

Ecological Restoration Design of Brownfield Landscape in Tianjin Harbour Park

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Abstract:

In this study, taking the brownfield landscape of Tianjin Harbour Park, the ecological restoration design scheme of cell regeneration is proposed according to the deterioration of its ecological environment and the decline of biodiversity. Through a comprehensive use of ecological theory and landscape design principles, as well as plant species selection and soil remediation techniques, it aims to restore and improve the ecosystem function and landscape aesthetic value of the region. The design scheme includes the following aspects: First, select suitable plant communities and tree species to increase vegetation cover and improve habitat conditions. Secondly, suitable animal species are introduced to increase the biodiversity and ecological balance. At the same time, appropriate soil remediation techniques are used to improve soil quality and nutritional status. Finally, combine the landscape design principles to create a pleasant visual and experiential environment to enhance the attractiveness and sustainability of the park. The design scheme will provide useful reference and guidance for the ecological restoration of the brownfield landscape in Tianjin Harbour Park, and help to improve the ecological quality and recreation value of the area.

Keywords:

Tianjin Harbour Park, Brownfield Landscape, Ecological Restoration

1. Introduction

In the process of urbanization, many areas face the problem of brownfield landscape, which cause soil degradation, reduced vegetation, and decreased ecological function due to the influence of human activities. As an important urban green lung and ecological landscape, the ecological restoration of its palnland landscape needs to attract our attention and attention. Cell regeneration is an ecological restoration design method that aims to restore and improve the ecosystem function and landscape aesthetic value of the region, by combining the appropriate plant species selection and soil remediation techniques. This paper aims to propose and discuss the ecological restoration design scheme of the brownfield landscape in Tianjin Harbour Park, in

order to restore and improve the ecological environment in this region through cell regeneration. The design scheme includes selecting suitable plant communities and tree species to increase vegetation coverage and improve habitat conditions; introducing suitable animal species to improve biodiversity and ecological balance; adopting appropriate soil restoration techniques to improve soil quality and nutritional status; and combining landscape design principles to create a pleasant visual and experiential environment to enhance the attractiveness and sustainability of the park [1]. Through the implementation of these ecological restoration design measures, we are expected to restore and improve the ecological quality of the brownfield landscape in Tianjin Harbour Park, and enhance its value as an urban green lung and people's leisure and entertainment place.

2. The Theoretical Basis of Ecological Restoration

2.1. Definition and characteristics of the ecosystem

The definition of an ecosystem: An ecosystem refers to a dynamic and balanced system formed by the interaction between living organisms and the abiotic environment that they are located in [2]. Ecosystem includes multiple levels and components such as species, communities, ecological niche and ecological process. It is a complex network of interdependence and interaction between organisms and the environment.

Characteristics of the ecosystem: Ecosystem is a comprehensive system, which includes a variety of organisms, environmental elements and ecological processes. The interaction between organisms and the interaction of environmental elements constitute the complexity of the ecosystem. There are multiple levels of components in ecosystems, from individuals, populations, communities to ecological niche and ecological processes. Each level has its own unique characteristics and functions, forming a distinct structure between each other. An ecosystem is a dynamic system in which organisms and environmental elements are in a changing state [3]. Species composition, community structure, and ecological processes in ecosystems are constantly adjusting and evolving to adapt to environmental changes.

2.2. Related theories and principles of ecological restoration

Theoretical basis of ecological restoration: Ecological restoration refers to the restoration, reconstruction or improvement of the function and structure of ecosystems that have been damaged or degraded through human intervention and management. (Table 1)

Principle: succession theory is an important theory in ecology that describes the dynamic changes of species in time and space. In ecological restoration, succession theory can be used to guide the process of vegetation restoration and select suitable plant species to promote the restoration and stability of the ecosystem.

Biodiversity is an important attribute of ecosystems that is essential for maintaining their function and stability. Ecological restoration should focus on protecting and increasing biodiversity to restore the integrity and health of damaged ecosystems [4].

Global change poses great pressure and threat to ecosystems, and ecological restoration needs to consider the impact of global change and take corresponding adaptive measures. Global change adaptation theory can guide strategies and

measures in ecological restoration to improve the adaptability of ecosystems to global change.

Table 1. *Distinction of concept.*

Name	Concept	Similarities And Differences
Ecological restoration	Through artificial means, to restore it to the normal and healthy ecological cycle function.	Emphasis on artificial means of intervention, mainly refers to the restoration and sustainable development of the ecological environment.
Sustainable development	Can satisfy the current work Can demand, can also meet Future functional requirements.	Start with the known problems, and explore the methods of urban sustainability.
Elastic city	Has to withstand the impact and can Recovery yourself soon Key features.	Emphasize the adaptability of the city itself after being impacted by multiple risks.

3. Analysis of the Current Situation of the Brownfield Landscape in Tianjin Harbour Park

3.1. Topography and soil conditions

Topography refers to the undulating characteristics of the terrain on the surface of the earth. In the ecological restoration design of the brownfield landscape in Tianjin Harbour Park, understanding the terrain condition is of great significance for reasonable vegetation selection, water configuration and drainage system planning. The terrain of the brownfield landscape in Tianjin Harbour Park is relatively flat, presenting an open plain landform. However, there may be weak fluctuations, slopes or low-lying areas, and these topographic features can have some influence on the distribution of water and plant growth. Soil is a complex natural resource formed by the earth's surface through the physical, chemical and biological action of rocks [5]. The factors such as soil texture, fertility and humidity have an important influence on vegetation growth and ecosystem function. In terms of the soil condition of the brownland landscape of Tianjin Harbour Park, there are mainly the following characteristics: The soil texture of the brownland landscape of Tianjin Harbour Park is mainly clay and loam. Cclay soil has high water retention and water holding capacity, but poor permeability.

Loam is relatively loose, water permeability and water retention. The soil fertility of the brownland landscape in Tianjin Harbour Park is generally low, which is mainly affected by the soil texture, organic matter content and nutrient supply. As brownfield landscapes generally experience land-use changes and disturbances, soil fertility may be further reduced. Soil humidity of the brownfield landscape of Tianjin Harbour Park is affected by precipitation and underground water level. Due to the relatively flat terrain and poor water flow, there may be poor rainwater drainage. At the same time, the change of groundwater level will also have a certain impact on soil humidity. Understanding the topography and soil conditions of the brownfield landscape in Tianjin Harbour Park is helpful to design suitable vegetation restoration scheme, select suitable water configuration and drainage system, and take reasonable soil improvement measures for soil fertility, so as to achieve the goal of ecological restoration.

3.2. Water quality and ecosystem function

Water quality refers to the comprehensive characterization of various physical, chemical and biological characteristics in water bodies. In the ecological restoration design of the brownfield landscape in Tianjin Harbour Park, it is of great significance to understand the condition of water quality for the restoration and maintenance of the ecosystem function. Surrounding industrial, agricultural and living activities may lead to the discharge of wastewater and pollutants, causing adverse effects on water quality. Water pollution may include pollutants such as organic matter, heavy metals, and nutrients. Factors such as overfertilization, agricultural non-point source pollution and urban drainage may lead to water eutrophication[6]. Eutrophication can lead to algae outbreaks and the death of aquatic life, affecting the ecological balance and water quality of water bodies. The water flow rate and water depth all affect the oxygen content, temperature stratification and the settlement of suspended particles. Too fast flow rate or too shallow water depth may cause water quality problems in water bodies, such as water with insufficient oxygen content and eutrophication.

Ecosystem function refers to the role and services played by the ecosystem in the process of maintaining and supporting the survival and evolution of organisms [7]. Understanding the ecosystem function of the brownland landscape in Tianjin Harbour Park can provide reference and guidance for ecological restoration. Biodiversity is an important function of ecosystems, which plays an important role in maintaining their structure and stability. restoring and increasing species diversity in brownfield landscapes can improve ecosystem fitness and resilience.

4. Case Analysis

In Qijiang Park, Zhongshan City

After several decades of industrialization process, Zhongshan Qijiang Park has a very strong historical and cultural significance . The original site was an abandoned shipyard. Its main purpose was to transport goods, but as the transport became more and more developed, it was gradually used by land transport instead of water transport, so the shipyard was abandoned, leaving many industrial sites (Figure 1). Later, the government decided to build the place into a park for people, and asked Professor Yu Kongjian to design and build it (Figure 2).



Figure 1. Original appearance of Qijiang Park in Zhongshan City.



Figure 2. Current situation of Qijiang Park in Zhongshan City.

At the beginning of the garden construction, the designers put forward three solutions to design, the first is the garden design for a very common lingnan landscape, after all, Zhongshan in lingnan region, the growth of plant types, so build it is give priority to with plant ecological landscape is reasonable. The second scheme is to design it into a European classical style landscape, because there are many overseas Chinese in Zhongshan, and many style architectural types also have many western

characteristics, so it is normal to make it into a European classical style [8]. The third design of bold and novel, is to keep some site renovation design, this idea for people still have a challenge, but the design of the more exciting can inspire designers interest, and the third design scheme can maximize save resources and cost, also can continue on the site of the history and culture, is also the history of the city. It is because of these reasons that the designers adopted this method to design. All the old ruins in the park will be retained, and then a secondary creative design for the park (Figure 3).



Figure 3. Final plan of Qijiang Park.

Zhongshan qi jiang park design is the designers in the self challenge, break through the previous ideas and ideas, design a unique style of leisure park, and on the function type has obvious division, is given priority to with the north, the north of the area near the urban traffic, so in the north area of the road, mainly is straight line, its purpose is to let people can have relatively open space, can less detours, and the south of the design area is mainly in natural landscape, using the original native plants, create privacy leisure space. The red part is the industrial culture exhibition area, which is the landscape node transforming the site in the site, mainly showing the industrial cultural landscape [9]. The yellow area is mainly a leisure and entertainment area, and the most interesting part of this area is the Zhongshan Art Museum. The green area is the natural ecological reserve. The main function of this area is to allow the people around it to enjoy the beautiful scenery, play, and walk in the garden.

5. Ecological restoration design scheme

5.1. Goal setting and repair principles

In the ecological restoration design of the brownfield landscape in Tianjin Harbour Park, a clear goal is crucial. The goal setting is designed to guide the implementation of the restoration project and ensure that the restoration measures can achieve the desired effect. Goal setting should be specific, measurable and achievable, considering the characteristics and needs of the ecosystem.

Restoration and enhance vegetation diversity in the brownfield landscape by introducing suitable plant species and increasing plant diversity. This helps to reconstruct the structure and function of the ecosystem, providing biodiversity conservation and ecological service functions.

The water quality of the brownfield landscape of Tianjin Harbour Park is improved by purifying the water body, controlling the pollution sources and regulating the flow rate [10]. This helps to restore the habitat of aquatic life and provide a suitable ecological environment, while protecting the health of water resources and water ecosystems.

By restoring the natural processes and ecological functions, the ecosystem function of the palm field landscape in Tianjin Harbour Park can be greatly enhanced. This restoration effort aims to improve various critical functions of the ecosystem, such as water purification, soil conservation, and climate regulation, in order to achieve the overarching goal of ecological restoration. One of the primary focuses of the restoration process is water purification. By restoring the natural hydrological cycle and implementing appropriate water management strategies, the palm field landscape can act as a natural filtration system, removing pollutants and improving water quality. This can be achieved through the incorporation of wetlands and the establishment of vegetative buffers, which help to retain and filter runoff water before it enters nearby water bodies. Soil conservation is another vital aspect of the restoration design. Through the implementation of erosion control measures, such as the use of erosion-control blankets, mulching, and terracing, soil degradation can be minimized and nutrients can be retained. Additionally, the introduction of suitable vegetation, including grasses and deep-rooted plants, can enhance soil stability and prevent soil erosion.

5.2. Soil improvement and vegetation restoration

By adding organic matter, such as humus, composting or biomass char, it can improve soil structure, increase soil water and fertilizer retention, provide nutrients and water needed for plant growth, and promote the restoration of vegetation and the function of the ecosystem. According to the test results of the soil pH value, appropriate measures can be taken to adjust the soil pH and make it suitable for the plant roots to absorb nutrients and water. For example, adding lime to increase the pH of acidic soil, or adding acid to reduce the pH of alkaline soil. Through reasonable drainage system and water management measures, the soil moisture should be regulated to prevent waterlogging and moisture oversaturation, and maintain appropriate soil moisture. This helps to improve soil aeration and root growth environment, promoting plant growth and root expansion. According to the content of soil nutrients and the needs of plants, timely nutrient supplementation can be conducted to provide the nutrient elements needed by plants. By applying organic fertilizer, inorganic fertilizer or trace element fertilizer, to supplement the missing nutrients in the soil, improve the soil fertility, and promote the recovery of vegetation.

Suitable plant species were selected for recovery based on the required ecosystem functions and soil conditions. Considering plant tolerance and adaptability, select plants that can adapt to the local climate, soil texture and humidity conditions. Reasonably configure and combine plants according to different ecological needs and functions. For example, plants with nitrogen fixation capacity were selected to improve soil nutrients, and plants with long roots and wind erosion resistance were selected to prevent soil erosion. The appropriate plant planting techniques are used to ensure good plant adaptation and growth. This includes timely sowing or transplanting, proper cultivation depth and spacing, and proper fertilization and watering.

6. Conclusions

The goal of the ecological restoration design is to restore the ecosystem function of brownfield landscapes, including increasing vegetation coverage, improving soil quality, and promoting biodiversity. In terms of vegetation restoration, plant species suitable for local climatic conditions and soil types should be selected, including herbs,

shrubs and trees. These plants can provide habitat, prevent soil erosion, and improve air quality. Soil remediation is a key step by including soil adding organic material, improving soil structure and supplementing suitable nutrient elements to improve soil quality and increase nutritional conditions for plant growth. To promote biodiversity, various biological habitats such as wetlands, stone piles, tree holes can be introduced into the design. These biological habitats are able to attract plants and animals of different species and increase biodiversity levels. Water resources management is also an important link, and measures such as rainwater collection, water purification and water recycling can be taken to ensure the water supply of the brownfield landscape and the health of the water environment. At the same time, regular monitoring and evaluation are required to understand the effect of ecological restoration design and timely adjust and improve the design scheme. Through the above ecological restoration design, we can effectively restore the ecosystem function of the brownfield landscape of Tianjin Harbour Park, improve the sustainability of the landscape, and provide people with a beautiful and healthy natural environment.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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