Optimization Strategy of Landscape Ecological Planning in Urban Green Space System

Guang Zhu1*, Linyan Huang1, Zihan Zhang1
1Northeastern University JangHo Architecture, Northeastern University, Shenyang, Liaoning, 110169, China
*Corresponding author’s e-mail: zhuguang1998@foxmail.com

Abstract. In recent years, China's urbanization process has increased year by year, and the environmental problems brought by it have become increasingly prominent. The urban ecological environment and urban green space are closely connected. The improvement and reconstruction of the ecological environment need to be realized through the urban green space system planning. Therefore, it is imperative to apply landscape ecology in the urban green space system planning. This paper first outlines the important role of urban green space systems in restoring ecological and environmental problems. Second, based on the research on the landscape ecological progress of urban green space systems at home and abroad, through in-depth investigation of some representative urban green space systems in China, the current domestic Problems existing in urban green space system planning. Finally, based on the principles of landscape ecology, an optimization strategy for landscape ecological planning in urban green space systems was proposed. The results show that the use of landscape ecology can rationally plan the landscape space, green space corridors, green space patches and other factors in the green space system, thereby achieving the purpose of improving the urban environment and promoting ecological balance.

1. Introduction
Today's social and environmental problems are getting worse. Urban green space system planning has risen to the height of ecological construction [1]. It is imperative to actively learn from existing domestic and foreign research results and apply landscape ecology to urban system planning. In the field of landscape ecology, foreign research has relatively focused on spatial patterns and planning management and the impact of spatial patterns on biodiversity, such as studying the landscape patterns of urban nature reserves and national forest parks in urban green spaces on a large scale, Protection and construction of biodiversity at small and medium scales [2]. However, the research in the field of urban landscape ecology is relatively weak, staying on the surface, and its research methods and related theories need further discussion. F. L. Omsted put forward the concept of urban landscape ecological planning in 1863. By integrating the ideas of landscape ecology into urban planning, landscape architecture and other disciplines, and integrating into the urban landscape ecological planning, the urban landscape ecological planning was formed. Concept [3]. The spatial distribution of various landscape elements is reasonably laid out, and the concept of urban landscape ecological planning is applied to urban green space system planning. Such an urban green space system's ecological landscape planning has both aesthetic value and ecology [4].

In China, the urban green space system planning and construction started late, the research is still immature, and the application of urban landscape ecology to urban green space system planning is just
starting [5]. Up to now, only Zhejiang, Fujian, Guangdong, Chongqing and other places in China have done relevant research on urban green landscape ecological planning. So it can be seen that in the research of landscape ecological planning, China lags behind the foreign countries in research field, research intensity and implementation intensity. Therefore, it is more reasonable to use the principle of urban landscape ecology to plan urban green space system landscape ecology based on the actual situation of urban green space system planning [6].

Foreign countries have been relatively mature in applying landscape ecology to urban green space system planning. Research work has focused on the protection and improvement of existing green spaces in cities, creating new urban green spaces and landscapes, and building urban green space networks [7]. Its main aspects are: the improvement of nature reserves; the overall optimization and reconstruction of urban parks and public squares on a large scale; the design and management of green passages in large cities; the maintenance of aquatic ecosystems, such as urban rivers and lakes etc. Discussion on the ecological function of "green road" and "green line" in urban structure.

Based on the study of landscape ecology in urban green space systems, this paper combines the current status of domestic urban green space system planning, and proposes optimization strategies for landscape ecological planning in urban green space systems from several aspects. Figure 1 shows the process of the urban green space planning system in this paper.

**Figure 1. Urban green space planning system process**

### 2. Analysis of urban green space system planning

#### 2.1. Lack of consideration of ecosystem integrity in green space layout

Most urban planning centers on human beings and their socio-economic factors, and life other than human beings is ignored. That is to say, the relationship between biology and environment in the city is left out of the principle of urban construction, which leads to the dispersion of urban natural ecological environment layout, the fragility of ecological structure, the low anti-interference and other natural capabilities, and then leads to the low efficiency of urban green space environment and the potential of urban natural production The force failed to work.

#### 2.2. Lack of consideration of ecological diversity in green space planning

Urban biodiversity refers to the differentiation of genes, species, communities and their ecosystems. It is directly related to the structure and function of urban natural ecological environment system, and together with the atmospheric, water and geotechnical environment, it constitutes the habitat basis for human survival in the city [8]. According to the principle of community biodiversity and community stability, in order to make the structure of urban green space system stable and coordinated development, it is necessary to increase the biodiversity of urban green space system. At present, the planting planning in the green space system lacks the consideration of ecology. In the selection of tree species, it mainly considers from the local tree species and the suitable tree species, but neglects the selection of plants from the ecological principle, such as from the aspects of exerting the photosynthetic efficiency of plants, maintaining the stability of population and adapting to the special ecological environment of the city.
2.3. Green space system lacks sustainable construction and management

In the landscape ecological planning of urban green space system, there are some construction phenomena of quick success and instant benefit, which are becoming increasingly fierce. For example, large-scale tree transplantation in some cities will not only have high cost and low survival rate, but also will cause serious damage to the ecological environment of the transplantation area. In addition, the follow-up management of the green space system can not keep up, which also leads to the situation that the construction of the green space system is fast and the destruction is faster, which is not conducive to the long-term use and sustainable development of the green space system.

3. Landscape ecological planning strategy of urban green space system

The landscape ecological planning of green space system is different from that of natural vegetation landscape. The natural vegetation landscape is not interfered or interfered lightly by human activities. It still maintains its original nature and species diversity. Therefore, strict ecological protection is the prerequisite for the planning of natural vegetation landscape. The human factor in urban green space system is of great significance, so the construction of human and environment is very important. The coordinated symbiosis system is the fundamental goal of urban green space system landscape ecological planning [9].

3.1. According to the theory of patch corridor matrix, the urban green space should be reasonably distributed

As shown in Figure 2, when planning the urban green space system, it is necessary to reasonably distribute patches of different grades and connect them with corridors, so as to form an organic whole and maximize the ecological benefits of the urban green space system.

(1) Patches in urban green space system generally refer to parks, squares, residential areas, etc. From the perspective of landscape ecology, when setting up the location of ecological green space, we should start from the overall landscape pattern, pay attention to the key local and connecting points, that is, the strategic points of landscape ecology, to open up green patches, so as to ensure the ecological effect of the whole urban green landscape; urban block green space should not only have a large number, but also be evenly distributed, large and small patches should be combined, and all kinds of gardens should be reasonably adjusted. The location, quantity, scale, etc. of the block green space can better play the function of the block green space; different types of parks and small amusement parks with different functions can be built to strengthen the greening of residential areas; according to the centralized and decentralized landscape pattern planning, the land can be used in a centralized way to ensure that the large-scale patches such as the suburban scenic areas and forests will not be damaged, and some natural vegetation can be reserved in the built-up area. To the purpose of combining centralized and decentralized allocation of ecological green space.
Corridor in urban green space system generally refers to all kinds of river, lake, riverside green belt, road green land, protective forest belt, etc., which can adjust microclimate and play a role of partition, barrier and connection. In the urban green space system, corridors can organically connect different regions, eliminate the heat island effect and prevent the invasion of cold wind. Therefore, the connection degree between urban green corridors and block green space should be strengthened to form a network distribution of green corridors. The corridor should have a certain width to have a good ecological effect. When planning the suburban green space system, a wide urban shelterbelt should be set up according to the site conditions, and it should be linked with the farmland shelterbelt to form a network system; when planning the urban green space system, an isolation belt should be set up between the residential areas and groups. In addition, in addition to the green corridor along the river, a certain width and different forms of vegetation belt should be planned along the road. The establishment of multi-layer green corridor can improve the road environment, create a variety of road landscape, and connect the green patches of the city.

Matrix control affects the material and energy exchange between patches, strengthens and buffers the "island" effect of patches, and controls the connectivity of the whole landscape, thus affecting the species migration between patches. Urban green space system planning should improve the quality and connectivity of all kinds of green space, reasonably adjust the spatial layout of block green space, green belt and substrate, promote the normal circulation and flow of energy, material and biology, and organically connect the urban internal green space with the suburban natural environment with the help of green corridor to form a perfect urban green space system, which is not only conducive to promoting urban space The exchange of air with the outside world, the mitigation of heat island effect, the improvement of urban environmental quality, and the protection of animal and plant species diversity can be achieved.

3.2. According to the theory of landscape heterogeneity, build a stable green system
The theory of landscape heterogeneity refers to the non-uniformity or non-randomness of things or their attributes in time or space distribution. The research shows that the greater the heterogeneity of landscape, the more types of landscape, the stronger the ability to prevent external interference, and the more stable the ecosystem. Therefore, landscape heterogeneity is of great significance to urban green space system planning [10]. Urban green space system planning can create a variety of landscapes by using the heterogeneity of the site conditions. In the planning of urban green space system, various green space forms with different types and functions should be shaped to increase the landscape heterogeneity in the urban green space system, so as to increase the stability of the urban green space system network.

3.3. According to the principle of landscape change, moderate interference to green space system
According to the principle of landscape ecology, landscape change is first related to disturbance. Disturbance is an event that changes landscape structure, function and dynamic process. The results show that under the condition of no disturbance, the horizontal structure of landscape gradually develops to homogeneity, and the heterogeneity will increase rapidly in moderate disturbance, and may increase or decrease in severe disturbance. Because the urban ecosystem is an unstable ecosystem, in the planning of urban green space system, we should take appropriate interference, introduce energy, material and information from outside the city, and make the material, energy and oxygen produced by the urban green space system approach the consumption of the city to the greatest extent through the reasonable pattern of the urban green space system, so as to achieve the balance and stability of the urban green space system; however, we should carefully introduce alien species, fully study and analyze the local ecological characteristics, and strictly screen and experiment alien species to avoid ecological disasters, such as invasion events like water hyacinth and Eupatorium adenophorum.
3.4. According to the theory of landscape heterogeneity, build a stable green system

Research shows that biodiversity has a positive impact on ecosystem stability. In the planting planning of urban green space system planning, we should pay attention to the allocation according to the biological and ecological characteristics of plants, try to maintain the diversity of plant species, avoid the simplification, study and analyze the characteristics of local plant communities, and establish a reasonable composite artificial plant community. In terms of plant allocation, it is not only necessary to consider the function and landscape effect, but also from the ecological point of view, so as to be suitable for the site and trees, and it is appropriate to mix a variety of plants; through the reasonable allocation of arbors, shrubs, grasses and climbing, vertical vines, ground cover plants, etc., a stable multi-layer mixed plant community is formed, which not only reflects the biological diversity, but also presents a rich landscape level. It is beneficial to enhance the urban greening rate and maintain the stability of the green space system. To maintain the long-term use and sustainable development of urban green space system, good maintenance management is also needed. The plant configuration in urban green space system belongs to artificial plant community, which is relatively fragile at the beginning of establishment. In addition to frequent human interference, limited plant growth environment and other factors, the maintenance work needs to take different maintenance methods according to the characteristics of different green spaces, and pay attention to communication with the citizens.

4. Conclusion

In the face of deteriorating urban environment, it is imperative to apply the principle of landscape ecology to urban green space system planning. According to the theory of landscape ecology patch corridor matrix, all kinds of urban green space can be reasonably arranged to form an organic whole and give full play to the maximum ecological benefits; according to the theory of landscape heterogeneity, various types of green space with different functions can be widely coexisted to strengthen the stability of urban green space system; according to the principle of landscape change, the law of moderate interference can be adopted. We should actively introduce energy, material and information from outside the city, and at the same time, we should carefully introduce alien species; according to the principle of biological diversity, we should establish a reasonable compound artificial plant community in planting planning, and strengthen the maintenance and management of green space system. In this way, we can apply the theory of landscape ecology to the planning of urban green space system, integrate the theory and method of landscape ecological planning with urban green space system planning, maintain urban ecological balance, protect biodiversity, and improve the environmental quality of urban landscape.

Acknowledgments
The research presented in this paper were supported by National Training Program of Innovation and Entrepreneurship for Undergraduates (Project: X20191014500198) and the Fundamental Research Funds for the Central Universities (N182410001).

References
[1] Livesley, S. J., McPherson, G. M., Calfapietra, C. (2016). The Urban Forest and Ecosystem Services: Impacts on Urban Water, Heat, and Pollution Cycles at the Tree, Street, and City Scale. J. Journal of Environment Quality, 45(1), 119.
[2] Norton, B. A., Coutts, A. M., Livesley, S. J., et al. Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. J. Landscape and Urban Planning. 2015, 134: 127-138.
[3] Kondo, M., Fluehr, J., McKeon, T., & Branas, C. (2018). Urban Green Space and Its Impact on Human Health. J. International Journal of Environmental Research and Public Health, 15(3), 445.
[4] Meerow, S., Newell, J. P. Spatial planning for multifunctional green infrastructure: Growing resilience in Detroit. J. Landscape and Urban Planning. 2017, 159: 62-75.

[5] Rigolon, A., Browning, M., Lee, K., & Shin, S. (2018). Access to Urban Green Space in Cities of the Global South: A Systematic Literature Review. J. Urban Science, 2(3), 67.

[6] Rupprecht, C. D. D., Byrne, J. A., Ueda, H., & Lo, A. Y. (2015). “It’s real, not fake like a park”: Residents’ perception and use of informal urban green-space in Brisbane, Australia and Sapporo, Japan. J. Landscape and Urban Planning, 143, 205–218.

[7] Žlender, V., Ward Thompson, C. (2017). Accessibility and use of peri-urban green space for inner-city dwellers: A comparative study. J. Landscape and Urban Planning, 165, 193–205.

[8] Hoang, L., Fenner, R. A. (2015). System interactions of stormwater management using sustainable urban drainage systems and green infrastructure. J. Urban Water Journal, 13(7), 739–758.

[9] Barbosa, A. E., Fernandes, J. N., David, L. M. (2012). Key issues for sustainable urban stormwater management. J. Water Research, 46(20), 6787–6798.

[10] Remucal, C. K., Ginder-Vogel, M. (2014). A critical review of the reactivity of manganese oxides with organic contaminants. J. Environmental Science: Processes & Impacts, 16(6), 1247.