survey of spontaneous plants in the lawns of the above eight parks by field investigation, recorded the species names, life forms, growth conditions and ornamental values of spontaneous plants in each survey site, and took photos.

2.3 Screening method　Spontaneous plants with application potential were used as selection criteria: (i) low and regular plants; (ii) colorful flowers and long flowering period; (iii) stolons or self-sowing and self-propagation; (iv) strong adaptability,

strong regeneration ability and pruning tolerance；(ⅴ) non-malignant invasive plants.

3 Results and analysis

3.1 Species composition of spontaneous plants in lawn

The results showed that there were 89 species of spontaneous plants belonging to 27 families and 71 species of dicotyledonous plants belonging to 24 families in Hangzhou urban parks. They are dominated by Asteraceae, Fabaceae, Euphorbiaceae and Scrophulariaceae families. There are 3 families and 18 species of monocotyledonous plants, mainly Poaceae and Cyperaceae. According to the classification of alien invasive plants in China, five species of malignant invasive plants were found, namely, *Alternanthera philoxeroides*, *Amaranthus blitum*, *Erigeron annuus*, *Alternanthera phi-* *loxeroides* and *Lepidium virginicum*.

3.2 Life-form and growth-form composition of spontaneous plants in lawn

There are 36 species of perennial herbs, accounting for 40.45%, such as *Lysimachia congestiflora*, *Taraxacum mongolicum*, *Viola grypoceras* and so on. There are 32 species of annual herbs such as *Commelina communis*, *Stellaria uliginosa*, accounting for 35.96%. There are 21 species of biennial herbs such as *Veronica persica* and *Medicago minima*, accounting for 23.60% (Table 1). There are 66 species (74.16%) of growth forms, such as *Ixeris japonica* and *Geranium carolinianum*. There are 15 creeping types, such as *Oxalis corniculata*, *Polygonum capitatum*, etc., accounting for 16.85%. There are 8 vine species, such as *Dichondra repens*, *Vicia cracca*, etc., accounting for 8.99% (Table 1).

Table 1 Life-form and growth-form composition of spontaneous plants in lawn

Life-form	Number of species	Percentage // %	Growth-form	Number of species	Percentage // %
Perennial herb	36	40.45	Erect	66	74.16
Annual herb	32	35.96	Creeping	15	16.85
Biennial herb	21	23.05	Vine	8	9.99

3.3 Recommendation for spontaneous plants with application potential in lawn

According to the screening method of spontaneous plants with application potential, 20 spontaneous plants with application potential were recommended (Table 2). These spontaneous plants have good application potential, which not only meet the needs of lawn landscape, but also overcome the shortcomings of traditional single lawn planting. For example, *Commelina communis* has a creeping stem with strong growth potential, and its flowers are like "butterflies", with a flowering pe- riod of 60 d, and its shape is very beautiful. *Kalimeris indica* has a plant height of 30 – 50 cm, grows close to the ground, has compact flowers, long flowering period and strong vitality. *Potentilla kleiniana* has creeping stems, beautiful leaves, bright green leaves, bright yellow flowers, and its flowering period can last for more than two months. Lysimachia congestiflora has creeping stem, beautiful and wild, and its flowering period can reach one and a half months.

Table 2 Recommended 20 species of spontaneous plants with application potential in park lawns of Hangzhou

Name	Life-form	Flower color	Name	Growth-form	Flower color
Corydalis decumbens	Erect	Red and purple	*Veronica persica*	Erect	Blue
Corydalis incisa	Erect	Blue and purple	*Lindernia crustacea*	Erect	Purple
Clinopodium gracile	Erect	Pink	*Duchesnea indica*	Creeping	Yellow
Glechoma longituba	Creeping	Pink	*Potentilla kleiniana*	Creeping	Yellow
Ixeridium chinense	Erect	Yellow	*Ranunculus sieboldii*	Erect	Yellow
Ixeris japonica	Erect	Yellow	*Stellaria uliginosa*	Erect	White
Kalimeris indica	Erect	Purple	*Lysimachia congestiflora*	Creeping	Yellow
Taraxacum mongolicum	Erect	Yellow	*Oxalis corniculata*	Erect	Yellow
Viola grypoceras	Erect	Purple	*Medicago minima*	Erect	Light yellow
Commelina communis	Erect	Blue	*Polygonum capitatum*	Creeping	Red

3.4 Analysis on application model of spontaneous plants in lawn

3.4.1 Using self-growing flowering plants on the lawn to form a flower-decorated lawn. The flower-decorated lawn is a lawn with ornamental value, which is mainly composed of gramineous herbaceous plants and a small amount of other perennial flower-viewing herbaceous plants. In order to improve the biodiversity of urban park lawn and ensure the landscape effect, the proportion of lawn in the whole park can be reduced, the proportion of lawn grass can be controlled at 60% – 70%, and spontaneous plants with small volume and strong vitality can be increased, such as *Oxalis corniculata*, *Taraxacum mongolicum*, *Viola grypoceras*, *Potentilla chinensis*, *Duchesnea indica* and *Ranunculus sieboldii*, etc., to form a flower-decorated lawn.

3.4.2 Reducing artificial intervention and promoting semi-natural succession of lawn. For urban lawns, natural management methods should be followed to reduce manual intervention, promote semi-natural succession of lawns, and transform lawns into

vegetation with abundant self-growing flowering wild plants[7]. The lawn is not fertilized or watered, and is irregularly pruned once every autumn, the grass clippings are left in the lawn after pruning, chemical fertilizers and pesticides are not used[8], and the lawn is not pruned in spring and summer, so that a large number of dicotyledonous plant species in the lawn will blossom. It is recommended to increase the diversity of spontaneous plants in lawns, to provide food and shelter for insects, amphibians and birds, and as well as a pleasant sensory experience for people.

3.4.3 Using self-growing grasses and wild flowers to form natural grassland. Lawn originated from natural grazing grassland. The use of self-growing grasses and annual and perennial broadleaf flowering wildflowers forms a stable natural community[9], presenting a natural grassland with advantages in terms of maintenance, aesthetics and biodiversity[10]. It is suggested that the natural grassland landscape should be constructed with low intervention. For example, malignant invasive plants such as *Erigeron annuus*, *Alternanthera philoxeroides* and *Lepidium virginicum* in natural grassland should be found and removed in time, and protect native self-growing grasses and wild flower in that natural grassland to the maximum extent. The natural grassland is covered with green grass, various wild flowers alternate, natural regeneration, and extensive management, which not only shows different landscape effects, but also is more conducive to maintaining the sustainable ecological community of urban biodiversity.

4　Conclusions

The biodiversity of urban spontaneous plants is an important part of urban ecosystem. The spontaneous plants in the lawn not only improve the biodiversity of the lawn, but also provide food and shelter for insects, amphibians and birds, and provide pleasant sensory experience for people. We investigated the spontaneous plants in eight different types of parks in Hangzhou by field survey. A total of 89 species of 27 families of spontaneous plants were found in Hangzhou urban parks, of which Asteraceae, Fabaceae and Poaceae were the dominant families. The life forms are mainly perennial herbs, and the growth forms are mostly erect. According

to the screening criteria, 20 spontaneous plants, such as *Ranunculus sieboldii*, *Taraxacum mongolicum* and *Corydalis decumbens*, are recommended for potential exploitation. According to the spontaneous plants of lawn, we put forward three application models, which were ornamental lawn, semi-natural succession of lawn and natural grassland.

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