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Article

Prediction study on plant diversity investigation and conservation plan-ning in Yiyang city

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Abstract: Taking the urban plants of Yiyang as the research object, the field investigation of Yiyang plants was carried out by using the method of combining route investigation and quadrat investigation, the current situation of plant di-versity level in Yiyang City was analyzed, and the planning content and construction strategy of plant diversity pro-tection in Yiyang City were studied, in order to provide reference for the effective protection of plant diversity in Yi-yang City. The results showed that there were 145 families, 481 genera and 955 species of vascular plants in Yiyang urban planning area; there are 232 species of garden plant resources in the central urban area, belonging to 62 families. 105 genera; the overall level of plant diversity in Yiyang City is general. Urban landscaping relies too much on exotic species, and the utilization rate of native plants in urban gardens is low.

Keywords: plant diversity; plant survey; protection planning; Yiyang city

1. Introduction

With the acceleration of urbanization and the influence of factors such as human activities and environmental changes, species are threatened and species structure is destroyed, resulting in the imbalance of ecosystems and the gradual loss of urban plant diversity [1]. Urban plant diversity is the premise and foundation of urban ecosystem stability, and the level of urban plant diversity has become a symbol of urban ecological environment construction [2,3]. The "National Environmental Protection "Thirteenth Five-Year" Science and Technology Development Plan Outline issued by the Ministry of Environmental Protection in 2016 put forward the planning objectives of the mechanism and mechanism of biodiversity conservation and restoration. "National Garden City Standard" [(2000) No. 106] stipulates that the plant species diversity protection plan within the urban planning area must be prepared separately.

Many scholars have done in-depth research on the investigation and protection of urban plant diversity. Liu [4]. Zhang et al. [5]. Zhang et al. [6] investigated and analyzed the current situation of urban plant diversity, and proposed that plant genetic diversity should be considered. Plant species diversity. Ecosystem diversity plant landscape diversity 4 levels to protect plant diversity planning. Xiang Guohong et al. [7] investigated the species and diversity of garden plants in Yiyang City, and put forward measures for the protection and utilization of urban garden plants; yang Lin et al. [8] still did not make in-depth and perfect research on the application planning of native plants in Yiyang urban park.

The vegetation types within the urban planning area of Yiyang are analyzed. Plant species. The plant characteristics were investigated on the spot, the current situation of plant diversity level was scientifically evaluated, and the planning object of plant

diversity protection in Yiyang City was defined. Purpose. Contents and strategies, and formulated the urban plant diversity protection plan of Yiyang, in order to provide a basis for the effective protection of urban plant diversity in Yiyang, and also provide a reference for the protection planning of plant diversity in other cities. At the same time, it is conducive to further improve the urban plant diversity data of our country.

2. Materials and methods

2.1. Overview of the study area

Yiyang is located in the north of Hunan Province, at 27°58′38″–29°31′42″ north latitude. East longitude 110°43′02″–112°55′48″, across the Dongting Lake area, is Zishui. Yuan river. The area where the Li River flows into the Yangtze River, with developed water systems and abundant water resources (hydropower resources) [9]; yiyang has a subtropical continental monsoon humid climate, with an overall high temperature. It is warm in winter and cool in summer. Precipitation is abundant. July is rainy and disastrous. The sunshine is generally less. Spring is cold, rainy and prominent [10]. The annual average temperature is 16.1–16.9°C, the sunshine is 1348–1772 h, the frost-free period is 263–276 d, and the rainfall is 230–1700 mm. There are various parent materials of soil formation in the territory, including weathered substances of slate shale. River impact. Weathered sandstone, etc. The soil changes from red soil to yellow red soil. Yellow soil changes.

2.2. Research methods

According to the vegetation types and distribution characteristics of Yiyang City, the route survey method is mainly adopted. In some areas, the quadrat survey method is combined with the step-by-step survey along the line. The quadrat survey is carried out in the secondary forest land with dense vegetation, taking the area of 10 m × 10 m shall be investigated and recorded one by one. For the woodland with obvious artificial intervention, the method of treading is mainly used. Focus on Wetlands in urban planning areas. Mountains. Plant varieties of various urban green spaces and scenic woodlands. Rare and endangered plants. Based on the detailed investigation and statistical analysis of ancient and famous trees and exotic plants, and under the guidance of ecology and dendrology, combined with the urban natural conditions and green space system planning of Yiyang City, this paper puts forward the protection planning and construction strategy of urban plant diversity in Yiyang City.

3. Results and analysis

3.1. Investigation results of urban plant diversity in Yiyang city

Families of plants within the urban planning area of Yiyang. Genera are abundant, but plant species diversity is relatively poor. According to the survey results, there are 8 vegetation types and 53 plant formations in Yiyang urban planning area. There are 955 species of vascular plants, 145 families and 481 genera, including 11 families, 13 genera and 14 species of ferns, 9 families, 23 genera and 53 species of gymnosperms, 125 families, 445 genera and 888 species of angiosperms (**Table 1**). Statistical analysis,

seed plant Department of Yiyang City. See **Table 2** for the distribution type statistics of genus. According to statistics, there are 18 families with more than 15 plant species (**Table 3**).

Table 1. Composition of the flora in Yiyang city.

Group	Quantity			Percentage of Hunan/%			Percentage of China/%		
	Family	Genus	Species	Family	Genus	Species	Family	Genus	Species
Fern	11	13	14	23.90	12.26	4.03	-	-	-
Gymnosperm	9	23	53	90.00	69.70	72.60	81.82	48.94	22.36
Angiosperms	125	445	888	62.19	31.47	18.28	37.54	14.16	3.13

Table 2. Afamily of more than 15plants in Yiyang city.

Rank	Family	Latinname	Species	Rank	Family	Latinname	Species
1	Rosaceae	Rosaceae	66	10	Paco	Vitaceae	21
2	Gramineae	Gramineae	48	11	Rubiaceae	Rubiaceae	20
3	Leguminous	Leguminosae	45	12	Pinaceae	Pinaceae	20
4	Lauraceae	Lauraceae	33	13	Euphorbiaceae	Euphorbiaceae	19
5	The composite family	Compositae	32	14	Sangko	Moraceae	18
6	Magnoliaceae	Magnoliaceae	25	15	Rutaceae	Rutaceae	16
7	Theaceae	Theaceae	23	16	Grapevine family	Vitaceae	16
8	Oleaceae	Oleaceae	22	17	Ileaceae	Aquifoliaceae	15
9	Fagaceae	Fagaceae	21	18	Caprifoliaceae	Caprifoliaceae	15

Table 3. Distribution patterns of seed plants family/genera in Yiyang city.

Serial No.	Distribution type	Number of families	Proportion of families/%	Number of genus	Proportion of genus/%	Percentage of Chinese genus/%
1	Widely distributed in the world	37	26.24	36	7.68	34.61
2	Pantropics	51	36.17	90	19.19	28.48
3	East Asia and tropical South America discontinuity	9	6.38	32	6.82	51.61
4	Old World tropics	2	1.42	23	4.90	15.65
5	Tropical Asia to tropical Oceania	3	2.13	23	4.90	15.65
6	Tropical Asia to tropical Africa	1	0.71	14	2.98	9.40
7	Tropical Asia	2	1.42	43	9.17	9.73
8	North temperate zone	22	15.60	64	13.65	30.05
9	East Asia and North America discontinuity	7	4.96	43	9.17	35.00
10	Old world temperate zone	0	0.00	20	4.26	17.54
11	Temperate Asia	0	0.00	4	0.85	7.27
12	Mediterranean sea. West Asia to Central Asia	1	0.71	9	1.92	5.92
13	Central Asia	0	0.00	0	0.00	0.00
14	East Asia	4	2.84	56	11.94	76.71
15	Unique to China	2	1.42	12	2.56	4.67

Total	141*	100.00	469	100

3.1.1. Diversity of urban garden plants

According to the survey, there are 232 species of garden plant resources (including varieties and cultivated varieties) in the central urban area of Yiyang, including 131 local species and 101 exotic plants, belonging to 62 families. 105 genera. There are 70 evergreen trees, 48 deciduous trees, 39 evergreen shrubs, 26 deciduous shrubs, 32 ground cover plants and 15 lianas. There are only 39 tree species and 87 shrub species commonly used in the urban area. From the perspective of family distribution type, the pantropical distribution type family is dominant in the garden plants of Yiyang City, followed by the temperate distribution family.

According to preliminary statistics, there are 124 families, 328 genera, 617 species of native plants in the urban planning area, and only 131 species of native trees in the central urban area of Yiyang. From the analysis of the composition of garden plant species, although the number of native plants slightly accounts for the majority, the number of introduced alien plants accounts for a large proportion. Among the 86 most commonly used garden plants, there are only 30 native garden plants (accounting for 34.88%), and the use quantity is concentrated in the native tree Cinnamomum camphora. Sweet-scented osmanthus. Duying, etc.

3.1.2. Diversity of ancient and famous trees

Yiyang City has superior natural conditions and many ancient and famous trees. According to statistics, there are 126 ancient and famous trees of all kinds in the built-up area, belonging to 12 families, 12 genera and 12 species. Among them, there are 73 camphor trees, accounting for 57.94%. There are 2 national second-class ancient trees over 300 years; there are 2 ginkgo trees growing for more than 200 years. Camphor 8. South wild jujube 4 plants, a total of 14 plants; there are 110 trees aged 100–200 years, accounting for 87.3%.

3.1.3. Diversity of rare and endangered plants

There are five national first-class species of rare and endangered protected plants in Yiyang City. There are 19 species at the national level. There are 44 species of wild plants under local key protection. Among them, Cycas revoluta thunb. Is a national first-class protected plant. Ginggo biloba L. Bretschneidera sinensis. Davidia involucrata baill. Metasequoia glyptostroboides Hu and w.c.cheng; the secondary protected plants are mainly Cephalotaxus oliveri mast. Fokienia hodginsii (Dunn) Henry et Thomas, et al. ; among the local key protected wild plants, there are 8 species of gymnosperms and 38 species of angiosperms.

3.1.4. Exotic plants and their impact on plant diversity

The main alien invasive plants that have been distributed in Yiyang City are Eichhornia crassipes. Alternanthera philoxeroides. Polygonum multiflora. Rumex japonicus. Erigeron annuus (L.)Pers. Wild chrysanthemum (Crassocephalum crepidioides). Conyza canadensis (L.) Cronq. About 20 species such as Phytolacca acinosa. Some plants such as Pennisetum. Water hyacinth. Granna and others have strong adaptability, even in barren dry land. River beach. Wasteland can also occupy the growth space of native plants and breed in large numbers. It grows well.

3.2. Protection planning of urban plant diversity

3.2.1. Guiding ideology of urban plant diversity protection planning

According to the current characteristics of vegetation in Yiyang City, the basic principle of giving priority to on-site protection, supplemented by ex situ protection, is to focus on the protection of Yiyang urban wetlands. Zonal forest vegetation. Old and Famous Trees. Rare and endangered plants and scenic woodlands of special value, while enriching the plant landscape of Yiyang City. Protection planning mainly includes plant diversity habitat protection planning. Hierarchical protection planning. Development, utilization and introduction planning of urban native plants. Rare and endangered plants and ancient and famous trees protection planning four aspects of planning and construction strategies, forming a nature reserve. Forest Park. Scenic Attraction. A multi-level urban plant diversity protection network system composed of nature reserves and ancient and famous trees gives full play to the ecological and service functions of plant diversity.

3.2.2. Urban plant diversity protection planning objectives

The overall goal of the plan is to improve the level of plant diversity in the urban planning area of Yiyang, coordinate the proportion of urban landscaping plants, stabilize the plant community structure, enrich the landscape content, and build Yiyang into an urban biodiversity structure with reasonable structure. A national garden city with sustainable and healthy development. National Forest City and national ecological garden city.

3.2.3. Overall layout of urban plant protection planning

According to the distribution of natural resources and cultural and historical resources in the urban planning area of Yiyang City, the plant diversity protection in the urban planning area will be based on vast mountains and dense forests. Based on the widely distributed water system and farmLand, a plant diversity protection network system covering the whole planning area will be formed, and efforts will be made to create “mountains”. Water. Forest. The protection space structure of the integration of “city” finally forms the “four water and four belts”. Five lakes and Six Mountains.The spatial protection pattern of “multiple corridors and multiple points” (**Figure 1**).

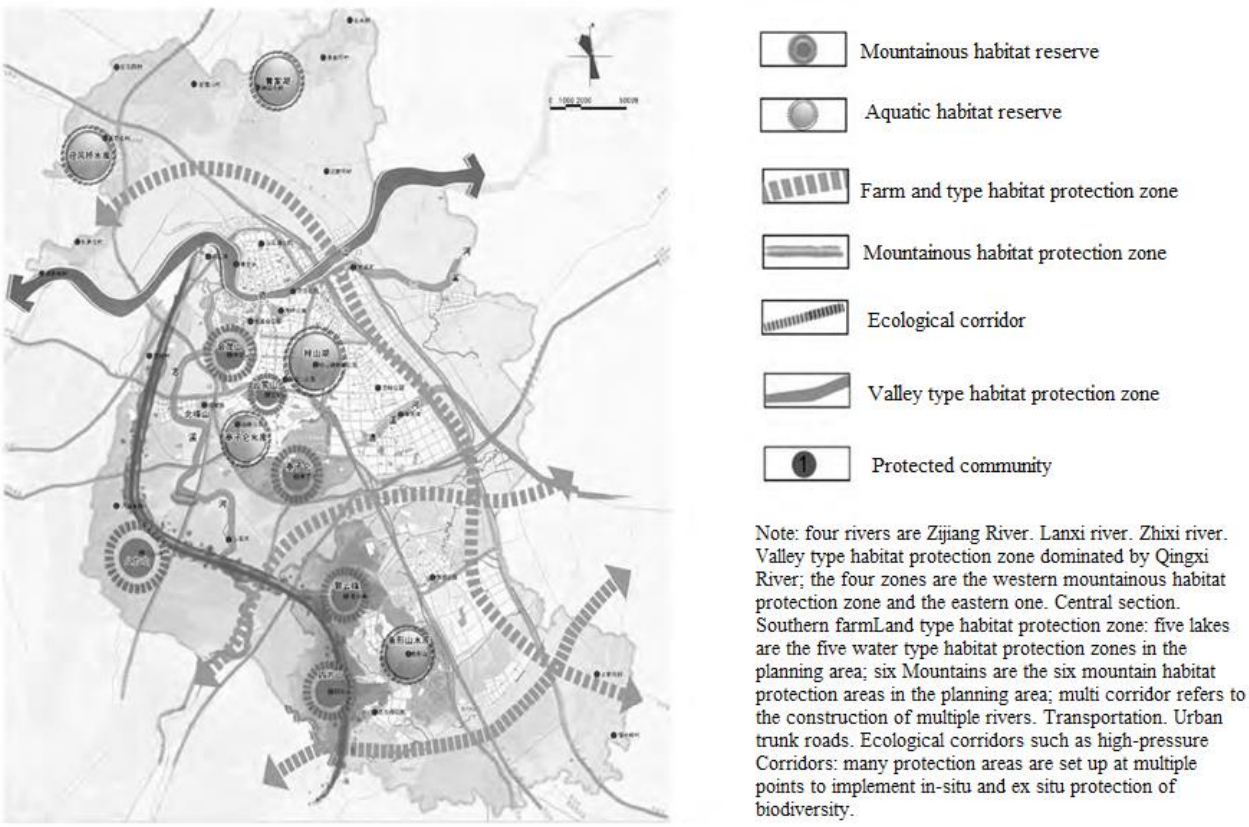

Figure 1. Landscape protection pattern of Yiyang city.

3.2.4. Contents of plant diversity protection planning

1) Plant diversity habitat protection planning. The protection of plant diversity habitat mainly adopts the combination of protection and restoration. In "four water and four belts". Five lakes and Six Mountains. Under the guidance of the overall spatial pattern planning of "multi corridor and multi-point" habitat, the plant diversity protection within the planning area mainly completes the specific habitat protection work through a large number of conservation areas. According to the distribution of plant resources around. Ecological sensitivity and importance, a total of 36 conservation areas are planned, including 25 in the suburbs. There are 11 in the central urban area (**Table 4**). Combined with urban landscaping in Yiyang City. According to the current situation of forest vegetation and landscape, the plant diversity protection in Yiyang urban planning area is divided into natural ecosystem protection according to the characteristics of plant diversity and regional nature and function. There are three types of artificial ecosystem protection and wetland ecosystem protection, with a total of 7 key protection types. See **Table 5** for specific division and functions. According to the actual situation of Yiyang's habitat, its habitat restoration and protection are mainly concentrated in two types: Wetlands and forests. Restoration and protection of wetland habitat. Specific restoration measures include: strengthening the protection of natural wetlands. Vigorously promote the ecological restoration of degraded wetlands. Promote the rational utilization of wetland resources. Comprehensive restoration using diversified technologies. According to the types and grades of forest damage in Yiyang planning area, as well as the planning and design ideas of forest landscape restoration, the main restoration measures for forest habitat

restoration are proposed: artificial restoration technology. Artificially promote forest vegetation restoration technology. Natural forest restoration technology. 2) Plant diversity protection level planning. The hierarchical protection planning of plant diversity in Yiyang mainly includes: species diversity. Genetic diversity. Ecosystem diversity and landscape diversity protection planning [11]. A. Species diversity protection. On the basis of protecting the existing 955 tree species, it is planned to develop to 1000 species in the short term, 1200 species in the long term and 1400 species in the long term. Native trees are the main species, and exotic plants with similar zonal characteristics are appropriately introduced to enrich plant types. In addition, coordinate the allocation proportion of urban garden plants, such as the proportion of coniferous and broad-leaved plants in the reference flora, and combined with the landscape effect of garden plant community, the number ratio of gymnosperms to angiosperms is planned to be 2:8. B. Genetic diversity protection. At present, there are only 232 species of garden plants in Yiyang City, and a large number of available garden plants are in wild state. The application of new varieties in gardens is also rare. Through the establishment of Yiyang excellent native plant germplasm resources conservation. Breeding bases or gene banks should take the construction of botanical gardens as the main measure to systematically collect and preserve native plant germplasm resources and strengthen the protection of genetic diversity. C. Landscape diversity protection. The protection of landscape diversity is mainly the protection of plant community diversity. Fully respect the natural landscape pattern of Yiyang City, protect and restore the natural combination of various ecosystems in Yiyang City; fully absorb the regional cultural characteristics of Yiyang, excavate and utilize the historical and cultural heritage, pay attention to the construction of the characteristic plant landscape of the characteristic cultural scenic spots (areas), and build the garden green space with the local characteristics of Yiyang, so as to better combine the plant landscape with the urban regional landscape. At the same time, we should vigorously promote the maple forest. Rhus chinensis shrub. Mountain awn grass. There are 11 typical natural plant community types such as fern bushes. D. Ecosystem diversity protection. The protection of ecosystem diversity within the urban planning area mainly includes wetlands. Forest. FarmLand and urban gardens are four types of ecosystems. Different protection measures should be taken for different ecosystems. For example, the protection of wetland ecosystem diversity mainly adopts strengthening the protection of wetlands in key areas and the treatment of surrounding environment, and establishing wetlands and land nurseries. For the urban garden ecosystem, the urban biodiversity protection base system is mainly established through the park construction.

Table 4. Plans for the planning of urban planning areas in Yiyang city.

Serial No.	Name	Site	Protected object	Serial No.	Name	Site	Protected object
Outlying suburbs							
1	Xinhuayuan Village	Pingkou town	Camphor tree. Toona sinensis. Taxus chinensis var. Mairei. Nanmu. Podocarpus. Red cabinet wood. Sweet-scented osmanthus. Citrus	14	Sifang mountain	Heshan District	Subtropical Evergreen Broad-leaved Forest
2	Xinwushan Village	Changchun Town	Camphor tree. Taxus chinensis var. Mairei. Toona sinensis. Podocarpus. Red cabinet wood. Sweet-scented osmanthus. Crape myrtle. Citrus	15	Fish shaped mountain	Heshan District	Subtropical Evergreen Broad-leaved Forest
3	Beishilun Village	Changchun Town	Podocarpus. Sweet-scented osmanthus. Crape myrtle. Camphor tree. Zelkova schneideriana. Toona sinensis. Taxus chinensis var. Mairei	16	Biyunfeng	Heshan District	Subtropical Evergreen Broad-leaved Forest
4	Lijiaping Village	Guoluping town	Podocarpus. Sweet-scented osmanthus. Crape myrtle. Citrus. Camphor tree. Zelkova schneideriana. Toona sinensis. Taxus chinensis var. Mairei. Red cabinet wood	17	Zhaizilun	Heshan District	Subtropical Evergreen Broad-leaved Forest
5	Yongxing	Beizhouzi town	Sweet-scented osmanthus. Crape myrtle. Taxus chinensis var. Mairei. Citrus. Camphor tree. Zelkova schneideriana. Toona sinensis	18	Huilong mountain	Heshan District	Subtropical Evergreen Broad-leaved Forest
6	Guoluping Village	Guoluping town	Camphor tree. Toona sinensis. Podocarpus. Red cabinet wood. Sweet-scented osmanthus. Crape myrtle. Citrus	19	Bafangshan	Heshan District	Subtropical Evergreen Broad-leaved Forest
7	Huanghualun Village	Yingfengqiao town	Camphor tree. Zelkova schneideriana. Taxus chinensis var. Mairei. Toona sinensis. Podocarpus. Red cabinet wood	20	Yunwu Mountain	Heshan District	Subtropical evergreen broad-leaved forest. Scenic forest
8	Changmaolun Village	Xinqiaohe town	Camphor tree. Zelkova schneideriana. Toona sinensis. Taxus chinensis var.mairei	21	Zhixi River	Heshan District	Wetland ecosystem

3.3. Urban plant diversity protection planning and construction strategy

3.3.1. Development and utilization of urban native plants

The development and utilization of native plants mainly take the nursery as the platform through excavation. Try planting. Screening and promotion of greening tree species increased year by year. For good growth. The ornamental effect is better. At present, the native plants in the wild state need to strengthen the domestication work and domesticate them into greening plants in urban gardens as soon as possible. Like palm wood. Castanea henryi. Catalpa. 39 kinds of native plants such as Chou La tree are the key domestication objects. The number of native plants in the planned garden has increased from 121 to 565, making the proportion of native plant species from 52.16% to 80.00%.

3.3.2. Introduction and application of exotic plants in urban gardens

According to the composition status of urban greening plant species in Yiyang City and the overall planning indicators of garden plants, on the premise of taking native plants as the main body, the absolute number of exotic plants should be appropriately increased, from the current 101 species to 135 species, and the

proportion of the total number should be reduced from the current 47.84% to 20.00%. On the basis of stabilizing the foreign plants that have been used in the urban landscaping of Yiyang at present, more than 30 kinds of foreign plants are selected as the key introduction and domestication objects, including micheliacrassipes. Micheliafloribun-da. Cinnamomumjaponicum. Machi-lusthunbergii. Machiluspauhoi. Phoebezhennan. Berberisthunbergii 'aurea'. Berberisthunbergiivar.atro-purpureachenault. Berberisvirgetorum. Mahoniabealei, et al.

3.3.3. Contain the invasion of harmful plants

In order to curb invasive plants, protect the local natural ecological environment and maintain the diversity of zonal species, the following measures are mainly taken:1) ecological substitution method is used to curb invasive alien species. According to the way of alien plant invasion, plant one or more plant species with high ecological security, such as local dominant species or natural enemies, to occupy the niche of invasive plant species. 2) Establish a defense system against alien invasive species. According to the basic laws and characteristics of plant invasion, corresponding control strategies should be adopted for alien invasive species: the plant inspection and quarantine department should strictly monitor, and those engaged in the introduction work should be cautious, which should be fully carried out before introduction. Scientific evaluation and prediction. Establish alien invasive plant database and alien species monitoring system, and prepare long-term management plan for invasive species. 3) Vigorously eradicate invasive pests. Biological control should be adopted for the invasive pests. Low pollution chemical prevention and control. Mechanical eradication and other methods. 4) Strengthen publicity and improve the public's concept of ecological security.

Table 5. Classification of biodiversity reserves in urban planning areas in Yiyang city.

Type	Classification	Content	Maincarrier
Natural ecosystem	Secondary forest vegetation reserve	Shrubs. Secondary bare land. Well preserved secondary vegetation of units, etc	Biyunfeng. Sifang mountain. Fish shaped mountain, etc
	Forest Park. Ecological reserve. Scenic forest	Surrounding suburban scenic spots. Forest Park. Country parks. Scenic forest, etc	Huilongshan. Yunwu Mountain. Zishan Lake Park. Zishan lake water conservation area, etc
	Old and Famous Trees	Ancient trees with more than 100 years and famous trees with human history and their habitats	Ancient and famous trees within the planning area
Axliricial ecosystem	Urban green space reserve. Suburban plantation reserve	Artificial vegetation and plant landscape of urban park green space, timber forest. Economic forest. Fruit forest, etc	White Horse Lake Park. Xiufeng park. Huilongshan park. Zhaizilun. Sifang Park and other large comprehensive parks
	Scientific research. Teaching. Production base reserve	Botanical Garden. Arboretum. Nursery. Flower beds. Grass nursery. Medicine garden. Tea garden. Orchards. Introduction Experimental Base	Botanical garden and introduction base
Wetland ecosystem	Natural wetland	Including marshland. Lakes. Rivers, etc	Huangjia lake. Zijiang. Zhixi river. Lanxi river. Qingxi River and its banks
	Constructed wetland	Including the pond. FarmLand. Reservoirs, etc	Fish shaped mountain reservoir. Zishanhu reservoir. Yingfengqiao reservoir, etc; A large number of farmLand on the outskirts of the urban area

3.3.4. Protection planning and construction of rare and endangered plants and ancient and famous trees

1) Protection of rare and endangered plants. The protection of rare and endangered plants in Yiyang City as a whole is in an unstable state. Its wild rare plant resources are seriously damaged, and many wild plants have been in an endangered state. Therefore, the protection of rare and endangered plants is extremely urgent, mainly to establish natural reserves (small) as a national. Supplement the provincial protected areas and improve the multi-level protection system; accelerate the construction of botanical gardens and introduction bases, establish germplasm bases, and implement ex situ conservation; establish a monitoring system, carry out research on the restoration of endangered species and other measures to promote the protection work. 2) Focus on the protection of ancient and famous trees. Ancient and famous trees are precious cultural relics with life and national culture. The symbol and evidence of a long history and ancient civilization [12]. Protecting famous and ancient trees also protects the gene pool of rare species resources and biodiversity. Its work is important for studying natural history and cultivating native tree species in the future. Breeding excellent varieties is of great significance [13]. The plan focuses on the protection of 126 ancient and famous trees with a tree age of more than 100 years in the urban area. File and monitor ancient and famous trees one by one, diagnose the reasons for the growth or population decline of plants, and protect and restore them in time.

4. Conclusion and discussion

Strengthening the construction of urban ecological environment is the key to improve the level of plant diversity. China is not perfect in the field of plant diversity protection planning, and efforts are still needed in urban plant diversity level investigation and protection planning. Based on the investigation of the level of plant diversity in Yiyang City, the statistics and analysis of plants in the urban planning area of Yiyang City were carried out. The results showed that Yiyang City was rich in plant resources and the families of plants. Genera are relatively abundant, but plant species diversity is relatively poor. The application of native tree species is relatively limited, which fails to fully reflect the characteristics of local plants. In formulating plant diversity protection planning and construction strategies according to the current situation, we should strive to form the carrier of plant diversity, formulate habitat protection strategies, improve the hierarchical protection planning system, establish and improve the ex situ protection network of rare and endangered animals and plants, protect genetic resources, increase the number of species, improve the level of plant diversity, provide rich germplasm resources for urban landscaping, and provide data basis for floristic plant research, Provide reference for the construction of national garden city.

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