

## PLANT COMMUNITY INVESTIGATION AND LANDSCAPE OPTIMIZATION DESIGN IN RURAL BULGARIA

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### Abstract

The problem of rural development in Bulgaria is urgent because of the gradual decline of rural population loss and ageing. The development of rural tourism was seen as an appropriate way to revitalize the Bulgarian countryside. The quality of plant community landscape is very important to the development of rural tourism. Plant community has an ecological function, aesthetic function and genetic value, so it is of great value to design plant landscape that takes an aesthetic function and ecological function into consideration. In this study, the "Braun-Blanquet" investigation method was adopted to record the data of the 4 most common types of plant habitats (roadside, residential courtyard, waterside and forestland) in the countryside through field investigation in the Bulgarian countryside. Firstly, the species composition of the whole plant community was analyzed, then the landscape evaluation of each habitat was carried out and the optimal design strategy was proposed. Finally, according to the results of landscape analysis, referring to the plant community structure of high landscape quality in each habitat, the optimization pattern of plant community was proposed to provide a reference for optimizing rural landscape and depositing tourism development in Bulgaria.

**Keywords:** Bulgaria, Landscape pattern design, rural plant community.

### INTRODUCTION

With the emergence of problems such as the loss of rural population, unemployment and ageing in Bulgaria, rural revitalization is extremely urgent. Due to the national and regional characteristics of rural areas, rural tourism is highly diversified nationwide, which has a positive impact on the development of specific villages and micro-regions (Nikolova, 2012). Rural tourism is helpful for the revitalization of the Bulgarian decadent regions to some degree (Vázquez et al., 2005). Bulgarian rural tourism is facing strong demand for the promotion of both national and international tourism (Georgiev et al., 2003). It is particularly important to improve the rural landscape style since rural landscape style is an important resource of rural tourism. In terms of a rural landscape, plants, as individuals with the meaning of life, not only witness the development and succession of a rural landscape but also reflect the regional characteristics and cultural characteristics of rural landscape (Wang, 2017). In this case, the optimization of rural plant landscape is one of the key methods to optimize the rural landscape, and thus to promote Bulgarian rural tourism.

Plant communities have multiple functions and potential values, such as ecological functions (microclimate improvement, air purification, soil and

water conservation, soil fertility enhancement, etc.), aesthetic functions (improving landscape quality), and genetic values (Edwards and Abivardi, 1998). Plant communities generally develop from simple to complex status. Complex communities are found with high species diversity and high ecological values (Song, 2001). The design method based on plant community is of great value in plant community design (Wang et al., 2017). In essence, landscape design could be regarded as the ecological design of a specific area, and the ecological principle is the core of landscape architecture. Landscape design is the design of human ecosystems (Yu et al., 2001).

Currently, researches on Bulgarian rural plants mainly focus on plant physiology and agricultural sciences (Cholakova et al., 2018; Zapryanova and Hristozova, 2018; Krustev et al., 2018; Zhalnov et al., 2018; Christova et al., 2018). Few studies on plant ecological landscape were published. Therefore, this study analyzed the status quo of the rural plant community in Bulgaria and then carried out landscape optimization design for the rural plant community under the premise of ensuring the ecological value of the habitat. Finally, the landscape patterns of plant communities in different habitats were proposed for practical application.

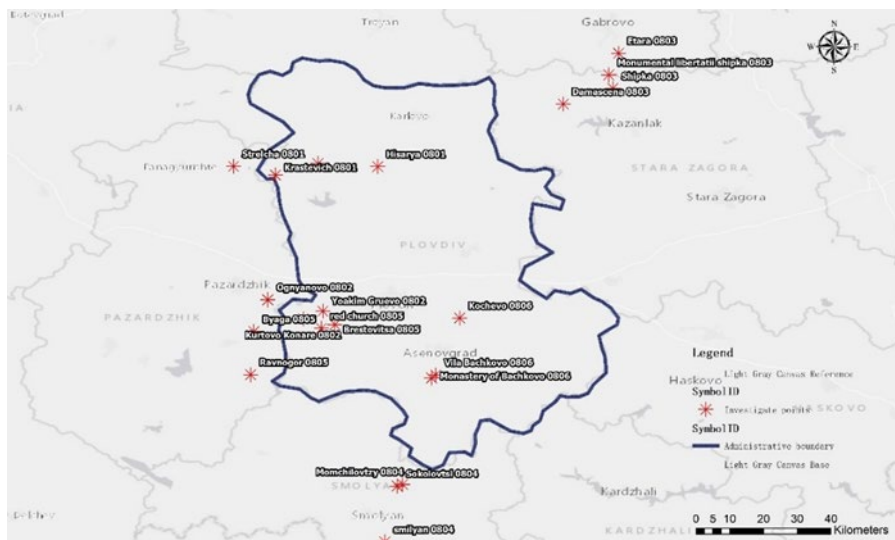


## METHODS

### Study area

Situated on the plain of Thrace in central Bulgaria, Plovdiv is one of the oldest cities in Europe and now is the second largest city in Bulgaria. Historically Plovdiv is a fertile agricultural area, so the rural Plovdiv has a certain degree of

universality and representativeness. The investigation was conducted within 16 villages and towns around Plovdiv: Strelcha, Krastevich, Hisarya, Yoakim Gruevo, Ognyanovo, Kurtovo, Etara, Shipka, Sokolovtsi, Smilyan, Momchilovtsi, Brestovitsa, Byaga, Ravnogor, Kochevo and Bachkovo.



**Fig. 1.** Distribution of investigated villages and towns around Plovdiv

### Location

Plovdiv has a humid subtropical climate with considerable humid continental influences. There are four distinct seasons with large temperature jumps between seasons. The total rainfall is 540 mm, evenly distributed throughout the year. The summer season lasts for 3.3 months, from 3 June to September 14, the daily average temperature more than 26°C. Winter festival lasts for 3.5 months, from November 24 to March 6, the daily average temperature below 10°C. Although it is located in the middle of a rich agricultural region, Plovdiv's economy has shifted from agriculture to industry since the beginning of the 20th century.

### Investigation content

A comprehensive sociological survey of plant communities was carried out using the "Braun-Blanquet" method of plant ecology (Bai, 2011). Because the community distribution in the village is scattered and the patch shape and area are different, the sample is set according to the specific boundary of the community (building, courtyard, road, river, etc.). According to the research needs and the specific characteristics of the rural plant community structure, each community sample is divided into vertical layer 1 (T1), 2 (T2), shrub (S) and herb (H). Trees with a height greater than 8 m

are included in the T1 layer, and trees less than 8 m are included in the T2 layer. Record the maximum height and total coverage of each layer. The plant species, number, average DBH (DBH, cm), maximum height and average height (H, m), average crown width (CW, m), crown type, and multi-cover were recorded for the arbour layer. For shrub and herb layers, record the name, maximum height (H, m) and multiple coverages of each species. The herb layer is randomly set with three 1m\*1m squares, and the height and coverage of each species are averaged as the height and coverage of the species in the whole plot. The multi-coverage is expressed in the Braun-Blanquet multi-coverage rating, and the coverage is estimated without subtracting the gap between the branches and leaves. The arbour layer, shrub layer and herb layer are divided according to the qualitative and quantitative criteria of urban plant survey summarized by Zhao Juanjuan et al. (2009). The seedlings of trees and shrubs are included in the layer where the height is located. The growth status of trees in the arbour layer and shrub layer was evaluated, and the growth potential of the trees was evaluated according to the physiological characteristics of the stems, branches and leaves of the plants. With reference to Citygreen's criteria, a tree growth status grading standard was

established, and plants with good, good, average, poor, and poor growth were rated 5-1. The average performance score (APS) is used to describe the growth potential of the entire community, which is equal to the sum of the growth scores of all trees in the community divided by the number of trees (Chen and Zhang, 2004). At the same time record the habitat characteristics of the plot, including slope direction, water conditions (sorghum, flat, low wetland, aquatic land), light conditions, surface coverage (grass, soil/bare land, litter, gravel/hard Ground paving, garbage), the surrounding environment of the community. In addition, the community plan will be drawn down, and the community number, north arrow, relative position of all plants, name and other information will be marked as a supplementary description of the information that is inconvenient to describe the text in the sample.

According to the research of existing scholars, the rural plant habitats are divided into four categories: waterside, residential courtyard,

forestland and roadside (Xia, 2018). The research is mainly in the interior of rural settlements and its surrounding environment. Most of the farmland is distributed in the periphery of the village. There is almost no large-scale farmland in the village (there are some vegetable fields in the courtyard), so the farmland is not divided into one category. In the 4 types of habitats, the waterside mainly refers to the village rivers and the plant communities around the lake; the residential courtyard refers to the environmental plant communities in the residential yards in front of and behind the house; the forestland refers to the landscape forests and the economic forests within the village; The roadside refers to the plant community on the main road or the branch road. According to the different conditions of each village, choose different numbers of plant community plots. A total of 137 plant communities in 4 types of habitats were investigated. The distribution of the sites for each habitat type is shown in Table 1.

**Table 1.** Number of investigated sites for four habitats

Habitat types	Residential courtyard	Waterside	Forestland	Roadside
Number of sites	45	17	27	48



**Fig. 2.** Four habitats investigated in villages(2-1 residential courtyard, 2-2 waterside, 2-3 forestland, 2-4 roadside). Note: photographs taken by authors

## RESULTS AND DISCUSSION

### Overall results

#### Family composition

Among the 137 plots investigated, a total of 219 species, 198 genera and 75 families were recorded, and the number distribution of plant species was ranked as shown in Table 2.

Five families with more than 10 species in the surveyed plants, a total of 68 genera and 79 species were found, accounting for 34.3% and 36.1% of the total genera, respectively. Two families with 6-9 species, a total of 13 genera and 15 species were identified, accounting for 6.6% and 6.8% of the total genera, respectively. It is found that 33 families have 2-5 species, a total of 82 genera and 90 species, accounting for 41.4% and 41.1% of the total genera, respectively. The

remaining 35 families were found with only one species (see Table 3).

The families with more than 10 species are Compositae, Rosaceae, Lamiaceae, Gramineae, and Leguminosae, accounting for 6.7%, 34.3% and 36.1% of the total families, genera, and species, respectively. Among them, Asteraceae is mainly weeds and partial garden ornamental flowers; Rosaceae is mainly fruit trees and some weeds planted in the courtyard; all Lamiaceae are weeds; Poaceae is mainly weeds and some turfgrass. Large deciduous trees, crops and some weeds were found in the Fabaceae family. Most of these dominant species are widely distributed in the world, thus cannot represent the characteristics of the flora of the region. It is found that Pinaceae, Cupressaceae, Fagaceae, Ulmaceae, Sapindaceae,

Betulaceae, Oleaceae, Bignoniaceae and Tiliaceae are common, and the widely used species are *Robinia pseudoacacia*, *Sophora japonica*, *Pinus thunbergii*, *Picea asperata*, *Celtis sinensis*, *Acer saccharinum*, *Tilia tuan*, *Betula platyphylla*, *Fraxinus chinensis*, *Platycladus orientalis*, *Esculus hippocastanum*, *Quercus acutissima* and *Castanea mollissima*.

#### Plant life forms

As shown in Table 4, among the 218 species identified as the most common in Bulgarian rural plant communities, 136 species were herbaceous, accounting for 63.5%. Among them, the major one

is annual and biennial herb, a total of 67 species, mainly of which are natural invasive weeds and less artificially cultivated ornamental species. The second most common species is an arbour, a total of 42 species. They are mainly deciduous trees, about 4 times of evergreen trees. 27 species of shrubs totally were found. Deciduous shrubs more than evergreen shrubs, and most of them are Rosaceae ornamental shrubs. Few are naturally growing. Besides, 2 species of ferns, 4 species of aquatic or marsh plants and 11 kinds of lianas were identified.

**Table 2.** Family and species compositions of the plants

Family	Genus/ species	Family	Genus/ species	Family	Genus/ species	Family	Genus/ species	Family	Genus/ species
Compositae	18/21	Caprifoliaceae	3/3	Geraniaceae	2/2	Ginkgoaceae	1/1	Verbenaceae	1/1
Rosaceae	14/21	Malvaceae	3/3	Plantaginaceae	2/2	Grossulariaceae	1/1	Cannabaceae	1/1
Lamiaceae	13/13	Scrophulariaceae	3/3	Araliaceae	2/2	Aquifoliaceae	1/1	Typhaceae	1/1
Poaceae	12/12	Euphorbiaceae	3/3	Boraginaceae	2/2	Celastraceae	1/1	Rubiaceae	1/1
Fabaceae	11/12	Brassicaceae	3/3	Onagraceae	2/2	Buxaceae	1/1	Primulaceae	1/1
Apiaceae	8/9	Apocynaceae	3/3	Crassulaceae	2/2	Simaroubaceae	1/1	Equisetaceae	1/1
Amaranthaceae	5/6	Vitaceae	2/3	Papaveraceae	2/2	Ebenaceae	1/1	Osmundaceae	1/1
Campanulaceae	5/5	Fagaceae	2/3	Adoxaceae	1/2	Phytolaccaceae	1/1	Orobanchaceae	1/1
Pinaceae	4/5	Salicaceae	2/2	Ranunculaceae	1/2	Potamogetonaceae	1/1	Violaceae	1/1
Convolvulaceae	4/4	Juglandaceae	2/2	Platanaceae	1/2	Aristolochiaceae	1/1	Asparagaceae	1/1
Caryophyllaceae	4/4	Ulmaceae	2/2	Sapindaceae	1/1	Portulacaceae	1/1	Araceae	1/1
Polygonaceae	3/4	Moraceae	2/2	Tiliaceae	1/1	Oxalidaceae	1/1	Balsaminaceae	1/1
Solanaceae	3/4	Bignoniaceae	2/2	Betulaceae	1/1	Zygophyllaceae	1/1	Iridaceae	1/1
Oleaceae	3/3	Hydrangeaceae	2/2	Aceraceae	1/1	Lythraceae	1/1	Cucurbitaceae	1/1
Cupressaceae	3/3	Berberidaceae	2/2	Hippocastanaceae	1/1	Urticaceae	1/1	Piperaceae	1/1

**Table 3.** Number and proportion of Bulgarian plant families

Category	Families with 1 species	Families with 2-5 species	Families with 6-9 species	Families with >10 species
Family (genus/species)	35 (35/35)	33 (82/90)	2 (13/15)	5 (68/79)
Proportion	46.7 (17.7/16.0)	44 (41.4/41.1)	2.7 (6.6/6.8)	6.7 (34.3/36.1)

**Table 4.** Life forms of plants in Bulgarian villages

Life forms	Bulgarian countryside vegetation		
	Types	Species	Proportion (%)
Arbors	Deciduous trees	33	19.2
	Evergreen trees	9	
Shrubs	Deciduous shrubs	22	10.0
	Evergreen trees	5	2.3
Herbs	Biennial herbs	67	60.7
	Renascent herbs	63	
	Ferns	2	1.0
	Aquatic or marsh plants	4	1.8
Liana	Liana	11	5.0
Total		219	100



### Habitat of a residential courtyard

Residential courtyards are areas most closely related to people's daily lives. Plant communities in residential courtyard and village plant communities often regarded as nested, and their functions are mainly reflected on the environmental improvement, economical production and wind reduction (Xia, 2018). Most of the plant communities in Bulgarian residential courtyards still maintain its traditional rural style, but most of them exert a huge space for the improvement of the landscape quality.

#### Common plant composition

In terms of fruits and vegetables, *Vitis vinifera* is the most frequently occurred. It is found in more than half of the courtyard, with vigorous growth. Some garden grape racks are established outside the courtyard, forming a street tree landscape. Common garden fruits are *Rubus idaeus*, *Cerasus pseudocerasus*, *Juglans regia*, *Prunus salicina*, *Malus pumila*, *Amygdalus persica* and *Ficus carica*, which are rich in seasonal changes. Vegetables are mainly *Lycopersicon esculentum*, *Cucumis sativus*, *Capsicum annuum*, *Foeniculum vulgare*, *Cucurbita moschata*, *Lablab purpureus* and *Solanum melongena*. Most vegetables are grown in the open air, while a small part of them are grown in greenhouses. A large number of ornamental plants are grown in rural courtyards, the most common of which are *Rosa rugosa*, *Calendula officinalis*,

*Platycladus orientalis* and *Dahlia pinnata*. *Tagetes erecta*, *Buxus sinica*, *Hydrangea macrophylla*, *Syringa oblata*, *Hosta plantaginea*, *Picea asperata*, *Oenothera biennis*, *Campsis grandiflora* and *Mentha canadensis* are common as well.

#### Landscape evaluation

According to plant community composition, the residential courtyard can be categorized as productive and ornamental types.

The first one is productive habitat (Fig. 3-a). Plants mainly include fruit trees and vegetables, a small number of flowers, and no large trees and shrubs. This type of plant community is simple, leading to low community stability; the vertical structure is relatively monotonous, resulting in a low canopy closure; the general aesthetic value of this type of courtyard is low; its ecological value is not high either, due to the interference of human farming.

The second type is ornamental (Fig. 3-b). Ornamental courtyards are mostly composed of some flowers and garden ornamental trees, few large trees. The layer of plant communities is relatively simple. Moreover, most plants in this habitat only show the beauty of individual plants rather than the aesthetics of the overall plant community. Large areas of lawns with big size are found in some courtyards, but their ecological value is lower than the complex plant community.



Fig. 3. Productive (3-a) and ornamental (3-b) residential courtyard (Taken by authors)

### Habitat of waterside

Rivers and streams in villages were once the main sources of water for villagers' daily life. Plant habitats on both sides of the river have various ecological environment improvements and landscape building functions such as improving species diversity, controlling soil erosion, effectively filtering pollutants, providing habitats for living organisms, and constructing waterfront scenery (Zhou and Xu, 2012).

How to protect and improve the ecological and landscape functions of waterside habitat is what we focused on.

#### Common plant composition

The waterside habitats are almost unattended, and the natural growth of herbaceous plants

accounts for a large proportion. Main large trees are *Salix babylonica*, *Tilia tuan*, *Paulownia fortunei* and so on. Small trees and fruit trees include *Celtis sinensis*, *Malus pumila*, *Cerasus pseudocerasus*, *Prunus salicina*, and the like. Shrub species are fewer. Main shrubs are *Syringa oblata*, *Rubus idaeus*, *Rubus parvifolius*, *Ribes janczewskii*, *Sambucus williamsii*, *Chaenomeles speciosa* and so on. The highest frequency of herbaceous plants is *Phragmites australis*, *Mentha canadensis*, *Plantago depressa*, *Urtica fissa*, *Lythrum salicaria*, *Trifolium repens* and *Trifolium repens*.

#### Landscape evaluation

Waterside habitats are very complex and cannot be generalized (Fig. 4-a,b,c,d,e). Even in the summer, the water level is relatively shallow,

which ensures the safety of waterside activities. People always like to be close to the water and have long existed as a regularity (Yan et al., 2001). However, the accessibility of waterside habitats in the country is generally low. At present, the relationship between plant communities at the waterside and residents' lives is weakened, and people rarely move along the water's edge. Therefore, although the waterside plant community

looks natural, it is actually disorderly, lacking of landscape beauty. In open vision habitats, community layer is single. Plants are mainly weeds, people are difficult to get close to the water. And the ecological value of the plant community is low. Habitats with closed vision are rich in community layer and have high ecological value, but people are hard to get close to water.



Fig. 4. Photos of waterside scenes (Taken by authors)

#### Habitat of forestland

Forestland is a relatively large area of blocky plant communities in rural areas. It is mainly the landscape forestland in the village, and some are natural forestland. Landscaped forestland is usually located in the public green space of the village, providing space for the villagers. Natural forestland is usually located on the edge of the countryside, preventing wind and consolidating soil, improving environmental quality and providing habitat for wild animals (Xia, 2018).

#### Common plant composition

The highest frequency arbour species in the forestland habitats are *Tilia tuan*, *Picea asperata*, *Fraxinus chinensis*, *Betula platyphylla*, *Aesculus hippocastanum*, *Acer saccharinum*, *Robinia pseudoacacia*, and *Platycladus orientalis*. The plant community is rich in community layer, and the vertical structure contains arbour shrub herb. In the landscaped forestland, ornamental shrubs such as *Ligustrum quihoui*, *Hibiscus syriacus*, *Lonicera fragrantissima*, *Forsythia viridissima*, *Syringa oblata*, *Chaenomeles speciosa* and *Spiraea salicifolia* have appeared. Fewer shrubs are growing in natural forestland, they are *Ribes*

*janczewskii* and *Rubus idaeus*. The most frequently occurring herbaceous plants are *Portulaca oleracea*, *Chenopodium album*, *Taraxacum mongolicum*, *Cynodon dactylon*, *Polygonum aviculare*, *Plantago depressa*, *Trifolium repens*, *Geranium wilfordii*, *Lolium perenne* and *Oxalis corniculata*.

#### Landscape evaluation

Overall, forestland has the highest landscape quality in all habitats (Fig. 5-a,b,c,d). In traditional villages, forestland mainly exists in the form of natural forestland. Natural forestland has higher ecological value than landscape forestland and also has certain natural aesthetic value. The planting methods of natural forestland are more natural, the species are diverse, the proportion of native tree species is also higher. In addition, community stability was better with a longer development time. The landscape forestland is more focused on the use of people, providing more suitable activity space for the villagers. But the rural situation is not fully considered during construction, resulting in poor community stability, which in turn increases the cost of maintenance.



Fig. 5. Forestland habitats of investigated Bulgarian villages (Taken by authors)

#### Habitat of roadside

Roadside habitats are important green corridors in rural ecosystems. Their main functions

include ecological pathways, pollution isolation, and landscape shaping (Xia, 2018).

### Common plant composition

Most of the roadside habitat community structure is the upper layer of the arbour and the lower layer of herbaceous plants. The upper arbours are mainly *Fraxinus chinensis*, *Tilia tuan*, *Picea asperata*, *Acer saccharinum*, *Morus alba*, *Juglans regia* and the like. The lower herbaceous plants are wild weeds, mainly *Portulaca oleracea*, *Chenopodium album*, *Taraxacum mongolicum*, *Polygonum aviculare*, *Plantago depressa*, *Trifolium repens*, *Malva cathayensis*, *Medicago sativa*, *Stellaria media*, *Hydrocotyle sibthorpioides*, *Amaranthus tricolor*, and *Erigeron Canadensis*.

### Landscape evaluation

The landscape status of roadside plant communities is generally poor (Fig. 6-a, b, c, d).



Fig. 6. Roadside of investigated Bulgarian villages (Taken by authors)

### PATTERNS DESIGN

We summarize the characteristics of plant communities with high landscape quality in each habitat and combines the space types of habitats to propose the planting patterns and species selection suggestions for habitat community landscape status. It is intended to be applied to the practice of rural plant habitat transformation and new construction.

#### Residential courtyard Habitat space types

The residential courtyard habitat space is divided into 3 types, as shown in Table 5. The first habitat is located on the front of the building, with the length of 15 m and width of 4 m. The second habitat (10 m long and 3 m wide) is located on the side of the building. The third habitat (12 m X 9 m) is located in the corner of the courtyard and is L-shaped.

#### Design strategy

(1) Multi-functional plant communities with a mixture of edible, spice and ornamental plants are preferred, closely combining production and landscape.

(2) Vegetation is applied for spatial division, taken middle cultivating in the middle, arbours surrounding as the main planting type. Besides, it is a good way to plant tall deciduous tree species with evergreen or deciduous small arbour species, with ornamental shrubs grown at the edge of the plot to enhance community viewing.

Roadside habitats are as much of a concern as the waterside habitats and even worse. Many villages were found to lack of plant communities on both sides of the main street.

The hard surface rate of the street is very high, leading to a low landscape effect and ecological service function. In most rural areas, there are "urbanization" problems such as the homogeneity of plant species and configuration, lower level of ecological service function and disappearance of landscape features. In most habitats, the plant community is single-layer, with only trees or herbs. Although herbs have high species richness, it is difficult to show natural beauty in a messy environment.

(3) Typical vegetation landscape culture of the village is maintained to inherit the cultural plants and classical plant configurations.

(4) The original plant community with high stability is preserved. Tall trees can be regarded as the skeleton. It is recommended to create a rich community layer, as well as planting ornamentals when sufficient space is enough.

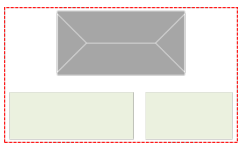
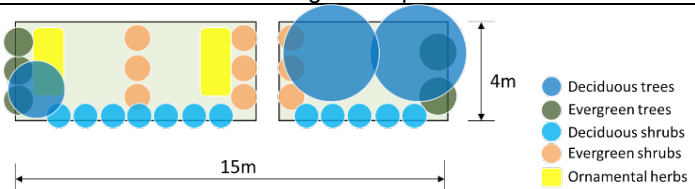
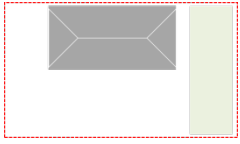
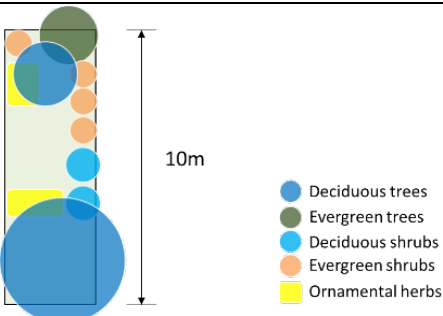
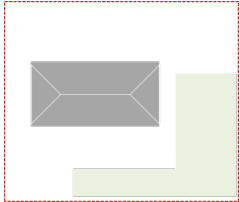
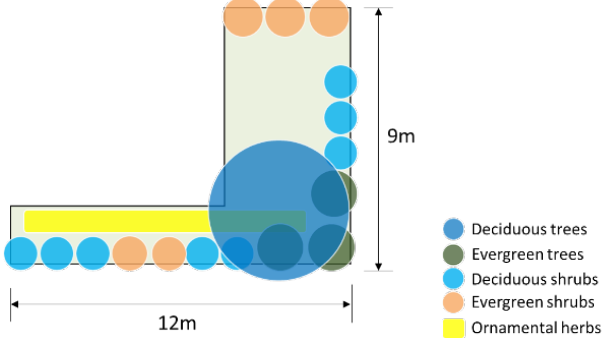
In terms of tree species selection, arbour layer can be selected from large deciduous trees such as *Robinia pseudoacacia*, *Fraxinus chinensis*, *Quercus acutissima*, *Juglans regia*, *Tilia tuan*, and *Acer saccharinum*. While small trees such as *Malus pumila*, *Prunus salicina*, *Amygdalus persica*, *Cerasus pseudocerasus*, *Chaenomeles speciosa* and *Diospyros kaki* are a good choice. Shrub layer can be selected from *Rubus idaeus*, *Ficus carica*, *Rosa rugosa*, *Spiraea salicifolia* and *Hydrangea macrophylla*, which are both ornamental and edible. Appropriate application of the shaped *Buxus sinica* is an embellishment. Some evergreen conifers such as *Cedrus deodara*, *Picea asperata*, *Platycladus orientalis* and *Ilex chinensis*, etc., can be used as background plants. Ornamental herbaceous plants are always indispensable in the courtyard. Biennial herbs such as *Tagetes patula*, *Zinnia elegans*, *Perilla frutescens*, *Petunia hybrida*, *Impatiens balsamina*, and other perennial herbs such as *Trifolium repens*, *Medicago sativa*, *Campanula medium*, *Lythrum salicaria*, *Verbena officinalis* and *Rohdea japonica* can be chosen. In addition, lianas



can also be used to decorate the wall. In addition to the essential *Vitis vinifera*, other species can be regarded as *Parthenocissus quinquefolia*, *Campsis*

*grandiflora*, *Hedera nepalensis*, *Clematis florida*, and *Trachelospermum jasminoides* perfect candidates.

**Table 5.** Habitat plant configuration patterns of residential courtyard

No.	Habitat space types	Plant configuration patterns
1		 <p>15m 4m</p> <ul style="list-style-type: none"> <li>Deciduous trees</li> <li>Evergreen trees</li> <li>Deciduous shrubs</li> <li>Evergreen shrubs</li> <li>Ornamental herbs</li> </ul> <p><i>Juglans regia</i> + <i>Malus pumila</i> - <i>Cedrus deodara</i> + <i>Picea asperata</i> + <i>Platycladus orientalis</i> - <i>Rubus idaeus</i> + <i>Rosa rugosa</i> + <i>Buxus sinica</i> + <i>Rosa laevigata</i></p>
2		 <p>10m</p> <ul style="list-style-type: none"> <li>Deciduous trees</li> <li>Evergreen trees</li> <li>Deciduous shrubs</li> <li>Evergreen shrubs</li> <li>Ornamental herbs</li> </ul> <p><i>Acer saccharinum</i> - <i>Cerasus pseudocerasus</i> + <i>Picea asperata</i> + <i>Ilex chinensis</i> - <i>Ficus carica</i> + <i>Spiraea salicifolia</i> + <i>Forsythia viridissima</i> + <i>Albizia kalkora</i> + <i>Hibiscus syriacus</i></p>
3		 <p>12m 9m</p> <ul style="list-style-type: none"> <li>Deciduous trees</li> <li>Evergreen trees</li> <li>Deciduous shrubs</li> <li>Evergreen shrubs</li> <li>Ornamental herbs</li> </ul> <p><i>Tilia tuan</i> - <i>Chamaecyparis obtusa</i> + <i>Cedrus deodara</i> - <i>Syringa oblata</i> + <i>Sambucus williamsii</i> + <i>Hydrangea macrophylla</i> + <i>Euonymus alatus</i></p>

Note: Ornamental herbs, spices and vegetables are not listed and can be flexibly planted in spare space.

### Waterside Habitat space types

According to different breadths of the habitat, it can be categorized into 3 types (Table 6). Their length is 20 m, 8 m and 5 m and width are 5 m, 2 m and 1 m, respectively.

#### Design strategy

(1) Taken both usage and ornamental needs of people, the overall design principle follows the construction of ecological and stable plant communities.

(2) Trees and shrubs with good conditions

should be protected, while weeds are supposed to be cleaned. Shrubs are added to increase community layers.

(3) Species unique to the waterside is preferred to enhance the landscape characteristics of the waterside.

(4) The community height should be designed according to the width of the river, and large trees can be planted near wide rivers.

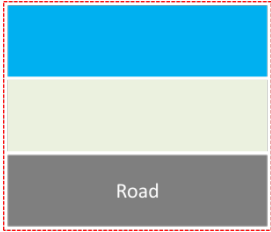
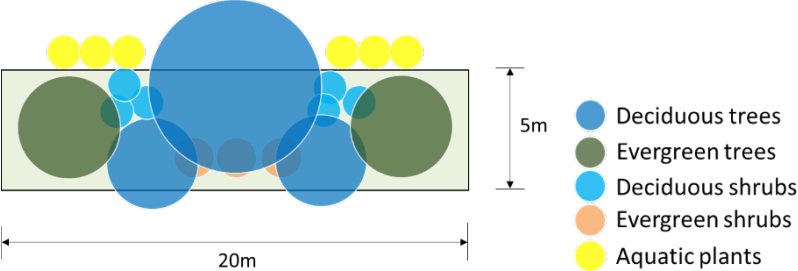

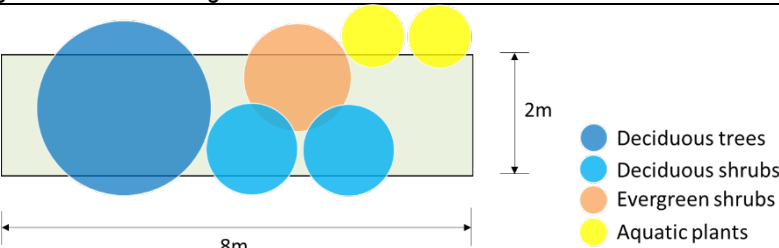

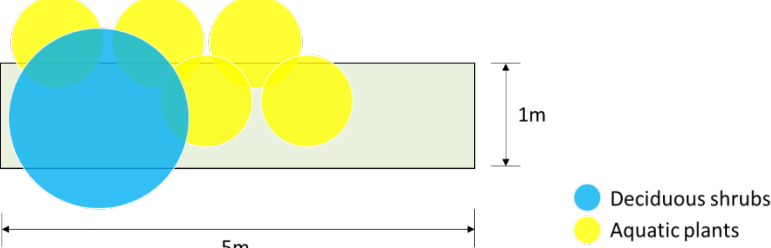
In terms of tree species selection, the arbour layer can be selected from *Betula platyphylla*, *Fraxinus chinensis*, *Paulownia fortunei*, *Salix*



*babylonica*, *Salix matsudana*, *Celtis sinensis*, *Pinus thunbergii*, and *Pinus densiflora*. *Albizia kalkora*, *Symphoricarpos sinensis*, *Euonymus alatus*, *Philadelphus incanus*, *Rosa rugosa*, *Rosa laevigata*, *Buddleja lindleyana*, *Sambucus*

*williamsii*, and *Nerium indicum* can be used as shrub layer. Herbs generally allow them to grow naturally. For aquatic plants, *Phragmites australis*, *Typha orientalis*, *Acorus calamus*, and *Lythrum salicaria* can be used.

**Table 6.** Habitat plant configuration patterns of waterside

No.	Habitat space types	Plant configuration patterns
1		 <p><i>Betula platyphylla</i> + <i>Pinus thunbergii</i> + <i>Pinus densiflora</i> - <i>Albizia kalkora</i> + <i>Symphoricarpos sinensis</i> + <i>Euonymus alatus</i> - <i>Typha orientalis</i> + <i>Gladiolus gandavensis</i> + <i>Phragmites australis</i></p>
2		 <p><i>Celtis sinensis</i> - <i>Philadelphus incanus</i> + <i>Rosa rugosa</i> + <i>Rosa laevigata</i> - <i>Buddleja lindleyana</i> + <i>Lythrum salicaria</i></p>
3		 <p><i>Sambucus williamsii</i> - <i>Cnidium monnieri</i> + <i>Phytolacca acinosa</i> + <i>Mentha canadensis</i> + <i>Lythrum salicaria</i> + <i>Iris tectorum</i></p>

### Forestland Habitat space types

The forestland in the countryside is generally blocky and enclosed, loosely connected with the surrounding environment. Two common landscape forestland types are designed. The first type is surrounded by buildings and roads with an area of about 400 m<sup>2</sup>. The second one is approximately 600 m<sup>2</sup>, surrounded by roads and paths.

#### Design strategy

(1) In general, the original community is mainly protected, and the incremental design is partially carried out.

(2) For natural forestland, the original dominant tree species should be retained and the structure

and the surrounding relationship of the forest need to be adjusted, to make sure that the new functional requirements are met while the stability and local characteristics of the community are maintained.

(3) For landscape forestland, the dominant species and native species with good growth are preferred to enrich the community layer. Ornamental shrubs can be increased, instead of artificial herbaceous ground cover.

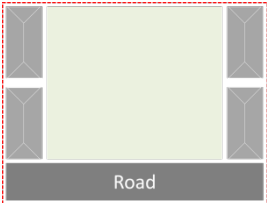
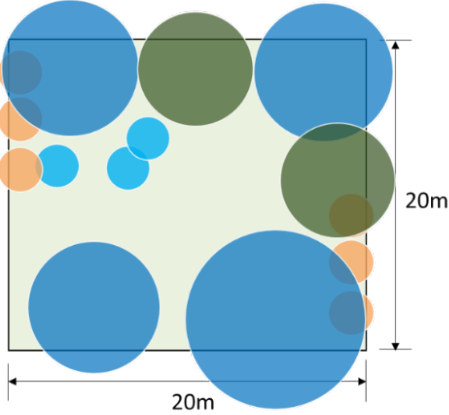
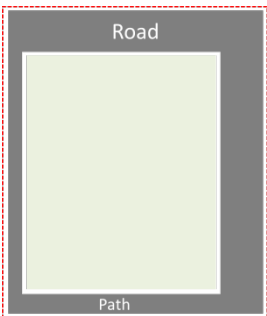
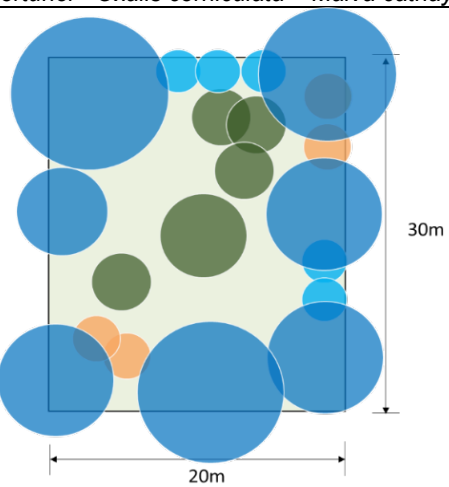
(4) The actual use needs to be considered when designing the community. Space for rest, activity and contemplation is essential in the forestland. The resting space should be private, while activity space is open. Also, the landscape in

viewing space is supposed to be varied.

For tree species selection, the arbor layer can be selected from *Robinia pseudoacacia*, *Aesculus chinensis*, *Juglans regia*, *Platanus orientalis*, *Paulownia fortunei*, *Acer negundo*, *Tilia tuan*, *Ulmus pumila*, *Celtis sinensis*, *Quercus acutissima*, *Quercus fabri*, *Salix babylonica*, *Pinus thunbergii*, *Cedrus deodara*, *Picea asperata*, *Abies fabri*, *Platycladus orientalis*, *Chamaecyparis obtusa*, etc.

The shrub layer can be selected from the *Forsythia viridissima*, *Hibiscus syriacus*, *Spiraea salicifolia*, *Hydrangea macrophylla*, *Buxus sinica*, and *Mahonia fortunei*. Herbs can choose *Oxalis corniculata*, *Malva cathayensis*, *Vinca major*, *Potentilla kleiniana*, *Setaria viridis* and *Leucanthemum maximum*.

**Table 7.**Habitat plant configuration patterns of forestland

No.	Habitat space types	Plant configuration patterns
1		 <p>● Deciduous trees ● Evergreen trees ● Deciduous shrubs ● Evergreen shrubs</p> <p><i>Fraxinus chinensis</i> + <i>Juglans regia</i> + <i>Platanus orientalis</i> + <i>Paulownia fortunei</i> + <i>Cedrus deodara</i> - <i>Platycladus orientalis</i> - <i>Albizia kalkora</i> + <i>Buxus sinica</i> var. <i>parvifolia</i> + <i>Pyracantha fortuneana</i> + <i>Mahonia fortunei</i> - <i>Oxalis corniculata</i> + <i>Malva cathayensis</i> + <i>Vinca major</i></p>
2		 <p>● Deciduous trees ● Evergreen trees ● Deciduous shrubs ● Evergreen shrubs</p> <p><i>Aesculus chinensis</i> + <i>Acer negundo</i> + <i>Tilia tuan</i> + <i>Ulmus pumila</i> + <i>Quercus acutissima</i> + <i>Robinia pseudoacacia</i> + <i>Picea asperata</i> - <i>Platycladus orientalis</i> + <i>Chamaecyparis obtusa</i> - <i>Forsythia viridissima</i> + <i>Hibiscus syriacus</i> + <i>Spiraea salicifolia</i> + <i>Hydrangea macrophylla</i> + <i>Buxus sinica</i> var. <i>parvifolia</i> + <i>Mahonia fortunei</i> - <i>Oxalis corniculata</i> + <i>Potentilla kleiniana</i> + <i>Setaria viridis</i> + <i>Leucanthemum maximum</i></p>

**Roadside  
Habitat space types**

The sequence sense of plant community in roadside habitat is stronger and corridor character

is more obvious than that of other habitats. It can be categorized into 2 types (Table. 8). The first one is a road on the edge of the country, next to farmland. The second is the road within the country, next to a residential courtyard or other buildings.

### Design strategy


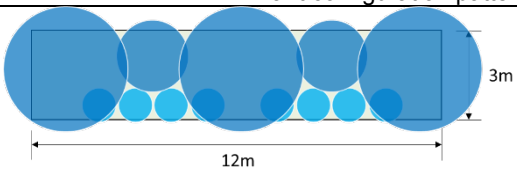
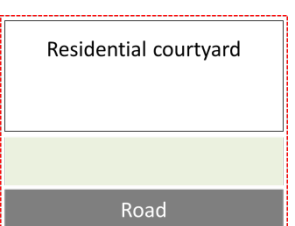
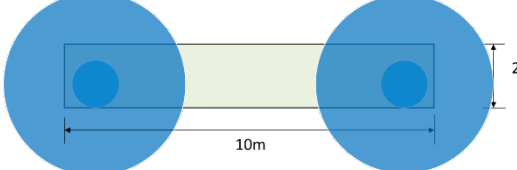
(1) Width of the roadside habitat should be ensured. Tall trees can be planted as the key species, and the diversity of herbaceous plants should be maintained to form an ecological corridor.

(2) Natural cultivation is preferred, instead of the application of shaped shrubs. Different species and community structures are selected according to the habitats around different roads.

(3) Native tree species with strong resistance, easy management and fewer pests and diseases, are selected here, forming road landscape with local characteristics.

In terms of tree species selection, the street tree can be selected from *Robinia pseudoacacia*, *Paulownia fortunei*, *Morus alba*, *Juglans regia*, *Cerasus pseudocerasus*, *Platanus orientalis*, *Populus simonii*, *Fraxinus chinensis*, etc. In the habitat on the side of farmland, fruit trees with high economic values can be used. The shrub layer can be selected from *Spiraea salicifolia*, *Rosa rugosa* or evergreen *Buxus sinica*. Spontaneous herbs are suggested.

**Table 8.** Habitat plant configuration pattern of roadside

No.	Habitat space types	Plant configuration patterns
1		 <p><i>Morus alba</i> + <i>Cerasus pseudocerasus</i> + <i>Juglans regia</i> - <i>Prunus salicina</i> - <i>Ficus carica</i></p>
2		 <p><i>Robinia pseudoacacia</i> + <i>Paulownia fortunei</i> - <i>Spiraea salicifolia</i> + <i>Hydrangea macrophylla</i> - <i>Oxalis corniculata</i> + <i>Medicago sativa</i> + <i>Trifolium repens</i></p>

### CONCLUSIONS

1. Among the 137 plots investigated, a total of 219 species, 198 genera and 75 families were recorded. Four habitats were categorized as a residential courtyard, waterside, forestland and roadside, and their landscape was evaluated. In residential courtyard habitat, most plants are of economic value. The landscapes retain rural features, but still, need to be improved. While, waterside habitat is lack of management and protection, which leads to a lack of landscape aesthetics. Herbaceous plants such as ornamental aquatic plants account for a large proportion of both species and quantity. The accessibility of waterside habitats is poor. In terms of forestland habitat, its ecological and aesthetic values are better than other habitats, with rich community structures and high stability.

2. Unfortunately, the roadside habitat has a high hard surface rate and the habitat is severely fragmented. Its plant community landscape is poor.

With monotonous plant community (only trees or only herbs in most habitats). It is exhibited as a messy environment due to a large number of herbs, though it has a high species richness.

3. According to the space types of different habitats, three patterns of residential courtyard plant configuration, 3 patterns of waterside plant configuration, 2 patterns of forestland plant configuration, and 2 patterns of roadside plant configuration are proposed an appropriate tree species are recommended.

### ACKNOWLEDGEMENT

Thanks to the funding of Science and technology cooperation and technology transfer of Bulgarian Center (KY201702012) support from Science and Technology Commission of Shanghai Municipality. Thanks to the funding of the Global Engagement Program of Shanghai Jiao Tong University. Thanks to the friends of the Institute of Agricultural Economics and Agricultural university-Plovdiv for their companionship and help during the research.

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# Appendix: List of Bulgarian village plants

No.	Family	Species	Life form
1	Rosaceae	<i>Malus pumila</i>	Deciduous tree
2		<i>Prunus salicina</i>	Deciduous tree
3		<i>Amygdalus persica</i>	Deciduous tree
4		<i>Armeniaca vulgaris</i>	Deciduous tree
5		<i>Cerasus pseudocerasus</i>	Deciduous tree
6		<i>Rubus idaeus</i>	Deciduous shrub
7		<i>Rubus parvifolius</i>	Deciduous shrub





8		<i>Rubus swinhoei</i>	Deciduous shrub
9		<i>Rubus corchorifolius</i>	Deciduous shrub
10		<i>Rosa multiflora</i>	Deciduous shrub
11		<i>Rosa rugosa</i>	Deciduous shrub
12		<i>Rosa laevigata</i>	Deciduous shrub
13		<i>Spiraea salicifolia</i>	Deciduous shrub
14		<i>Chaenomeles speciosa</i>	Deciduous tree
15		<i>Potentilla chinensis</i>	Renascent herb
16		<i>Potentilla discolor</i>	Renascent herb
17		<i>Potentilla kleiniana</i>	Biennial herb
18		<i>Duchesnea indica</i>	Renascent herb
19		<i>Agrimonia pilosa</i>	Renascent herb
20		<i>Geum aleppicum</i>	Renascent herb
21		<i>Pyracantha fortuneana</i>	Evergreen shrub
22	Asteraceae	<i>Cirsium japonicum</i>	Renascent herb
22		<i>Erigeron canadensis</i>	Renascent herb
23		<i>Erigeron annuus</i>	Biennial herb
24		<i>Taraxacum mongolicum</i>	Renascent herb
25		<i>Hemisteptia lyrata</i>	Renascent herb
26		<i>Xanthium strumarium</i>	Biennial herb
27		<i>Sonchus oleraceus</i>	Biennial herb
28		<i>Sonchus wightianus</i>	Biennial herb
29		<i>Eupatorium japonicum</i>	Renascent herb
30		<i>Youngia Japonica</i>	Biennial herb
31		<i>Carduus nutans</i>	Biennial herb
32		<i>Arctium lappa</i>	Biennial herb
33		<i>Tagetes patula</i>	Biennial herb
34		<i>Tagetes erecta</i>	Biennial herb
35		<i>Achillea millefolium</i>	Renascent herb
36		<i>Artemisia argyi</i>	Renascent herb
37		<i>Cichorium intybus</i>	Renascent herb
38		<i>Ixeris polycephala</i>	Biennial herb
39		<i>Bidens pilosa</i>	Biennial herb
40		<i>Eclipta prostrata</i>	Biennial herb
41		<i>Zinnia elegans</i>	Biennial herb
42	Lamiaceae	<i>Anisomeles indica</i>	Renascent herb
43		<i>Mentha canadensis</i>	Biennial herb
44		<i>Leonurus japonicas</i>	Biennial herb
45		<i>Prunella vulgaris</i>	Renascent herb
46		<i>Salvia plebeian</i>	Biennial herb
47		<i>Teucrium viscidum</i>	Renascent herb
48		<i>Agastache rugosa</i>	Renascent herb
49		<i>Lamium barbatum</i>	Renascent herb
50		<i>Scutellaria indica</i>	Renascent herb
51		<i>Perilla frutescens</i>	Biennial herb
52		<i>Glechoma longituba</i>	Renascent herb
53		<i>Scutellaria barbata</i>	Renascent herb
54		<i>Clinopodium polycephalum</i>	Renascent herb
55	Poaceae	<i>Cynodon dactylon</i>	Renascent herb
56		<i>Eragrostis ferruginea</i>	Renascent herb
57		<i>Setaria viridis</i>	Biennial herb
58		<i>Digitaria sanguinalis</i>	Biennial herb
59		<i>Lolium perenne</i>	Renascent herb
60		<i>Phragmites australis</i>	Renascent herb



61		<i>Eleusine indica</i>	Biennial herb
62		<i>Paspalum thunbergii</i>	Renasant herb
63		<i>Hordeum vulgare</i>	Biennial herb
64		<i>Phalaris arundinacea</i>	Renasant herb
65		<i>Echinochloa crusgalli</i>	Biennial herb
66		<i>Poa annua</i>	Biennial herb
67	Fabaceae	<i>Albizia kalkora</i>	Deciduous shrub
68		<i>Sophora japonica</i>	Deciduous tree
69		<i>Lotus corniculatus</i>	Renasant herb
70		<i>Trifolium repens</i>	Renasant herb
71		<i>Trifolium pretense</i>	Renasant herb
72		<i>Indigofera tinctoria</i>	Deciduous shrub
73		<i>Medicago sativa</i>	Renasant herb
74		<i>Melilotus officinalis</i>	Biennial herb
75		<i>Sophora japonica</i>	Deciduous tree
76		<i>Robinia pseudoacacia</i>	Deciduous tree
77		<i>Pisum sativum</i>	Biennial herb
78		<i>Phaseolus vulgaris</i>	Biennial herb
79	Apiaceae	<i>Cnidium monnieri</i>	Biennial herb
80		<i>Daucus carota</i>	Biennial herb
81		<i>Angelica polymorpha</i>	Renasant herb
82		<i>Angelica biserrata</i>	Renasant herb
83		<i>Peucedanum praeruptorum</i>	Renasant herb
84		<i>Oenanthe javanica</i>	Renasant herb
85		<i>Anthriscus sylvestris</i>	Biennial herb
86		<i>Bupleurum chinense</i>	Renasant herb
87		<i>Foeniculum vulgare</i>	Biennial herb
88	Amaranthaceae	<i>Amaranthus tricolor</i>	Biennial herb
89		<i>Amaranthus blitum</i>	Biennial herb
90		<i>Chenopodium album</i>	Biennial herb
91		<i>Salsola collina</i>	Biennial herb
92		<i>Dysphania ambrosioides</i>	Biennial herb
93		<i>Celosia argentea</i>	Biennial herb
94	Campanulaceae	<i>Peracarpa carnosia</i>	Renasant herb
95		<i>Adenophora stricta</i>	Renasant herb
96		<i>Platycodon grandiflorus</i>	Renasant herb
97		<i>Campanula medium</i>	Renasant herb
98		<i>Wahlenbergia marginata</i>	Renasant herb
99	Pinaceae	<i>Pinus nigra</i>	Evergreen tree
100		<i>Pinus densiflora</i>	Evergreen tree
101		<i>Cedrus deodara</i>	Evergreen tree
102		<i>Abies fabri</i>	Evergreen tree
103		<i>Picea asperata</i>	Evergreen tree
104	Convolvulaceae	<i>Calystegia hederacea</i>	Biennial herb
105		<i>Convolvulus arvensis</i>	Renasant herb
106		<i>Cuscuta chinensis</i>	Biennial herb
107		<i>Ipomoea batatas</i>	Liana
108	Polygonaceae	<i>Polygonum aviculare</i>	Biennial herb
109		<i>Polygonum orientale</i>	Biennial herb
110		<i>Rumex acetosa</i>	Renasant herb
111		<i>Reynoutria japonica</i>	Renasant herb
112	Caryophyllaceae	<i>Myosoton aquaticum</i>	Renasant herb
113		<i>Stellaria media</i>	Biennial herb
114		<i>Dianthus chinensis</i>	Renasant herb



115		<i>Saponaria officinalis</i>	Renascent herb
116	Solanaceae	<i>Petunia hybrida</i>	Biennial herb
117		<i>Solanum nigrum</i>	Biennial herb
118		<i>Solanum melongena</i>	Biennial herb
119		<i>Lycopersicon esculentum</i>	Biennial herb
120	Oleaceae	<i>Fraxinus chinensis</i>	Deciduous tree
121		<i>Forsythia viridissima</i>	Deciduous shrub
122		<i>Syringa oblata</i>	Deciduous shrub
123	Cupressaceae	<i>Platycladus orientalis</i>	Evergreen tree
124		<i>Chamaecyparis obtuse</i>	Evergreen tree
125		<i>Cupressus funebris</i>	Evergreen tree
126	Fagaceae	<i>Quercus acutissima</i>	Deciduous tree
127		<i>Quercus fabri</i>	Deciduous tree
128		<i>Castanea mollissima</i>	Deciduous tree
129	Caprifoliaceae	<i>Lonicera fragrantissima</i>	Deciduous shrub
130		<i>Symphoricarpos sinensis</i>	Deciduous shrub
131		<i>Lonicera maackii</i>	Deciduous shrub
132	Malvaceae	<i>Hibiscus syriacus</i>	Deciduous shrub
133		<i>Malva cathayensis</i>	Biennial herb
134		<i>Firmiana simplex</i>	Deciduous tree
135	Scrophulariaceae	<i>Paulownia fortunei</i>	Deciduous tree
136		<i>Verbascum thapsus</i>	Biennial herb
137		<i>Buddleja lindleyana</i>	Deciduous shrub
138	Euphorbiaceae	<i>Euphorbia pekinensis</i>	Renascent herb
139		<i>Acalypha australis</i>	Biennial herb
140		<i>Ricinus communis</i>	Biennial herb
141	Brassicaceae	<i>Lepidium apetalum</i>	Biennial herb
142		<i>Rorippa indica</i>	Biennial herb
143		<i>Cardamine hirsuta</i>	Biennial herb
144	Apocynaceae	<i>Trachelospermum jasminoides</i>	Liana
145		<i>Vinca major</i>	Deciduous shrub
146		<i>Nerium indicum</i>	Evergreen shrub
147	Vitaceae	<i>Vitis vinifera</i>	Liana
148		<i>Parthenocissus quinquefolia</i>	Liana
149		<i>Parthenocissus tricuspidata</i>	Liana
150	Platanaceae	<i>Platanus orientalis</i>	Deciduous tree
151		<i>Platanus acerifolia</i>	Deciduous tree
152	Ulmaceae	<i>Celtis sinensis</i>	Deciduous tree
153		<i>Ulmus pumila</i>	Deciduous tree
154	Juglandaceae	<i>Juglans regia</i>	Deciduous tree
155		<i>Pterocarya stenoptera</i>	Deciduous tree
156	Salicaceae	<i>Salix babylonica</i>	Deciduous tree
157		<i>Populus simonii</i>	Deciduous tree
158	Moraceae	<i>Morus alba</i>	Deciduous tree
159		<i>Ficus carica</i>	Deciduous shrub
160	Bignoniaceae	<i>Catalpa bungei</i>	Deciduous tree
161		<i>Campsis grandiflora</i>	Liana
162	Adoxaceae	<i>Sambucus williamsii</i>	Deciduous shrub
163		<i>Sambucus javanica</i>	Renascent herb
164	Berberidaceae	<i>Mahonia fortunei</i>	Evergreen shrub
165		<i>Berberis yhunbergii</i>	Deciduous shrub
166	Hydrangeaceae	<i>Philadelphus incanus</i>	Deciduous shrub
167		<i>Hydrangea macrophylla</i>	Deciduous shrub
168	Geraniaceae	<i>Geranium wilfordii</i>	Renascent herb



169		<i>Pelargonium hortorum</i>	Renascent herb
170	Plantaginaceae	<i>Plantago depressa</i>	Biennial herb
171		<i>Antirrhinum majus</i>	Renascent herb
172	Araliaceae	<i>Hydrocotyle sibthorpioides</i>	Renascent herb
173		<i>Hedera nepalensis</i>	Liana
174	Boraginaceae	<i>Trigonotis peduncularis</i>	Biennial herb
175		<i>Anchusa italica</i>	Renascent herb
176	Onagraceae	<i>Epilobium hirsutum</i>	Renascent herb
177		<i>Oenothera speciosa</i>	Biennial herb
178	Crassulaceae	<i>Sedum hispanicum</i>	Renascent herb
179		<i>Hylotelephium spectabile</i>	Renascent herb
180	Ranunculaceae	<i>Clematis florida</i>	Liana
181		<i>Clematis apiifolia</i>	Liana
182	Papaveraceae	<i>Corydalis bungeana</i>	Biennial herb
183		<i>Corydalis edulis</i>	Biennial herb
184	Sapindaceae	<i>Acer saccharinum</i>	Deciduous tree
185	Tiliaceae	<i>Tilia tuan</i>	Deciduous tree
186	Betulaceae	<i>Betula platyphylla</i>	Deciduous tree
187	Aceraceae	<i>Acer negundo</i>	Deciduous tree
188	Sapindaceae	<i>Aesculus chinensis</i>	Deciduous tree
189	Ginkgoaceae	<i>Ginkgo biloba</i>	Deciduous tree
190	Grossulariaceae	<i>Ribes nigrum</i>	Deciduous shrub
191	Aquifoliaceae	<i>Ilex chinensis</i>	Deciduous tree
192	Celastraceae	<i>Euonymus alatus</i>	Deciduous shrub
193	Buxaceae	<i>Buxus sinica</i>	Evergreen shrub
194	Simaroubaceae	<i>Ailanthus altissima</i>	Deciduous tree
195	Ebenaceae	<i>Diospyros kaki</i>	Deciduous tree
196	Phytolaccaceae	<i>Phytolacca acinosa</i>	Renascent herb
197	Potamogetonaceae	<i>Potamogeton crispus</i>	Aquatic or marsh plants
198	Aristolochiaceae	<i>Aristolochia debilis</i>	Liana
199	Portulacaceae	<i>Portulaca oleracea</i>	Biennial herb
200	Oxalidaceae	<i>Oxalis corniculata</i>	Biennial herb
201	Zygophyllaceae	<i>Tribulus terrestris</i>	Biennial herb
202	Lythraceae	<i>Lythrum salicaria</i>	Renascent herb
203	Urticaceae	<i>Urtica cannabina</i>	Renascent herb
204	Verbenaceae	<i>Verbena officinalis</i>	Renascent herb
205	Cannabaceae	<i>Humulus scandens</i>	Biennial herb
206	Typhaceae	<i>Typha orientalis</i>	Aquatic or marsh plants
207	Rubiaceae	<i>Galium aparine</i>	Biennial herb
208	Primulaceae	<i>Lysimachia candida</i>	Biennial herb
209	Equisetaceae	<i>Equisetum hyemale</i>	Fern
210	Osmundaceae	<i>Osmunda japonica</i>	Fern
211	Orobanchaceae	<i>Phtheirospermum japonicum</i>	Biennial herb
212	Violaceae	<i>Viola arcuate</i>	Renascent herb
213	Asparagaceae	<i>Rohdea japonica</i>	Renascent herb
214	Araceae	<i>Colocasia esculenta</i>	Aquatic or marsh plants
215	Balsaminaceae	<i>Impatiens balsamina</i>	Biennial herb
216	Iridaceae	<i>Gladiolus gandavensis</i>	Aquatic or marsh plants
217	Cucurbitaceae	<i>Cucurbita moschata</i>	Biennial herb
218	Piperaceae	<i>Piper nigrum</i>	Liana