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## Theory and method of urban landscape ecological planning based on complexity theory

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### ABSTRACT

Many cities face a series of so-called city diseases such as traffic jam, housing problems and environmental pollution as economy has developed and cities have expanded rapidly. In this paper, based on the discussion on the theory of restoration ecology and landscape ecology of urban green space system planning, according to the need of economic development and the results of the above research, the framework and measures of urban green space system planning was proposed. Based on the complexity characteristics of urban ecosystem, the systematical theory and ecology, assessment and planning of urban ecosystem were developed. This study has been helpful to develop ecosystem modeling based on complexity theory and further improve cognition to the development law of urban ecosystem. Moreover, the complexity theory could more accurately and effectively account for the complex behaviors of urban ecosystem, and promote the sustainable development of urban ecosystem more effectively.

### KEYWORDS

Urban landscape ecology; Ecological planning; Complexity.



**INTRODUCTION**

Urban landscape can generally be divided into the natural landscape, artificial landscape and cultural landscape three categories, has been observed in nature is based on the natural landscape of mountains and lakes. Planetarium and other plants, animals and elements that constitute the urban landscape refer to the city and its surrounding people observed by natural artificial and human composite made of three elements of the environmental landscape, each city its natural and geographical differences due to different environmental conditions politics economy history cultural background and customs of the people and show their style features, but its landscape composition showed a variety of static essence of physical space and activities were performed in which people and objects<sup>[1]</sup>.

The purpose is to understand the urban landscape classification of the different characteristics of the urban landscape, and thus to grasp the characteristics of the formation of relevant factors, in order to create a variety of urban space environment. Different ways of thinking corresponds to a different classification method. According to people's imagery of the city, attributed to the five elements of the city's image, namely: roads paths; along edges; area districts; nodes; landmarks. Both natural and urban landscapes have artificial landscapes, both static and dynamic hardware facilities have software activities, the performance of the various elements of the urban landscape interwoven with and play. Urban Landscape art is a temporal art, it is as the observer moves in space and showing a picture depicting continuous. Overall urban landscape superimposed made by each local landscape. The city is the historical heritage, each city has its own production, the development process, it has experienced generations of construction and reconstruction, the generation of different style. Urban landscape is just a process, there is no final result. With the development of the city's urban landscape constantly changing.

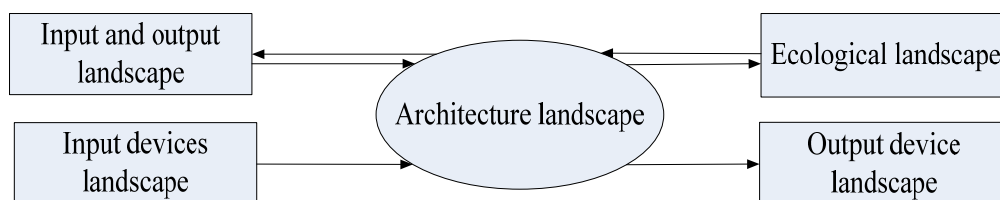
Urban landscape is a unified economic entity, social entities and natural entities, which both the two ecosystems - properties of natural ecosystems and human ecosystems. A work of urban landscape ecological planning is to the urban landscape as an object, according to the characteristics of the urban landscape structure, function and dynamics aspects of the urban landscape construction, protection, measures to adjust and improve its spatial layout and configuration planning and design. That is based on ecological principles and methods, rational planning of landscape spatial and functional structure, the corridor (Corridor), a reasonable amount and spatial distribution of plaque (Patch) and matrix (Matrix) and other landscape elements, so that the flow of information, material flow and smooth flow of energy and coordination to make the urban landscape in line with the principles of ecology, has a certain aesthetic value, which is suitable for human habitation<sup>[2]</sup>. Figure 1 shows the urban landscape.



**Figure 1 : Urban landscape**

**ECOLOGICAL CHARACTERISTICS OF URBAN LANDSCAPE**

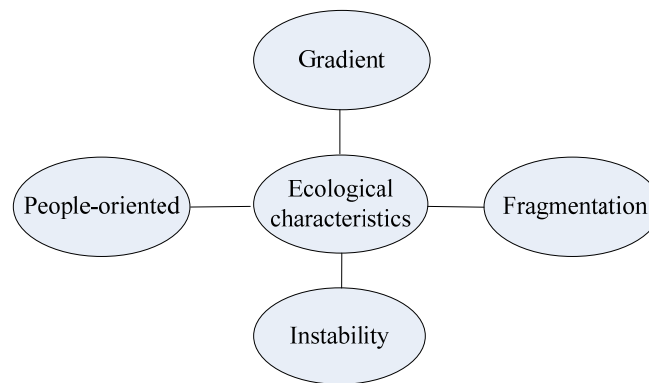
The city is the core of the human landscape ecosystem,, natural landscape and the evolution of man-made landscapes are to be subject to human needs and the development process in the city. From the composition of the interaction between the elements of the urban landscape, the city can be divided into the composition of the main architectural landscape, including residential, shopping malls, hotels, office buildings and other residential, office, study, building work; landscape input facilities such as electricity, water, gas facilities, landscape output facilities such as various types of sewage systems; input and output facilities, transportation facilities and other landscape means; ecological landscapes such as parks, green spaces, rivers, lakes, etc.<sup>[3]</sup>. Figure 2 shows the element analysis of the urban landscape.



**Figure 2 : Element analysis of the urban landscape**

The urban landscape refers to within the city limits, the overall visual variety of visual things and visual events constituted. Meanwhile, the urban landscape of the city to give people a comprehensive impression and perception, that the object of the things the city is reflected in people's minds, therefore, has a dual character of the urban landscape. Urban landscape is a product of the interaction between the natural landscape and cultural landscape, and is based on the natural elements of human factors superimposed on economic activity and social activities, is a country, a nation or a region of natural, economic and socio-cultural comprehensive reflection, is the product of generations of city residents and business creation.

This is different from other urban landscape of the most important features of the landscape. Due to the strong influence of human activities, natural conditions in cities, from hydrometeorology structure to the surface, flora and fauna, have undergone great changes. Urban landscape look different regions, to a certain extent, reflect the local socio-economic development and historical and cultural features. With the changes in social and economic development, as well as political, cultural and other factors, the urban landscape changes fast. China's reform and opening-up policy affected not only the emergence of a large number of new city, and the old city has undergone tremendous changes. Like Beijing, Shanghai, Guangzhou and other cities, urban renewal and expansion of the Metro while simultaneously, the pace of development for nearly 10 years, almost equivalent to the total development of the past few decades. Extensive transportation network was introduced into many patches of varying sizes within the city and the urban landscape. The fragmentation of the urban and urban residents are working and living to adapt. Many small patches according to their different nature, functions, combination of different sizes "functional group" can also put these "functional groups" as plaques<sup>[4]</sup>. Figure 3 shows the ecological characteristics of urban landscape.



**Figure 3 : Ecological characteristics of urban landscape**

Single core city, from the city center to the edge of area, intensity of human activity decreases, the way it has changed, showing population density, function, gradient of the graded. Downtown has a big shopping mall in general, as well as cultural, educational, judicial, administrative departments, outside the transition area for light industry, universities, railway stations, etc., again periphery, the layout of the heavy industrial area, the larger parks, residential areas, etc. Multi-core cities, too, but the gradient of the performance is more complex. Landscape ecological planning of a city is to create a good production and living environment, and create a beautiful urban landscape, therefore, the urban landscape ecological planning to consider the overall layout of the urban landscape and architectural landscape. The overall layout of the urban landscape and architectural landscape of the city is based on the nature, size and status quo conditions, the overall concept art layout of urban construction, urban construction to determine the skeleton of art, reflecting the urban aesthetic requirements. Is an important area of urban landscape sensitive areas, should grasp the overall harmonious architectural space groups the United States, organizations of the urban environment, so that a heterogeneous landscape into a unified pattern in landscape planning.

### ECOLOGICAL ASSESSMENT OF COMPLEXITY THEORY

Core complex adaptive systems theory is adaptable to create complexity, describes the process of evolution in the development of complex systems in the body can change their behavior through learning, so as to achieve mutual coordination and the environment, mutual adaptation. The new organization will make the interaction patterns of behavior between the main complicated adaptive systems emerge out there at each level new model appears. Complex adaptive system is generated by low levels of high-level interaction phenomena, high-level phenomena on the phenomenon of low-level components. Complex adaptive systems theory to analyze and describe the hierarchical structure and function of complex systems, and complex adaptive systems theory in terms of algorithms and models have achieved great success, such as complex adaptive systems theory on the formation of a standard computer algorithms such as genetic algorithms, it has a universal and maneuverability in the field of environment has been developed in science<sup>[5]</sup>.

City model approach is the ideological foundation systems engineering on the use of mathematical methods to simulate urban abstract and based on this analysis and research on the city, in order to obtain the results of urban planning optimization. Modern urban ecologists tend to improve urban spatial structure, urban development mechanism established to coordinate the various aspects of the relationship between social class and other cities. To simulate the evolution of urban ecology through the city model, can achieve the comprehensive evaluation of the current situation and problems faced by urban systems, as well as simulation, forecasting the future development of the purpose of the urban system. From the practical point of view, the city is divided into three categories model: 1) part of the model and the overall model. Part of the model only for a subsystem of the entire city system, and the overall model is to consider a set of subsystems; 2) optimization model and non-optimized models. Both are aimed at the real situation in the real world, the optimization model is used to derive the optimal layout scheme in various situations; 3) linear models and nonlinear models. Meaning city model is not descriptive, more important is the predictability that it describes not only the urban system, and can predict the specific plan for the future situation of the city area. Another feature of the city model it is static or relatively static model equations. Due to the complexity of urban systems has been in a dynamic, non-equilibrium state of being, there is no adequate theory to explain the phenomenon of a large number of complex and dynamic mechanism, making it impossible to Generate a dynamic model of the city in the true sense..

Urban ecosystem models and methods have gradually become systematic, practical, adaptable, and low cost trends. Given the complexity of quantitative research in the application of urban ecosystem computational complexity, the new algorithm is to study the success of the support base. Believed to make the research results to enhance operability, such as genetic algorithms, neural networks and other methods in the study of urban complex application and development will also become an important area, in addition, also the inevitable trend of computing technology and IT integration. For the urban ecological planning is concerned, we must first study of urban ecosystems, between which is a social, economic, environmental and other factors by through interactions, interdependence and mutual restraint complex giant system closely constituted. To study the ecological environment of the city, researchers often need to study the population associated subsystems, economic system and social system, and the spatial extent of the study is also growing, sometimes across the city and even the country. Complexity Science impact on the urban ecosystem characteristics and analysis is a very valuable research method, its environmental phenomena in nature study reveals a new environmental research ideas and models. It also shows that we have to complexity theory and concept to describe the urban ecosystem, and the complexity of the mathematical methods to solve the problem of urban pollution control and protection of resources and environment<sup>[6]</sup>.

## DESIGN AND CONSTRUCTION OF ECOLOGICAL PLANNING

Planning the overall emphasis is "three lines on both sides of multi-point" comprehensive layout format. "Three line" is the three most important three landscape axis; both sides of the river is reserved for reducing flood and natural mountain; multi-point is to live in the region include topics Square. Retain wetlands and entertainment landscape architecture, including multiple nodes. Plan hopes to create a cultural and natural environment for the residents of harmony and unity through this complex system of green landscape. Green-dimensional pattern layout emphasizes diverse, ranging from residential buildings, such as roof racks gate, west balcony wall climbing plants and flower beds, etc. and the external environment, river protection embankment design, as well as to ensure the diversity of species, planning also separately considered a wetland. In order to enrich the landscape of residential areas, designers arrange a variety of pieces in different locations in the river side has a gallery, trestle, stone street lights, etc., for residents along the river to create some good scenery with leisure. Combining the courtyard overhead layer, the green into the room, convenient for residents in need of outdoor activities rain, water the entire residential area, green, at the designer's sketch treatment effective combination together, so that residents have a good outdoor environment<sup>[7]</sup>. Figure 4 shows the design and construction of ecological planning.

Ecological landscape planning includes the following: natural ecosystems and artificial ecosystem planning, ecological green corridors, vegetation configuration. Eco-design principles set its surrounding corridor is sufficient buffer to prevent alien species from adjacent landscape aggression "mainly based on the width of the buffer status quo base in Ningbo and the distribution mechanism landscape and invasive species determined to set two main ecological corridor: river ecological Corridor, ecological core corridor: The main roads as well as by community 15M green belt on both sides of the composition "has the following functions: to ensure biological migration channels; terrestrial vegetation of sufficient width (> 80M) can ensure biodiversity : the green with tall trees and shrubs mainly waterside temperature can drop 5-10 degrees.

After planting, with straw mulch, mulch with straw to suppress and prevent wind, dry and weed growth. After rotting straw decomposition can increase the nutrients of the soil. Death decaying plants, you want to harvest, to prevent secondary pollution and destruction of the water landscape. In addition, it can be based on urban river corridor restoration area specific natural conditions, the use of existing vegetation knowledge, by type inference climax community of the region's potential natural vegetation types, applications, "simulated natural" approach to be eco-green, to create in the species composition and community structure and regional communities near the top of the artificial forest. To meet the urban river corridor needs a variety of functions and ecology, landscape, recreation and historic preservation and so on, designed to restore ecological corridors should be carefully considered to protect native species diversity, with special focus on the following a few questions: 1) corridor should adapt the trajectory of biological evolution, vegetation constitute corridor should be native species; 2) corridors must be connected provenance habitat, there must be sufficient width, otherwise the corridor not only can't play contact the utility space, and may cause the invasion of alien species<sup>[8]</sup>.

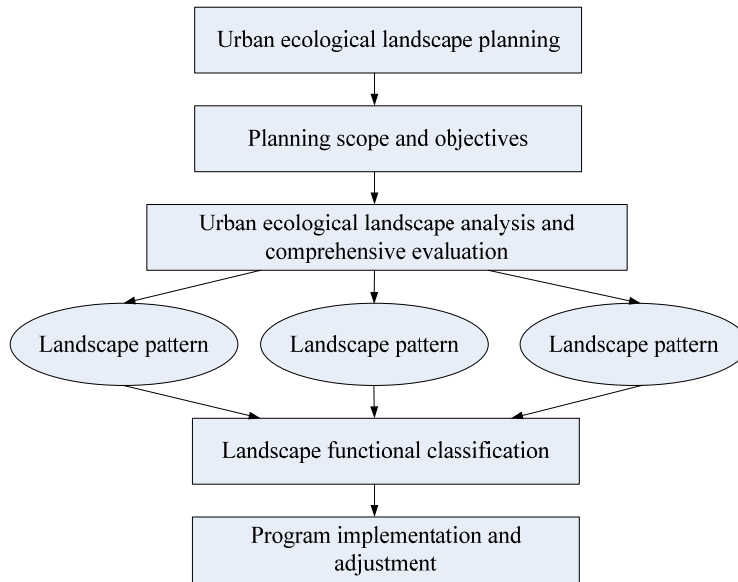


Figure 4 : Design and construction of ecological planning

**THE KEY TECHNOLOGIES OF URBAN LANDSCAPE ECOLOGICAL PLANNING**

Eco-technology urban landscape ecological planning, including green energy technologies and green technologies, as well as the corresponding auxiliary energy system with the former mainly includes three aspects of solar and wind energy collection, storage devices and thermal receiver, which also includes three aspects: general requirements and environmental technology requirements. Solar power is mainly solar panels installed on the roof, usually for the west and the south slope of the roof, currently integrated solar panels photovoltaic system technology has matured, applications are more widely used, but also in the cost competitive. Solar collector system devices should be coordinated with the building facade design; installation location unobstructed solar collector system, should be selected in the lee, and rain, moisture measures; inclination towards design specifications should comply with the relevant requirements ; solar collector piping system should be and residential water supply facilities, system piping, valves and other accessories should be used in long-life, anti-aging, anti-rust products: installation of solar collector system should be reliable, and easy maintenance management; when using solar photovoltaic technology, power generation systems and cell should power grid<sup>[9]</sup>.

Vegetation configure the following principles: 1) increase the density of vegetation to increase biomass levels, focusing on vertical green, shade, landscape vegetation; 2) planting design seeks to optimize the relationship between the water requirements of plants and local climate conditions between Ningbo, and more generally use of native plants. Joe mainly local students, shrubs, such as willows, camphor, fir, acacia, gingko, etc.; 3) implies huge energy to reduce fertilizer and excessive fertilization brought cause eutrophication of water bodies, must be minimized the use of fertilizers, especially nitrogen fertilizer contains a large mixing ingredients; 4) to consider lowering the noise, noise in an appropriate form a green facility; 5) configured to control pedestrian zone vegetation wind effect. Diarrhea flood drainage can use green concrete revetment, which is available planting turf, special concrete low vegetation. Figure 5 shows thevegetation configure principles.

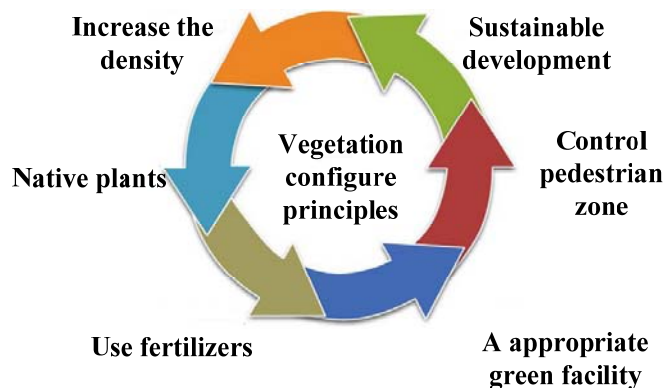


Figure 5 : Vegetation configure principles

Ecological urban design, urban design, especially the local eco-design and eco-city neighborhood should be a basis for planning and management of urban construction. For different types of urban construction projects, combined with urban planning and management, you can have different ways to implement eco-city design requirements, land use planning and management, the conversion of land use as a condition for project planning, architecture, an important basis for environmental design; construction planning and management, combined with the specific reported that construction plan and construction design, type of case to case review to be implemented, direct control and guidance of micro, specific development and construction, the implementation of eco-design in urban planning and management systems. Noise pollution in urban residential areas mostly from road traffic noise, in order to reduce road traffic noise on the living environment, generally the following methods: 1) pavement materials, general road asphalt mastic gravel road to reduce the noise effect best; 2) set to prohibit signs; 3) anti-noise barrier is generally convex wall honeycomb holes and vertical greening (the main living areas as reducing noise absorbing panels, set at the cell edge transit on; 4) vegetation noise in this district plan, mainly in the form of vegetation, the width of the appropriate species selection, plant density, vegetation can absorb the sound waves reach, reduce the effect of noise, planting vegetation following principles: dwarf trees than good anti-noise effect of high trees; broadleaf forest better than coniferous forests: a few narrow layer of dense forest belt is better than the effect<sup>[10]</sup>.

## CONCLUSION

Urban ecological system is a huge, complex, multiple-variant, dynamic and open system, which brings various complicated problems seriously restricting the sustainable development of urban ecological system. In this paper, a macroscopic control planning has great significance to the sustainable development of the hybrid system between urban ecological, social and economic systems. The complexity relevant theories were introduced in the urban ecological planning. The function of urban eco-economics system is lessened resulted from the unreasonable ecological position of landscape and the disorder inner elements of urban landscape. This dissertation first reviews the research progress on complexity theory and its applications to the models of urban ecosystem, and accounts for the current problems on complex ecosystem models. Then from the respective of the mathematic theories, methodologies and applications and based on complexity theory, the focus is given on the development of new theory and new methodology for the urban ecological modeling establishment.

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