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Research on Ecological Restoration of Landscape Environment Based on the Perspective of Regional Environmental Culture

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ABSTRACT

With the rapid development of economy, the rapid growth of population and the accelerating pace of urbanization, water pollution is becoming more and more serious. Most urban parks and lakes are polluted and seriously eutrophic, losing their due landscape ecological value. This study takes lake A in a city as an example, based on the perspective of geographical environment and relying on the ecological restoration project of Lake A. This paper analyzes the changes of physical and chemical indexes and biological indexes of water quality with time series through the whole process tracking and monitoring of ecological restoration project; Through the evaluation of eutrophication of lake A, the test indexes and sensitivity of ecological restoration effect are studied. Combined with the current eutrophication evaluation system, new water quality test parameters are proposed to diagnose and evaluate the water quality of shallow eutrophic lakes after ecological restoration. The results show that through the implementation of ecological restoration project, the water quality of lake A has been well improved and basically stabilized at the class IV standard of surface water; The dominant species of phytoplankton community changed from large-scale colony algae to small-scale individual algae, the algal biomass was well controlled and the eutrophication status was improved.

Keywords: Geographical Environment Perspective, Park Lake Landscape, Ecological Restoration, Urbanization.

INTRODUCTION

In the colorful water body of nature, the lake is the treasure and the pearl of water resources (Macdonald & King, 2018). Compared with other forms of water bodies, lakes can create and improve the ecological environment, and often become the sustenance object of people's emotional life, with unique resource advantages (Reyes-García et al., 2019). Urban artificial lakes refer to small and medium-sized artificial lakes located in the urban areas or suburbs of large and medium-sized cities. In recent years, many countries have gradually attached importance to the construction of urban ecological environment, successively put forward the concepts of building "ecological city", "garden city" and "green home", and gradually implemented them (Winkler et al., 2018). With the development and expansion of the city, many lake scenic spots that used to be in the suburbs or extend outside the city are gradually surrounded by the city and become urban lakes (Vrahnakis, Nasiakou, & Soutsas, 2021). These natural lake scenic spots that have been integrated with the city are no longer simple natural scenery or scenic spots. The scenic spots at the junction with the city will inevitably become urban parks, from the original single production and life lakes to urban park lakes with multiple meanings such as history, culture, ecology, landscape, recreation and urban image (Fox & Cundill, 2018). Today, the natural lake landscape as an urban park condenses the continuous efforts of predecessors and is the carrier of urban historical and cultural inheritance. It can not only regulate the climate of a region and play an important role in improving the urban ecological environment, but also play an important role in shaping the characteristics of urban landscape (Cross & Lambers, 2017). Lakes, rivers, mountains and roads in the city constitute the skeleton of the urban spatial pattern. The green open space composed of scenic lakes is also one of the most attractive places in the city. Under the guidance of ecological principles, ecological remediation is a comprehensive remediation method of polluted environment based on bioremediation, combined with various physical remediation, chemical remediation and engineering technical measures, through optimal combination, so as to achieve the best effect and minimum cost (Matzek, Wilson, & Kragt, 2019). Ecological restoration of polluted environment is to optimize and synthesize various restoration methods according to ecological principles. Its primary characteristic is that it strictly follows the ecological principles of circular regeneration, harmonious coexistence, overall optimization and regional differentiation; Secondly, ecological restoration is mainly completed through the life activities of microorganisms and plants (Pan et al., 2019). Various factors affecting biological life will also become important factors affecting ecological restoration. Therefore, ecological restoration also has the characteristics of many and complex influencing factors; Thirdly, the smooth implementation of ecological restoration requires the participation of many disciplines such as physics, chemistry, botany, microbiology, cultivation and environmental engineering. Interdisciplinary is also the characteristic of ecological restoration (Abella, Schetter, & Walters., 2018).

However, with the continuous acceleration of urban development in recent years, the contradiction between urban construction and natural lakes has become increasingly prominent (Zou, 2019). To develop the city, more construction land is needed. In order to solve this problem, on the one hand, it extends to the surrounding areas and "spread the big cake" outward, on the other hand, it occupies various natural spaces in the city. In a modern city with an inch of land and an inch of gold, it is difficult for the golden areas surrounding natural lakes to escape the fate of being eroded (Luke et al., 2017). Urban development has plundered the development and utilization of scenic lake resources and adopted a step-by-step pressing strategy, so that the remaining natural scenic lakes that have escaped the annihilation of nature have to face the deterioration of ecology and the decline of landscape quality due to human intervention, Even the plight of the continuous disappearance of natural water landscape (Gann et al., 2018). Many urban lake parks used to be beautiful natural scenic spots, but now there is a serious tendency of urbanization, which is full of a large number of artificial landscapes. The natural landscape style of the lake park has been broken, and the original good landscape ecological pattern of the city has also been seriously affected (Tang et al., 2019). There are some phenomena, such as the intensification of the heat island effect, the bottleneck of the development of urban outdoor green public space and urban ecological construction, and even ecological crisis and one side of a thousand cities. The environmental capacity and ecological carrying capacity of many urban artificial lakes are overburdened, and the ecosystem has been seriously damaged. The park artificial lakes above China have been polluted to varying degrees (Strzelecka, Woosnam, & Nisbett, 2018). The pollution indicators such as chemical oxygen demand, total nitrogen, total phosphorus and non-ionic ammonia mostly exceed the national surface water environmental quality standards. Generally, the eutrophication of artificial lakes is serious. The contents of phosphate and nitrogen salts are high, and the contents of bottom nutrients and organic matter are also high, which are higher than those of natural lakes. Some are even several times higher than those of urban water bodies such as Hangzhou West Lake and Nanjing Xuanwu Lake. Due to the destruction of water structure and ecological function, the biodiversity of water body is lost, the aquatic resources and their aesthetic value are damaged, and the water body set up to improve the environment has also lost its significance. This result is contrary to the original intention of improving people's living standards (Mansourian & Parrotta, 2019).

Ecological restoration uses the principle of ecosystem, adopts various methods to repair the biological population and structure of damaged water ecosystem, rebuild healthy aquatic ecosystem, repair and strengthen the main functions of water ecosystem, and enable the ecosystem to realize a virtuous cycle of overall coordination, self-maintenance and self-succession (Hu, Chang, Liu, & Feng, 2018). Ecological restoration governs the polluted water body by strengthening the self-purification ability of nature, which reflects the logical idea of pollution control of harmonious coexistence between man and nature. It is a new technology widely used in the treatment of polluted lakes at present. This study takes lake A in a city as an example, relying on the ecological restoration project of Lake A. Through the study of eutrophication of Lake A, this paper studies the test indicators of ecological restoration effect and the sensitivity of each indicator of ecological restoration effect, combined with the current eutrophication evaluation system. A new water quality inspection parameter is proposed to diagnose and evaluate the water quality of shallow eutrophic lakes after ecological restoration, which provides a new method for the diagnosis and evaluation of water quality of urban shallow lakes after ecological restoration.

RELATED WORKS

The theory of "lake ecological restoration" originated in Europe and America. Based on many years of research on basic theories and applied technologies of Limnology, American scholars have explored and planned the ways of restoration and reconstruction of the damaged aquatic ecosystems of the five Great Lakes, such as Lake Erie and Lake Michigan (Li, Gao, & Chen, 2020). Remarkable achievements have been made in the eutrophication control of the Great Lakes, the removal of refractory toxic pollutants, the restoration of fishery resources and the reconstruction of natural landscape. Lake Washington has achieved remarkable results in eutrophication water quality control and improvement, which is regarded as an example of lake ecological restoration. Some European countries have carried out a lot of research on water ecosystem restoration and achieved remarkable results. Biological manipulation technology has been applied in Britain to keep low algae biomass and high transparency in reservoirs near London (Cui et al., 2018). Trummen Lake in Sweden receives a large amount of domestic and industrial sewage, resulting in serious fish death. As a result of the subsequent centralized treatment of ecological engineering, the water quality has been greatly improved. Zhu et al. (2019) proposed bottom-up and top-down treatment methods to realize lake ecosystem restoration, that is, control from the input of nutrients and aquatic organisms at the initial level of the food chain, so as to control the input and output load of pollutants and achieve the purpose of purifying the whole system. This method provides a new idea for the restoration of lake ecosystem, that is, in the process of lake ecological restoration, the top control of pollution sources and the treatment of pollutants at the bottom of the lake must be carried out at the same time, so as to fundamentally solve the environmental problems of the lake and realize the goal of lake ecological restoration (Park & Choi, 2020). Japan, South Korea and other countries in Asia have paid special attention to the research of ecological restoration in recent years, and implemented a series of ecological restoration projects to improve the water quality of rivers and lakes and ensure the drinking safety of drinking water (Tidball, Metcalf, Bain, & Elmqvist, 2018). The research on Lake Ecological Restoration mainly focuses on the restoration of wetland around the lake, the restoration of lakeside zone, the restoration of aquatic organisms and so on. On the basis of in-depth and detailed research on the ecosystem characteristics of Bai yang Dian, Hebei Province, the Institute of geography, the Institute of zoology and the ecological environment research center of the Chinese Academy of Sciences put forward a comprehensive technical scheme for regional water pollution control and water ecosystem restoration of Bai yang Dian (Sousa & Ríos-Touma, 2018). The field experiment conducted by White (White & Long, 2019) in Bai yang Dian studied the interception effect of the water land ecotone composed of aquatic plants on terrestrial nutrients. The results show that the reed community and the small ditch between communities in the water land ecotone around the lake can effectively intercept terrestrial nutrients. Li (T. Li et al., 2019) introduced the theory of lakeside ecosystem restoration and reconstruction, discussed the process of lakeside ecosystem restoration and reconstruction, and made a detailed comparative analysis of the main applied technologies. Fetene, Yeshitela, & Gebremariam, (2019) studied the remediation of micro pollution in water source lakes and reservoirs, and pointed out that the biological manipulation remediation method is a cheap and applicable method, which is suitable for the development of China's national conditions. Xu et al. (2019) studied the function of inhibiting cyanobacteria in the ecological restoration area along the northeast coast of Dian chi Lake. The results show that the restoration area can capture, enrich, decompose and eliminate floating cyanobacteria. At the same time, it can inhibit algae photosynthesis through the shading of aquatic plants, so as to achieve the effect of algae removal (Wallace & Clarkson, 2019). Water hyacinth is widely used to treat lake eutrophication by using aquatic plants. Water hyacinth is used to treat domestic sewage, and water hyacinth is used to purify wastewater from printing and dyeing, papermaking and petrochemical industry. Many studies have shown that it has excellent enrichment ability for heavy metals and has been used to treat a variety of heavy metals and polluted water bodies. So far, the research technology, methods and means of ecological restoration have made some gratifying achievements. However, due to the differences of regional and environmental conditions and the elements of park lake ecosystem, the problem of lake ecosystem restoration is still a difficult and hot issue.

METHODOLOGY

Landscape Elements and Functions of Urban Lake Park

The form of Urban Lake Park is the external manifestation of the complex relationship between various elements in the lake dominated environment. They always exist under certain conditions. On the one hand, the elements compete for space resources, on the other hand, they cooperate with each other to form a comprehensive whole. Therefore, it is constantly changing, with dynamic characteristics and development nature. To truly understand and study the Urban Lake Park, we need to study the landscape elements, the relationship and combination of elements, and find out the law of its development. Because there is no relevant literature to study the landscape element system of urban lake park before, based on the guidance of landscape ecology, the author integrates the urban landscape elements, lake and park landscape element system analyzed above, and puts forward the corresponding landscape element system of urban lake park after integration, analysis and refinement, as shown in figure 1. Among them, abiotic elements include natural conditions, such as climate, hydrology, geology, landform, soil, natural resources, such as solar radiation, water, land, salt mine and cultural resources. Elements mainly refer to human beings and their activities, including urban people, various artificial facilities and spiritual culture. Biological elements include natural plants and animals, such as forest land, grassland flying and ground animals and their habitats.

The landscape elements in urban lake park are not only independent, but also interrelated and restrict each other, forming a perfect and sustainable landscape system.

Ecological Restoration Methods

Ecological Engineering Technology of Constructing Wetland

Lakeside wetland project is a method to make full use of topographic conditions, artificially restore or build semi natural wetland system to improve the original lakeside ecological environment. Lakeside wetland is a transition and buffer area between water and land ecosystems. It has the functions of maintaining species diversity, regulating and stabilizing adjacent ecosystems, purifying water bodies and reducing pollution. Especially in the control of non-point source pollution. It can effectively remove pollutants through closure, sedimentation, adsorption and absorption, and create a pleasant landscape effect at the same time. The establishment of the wetland protection belt around the lake can effectively block and intercept the suspended solids carried by the surface runoff to degrade nitrogen, phosphorus nutrients and other organic matter, which is the last line of defense to control the land surface runoff or subsurface nutrients into the lake from the way of migration and transformation.

Artificial Medium Shore Ecological Purification Project

Artificial medium shore ecological purification project is in the lakeside zone where the lakeside is steep, the erosion is serious, the matrix is poor and hemorrhoids, and the vegetation is difficult to recover, or in the special-purpose zone where it is difficult to adopt other restoration technologies. Artificial media such as ceramic fragments and large rubble are stacked on the bank randomly or in some way, on the one hand, to reduce Lake scouring, on the other hand, to create a small environment suitable for the survival of microorganisms and benthic attached organisms in and between the artificial media, so as to achieve a certain goal of water purification and bank protection. Revetment is the landscape boundary between water and land. It is a heterogeneous landscape between water and land in a specific time and space scale. Under natural conditions, the distribution of revetment form is usually a strip structure parallel to the water edge, which has a variety of functions in the ecological dynamic system.

Artificial Aeration Technology

Aeration and oxygenation purification technology is to artificially fill air or oxygen into the water body according to the characteristics of hypoxia after lake water body is polluted, so as to accelerate the reoxygenation process of water body, so as to improve the dissolved oxygen level of water body. It is a rapid, efficient, simple and feasible technology for the treatment of polluted water bodies to restore the vitality of aerobic microorganisms in water bodies and enhance the self purification capacity of water bodies, so as to improve the water quality of lakes and reservoirs and promote the recovery of water ecosystem.

Add Microbial Preparation

In most lakes, there are many natural purification processes carried out by indigenous microorganisms, but the process is very slow. The reason is the lack of dissolved oxygen or other electron receptors and other conditions. Another limiting factor is that effective microorganisms often grow very slowly. Therefore, the addition of microbial agents and dominant bacteria can strengthen the water purification project and awaken the inactive microorganisms in the water. The addition of microbial agents will not destroy the ecological balance of the water body, and it is beneficial bacteria and does not pollute the environment. At the same time, it can also be used as bait for fish and shrimp in the water to promote biological growth. When the organic matter in the water body is degraded to a certain extent by microorganisms, the nutrients in the water body are controlled and the eutrophication is controlled. At this time, the growth of microorganisms is inhibited due to lack of nutrition. Therefore, the repair of polluted water body by microbial agents will not cause a large number of microorganisms and secondary pollution.

Layout of Sampling Points

According to the shape of the lake and the needs of research, four tracking and monitoring points are set at the lake inlet, the central area of the lake and the coastal zone around the lake. The characteristics of each point are as follows: point A: about 20m away from the shore, with a sewage outlet nearby; Point B: Lake Center; Point C: the bank corresponding to constructed wetland B, under willows; Point D: submerged plant planting area under the landscape bridge

ANALYSIS ON ECOLOGICAL RESTORATION OF PARK LAKES FROM THE PERSPECTIVE OF GEOGRAPHICAL ENVIRONMENT (TAKING LAKE A OF A CITY AS AN EXAMPLE)

Through man-made regulation, the ecological restoration project restores the polluted ecosystem to the natural state before interference, and restores its reasonable structure and ecological function. Ecological restoration project is an important tool for lake eutrophication control. Through ecological restoration project, we can improve the water quality of eutrophic lakes, improve the ecosystem structure and improve the ecosystem service function. After the ecological restoration work, this chapter makes an in-depth study on these problems, such as the restoration effect of the restoration project on the water quality and ecology of lake A, whether the eutrophication of lake A can be improved, how the temporal and spatial sequence changes of various ecological factors and the relationship between indicators.

Water Temperature and Transparency

Water temperature can affect dissolved oxygen concentration, chemical reaction rate and microbial activity. It is one of the most important common water quality indicators. During the survey, the water temperature of lake a basically changes with climate change, fluctuating at 16-35 ℃. Due to the small water area of lake A, the water temperature difference of the four sampling points is maintained at ± 0.5 ℃, which can be approximately considered as the same. The water temperature of lake A is suitable for the growth of algae, especially in summer. It is more suitable for the growth and reproduction of aquatic organisms such as algae. Careless management is easy to cause the explosive growth of algae in the water, causing the deterioration of water quality and the degradation of water function. Transparency (SD) refers to the clarification degree of water body and is one of the characteristic indicators of eutrophication. The lower the SD, the higher the eutrophication degree. Relevant studies show that the correlation between Lake nutritional status and SD is the highest (among all physical and chemical water quality indexes); TSI is an evaluation method of Lake nutritional status based on water SD. The change trend of transparency of lake a during the monitoring period is shown in figure 4. During the construction of ecological restoration project, the SD of lake a is basically at a standstill stage, basically stable at 40-50cm; In June, due to the gradual rise of temperature and suitable for phytoplankton growth, SD decreased significantly to less than 40cm; In July, the ecological restoration project began to operate, the SD of lake A increased steadily, and the SD of the whole lake was basically stable at about 80cm.

Dissolved Oxygen and Chemical Oxygen Demand

The size of dissolved oxygen (DO) has an important impact on the survival of organisms in water. Higher dissolved oxygen content is conducive to inhibiting the release of nutrients from sediments to water. It can be seen from figure 5 that the DO of lake A water body increased steadily during the monitoring period; The DO level in summer and autumn was significantly higher than that in spring and winter. The investigation of water quality and ecological background value of lake A shows that the DO of lake A is 2.7 ± 0.3mg/l; After ecological restoration, the DO of lake A was significantly improved, and the DO of the whole lake increased to 8.8 ± 0.8mg/l. With the increase of temperature, algae in lake A are active, and their photosynthesis makes a significant contribution to the rise of DO. After the operation of the restoration project, the DO of lake a is basically maintained in saturated state (greater than 10 mg/L).

Chemical oxygen demand (COD) is an index to measure the content of organic matter in water. The greater the chemical oxygen demand, the more serious the water is polluted by organic matter. The change of COD of lake A with time and space during the monitoring period is shown in figure 6. It can be seen from the figure that the COD of lake A generally shows downward trend during the monitoring period. In the summer of 2021, when the water temperature is high and the water quality is usually the most unfavorable, the COD of lake a has an outbreak process. In July, the COD of the whole lake is as high as 81 ± 7mg / L, and the organic pollution is serious. With the operation of ecological engineering, COD in the whole lake began to decline in an all-round way.

Total Phosphorus

Total phosphorus (TP) is the result of the determination of various forms of phosphorus into orthophosphate after digestion. It is one of the commonly used eutrophication evaluation indexes. Phosphorus in water is a key element for algae growth. Excess phosphorus is the main reason for lake eutrophication. Figure 7 shows the temporal and spatial changes of TP in the lake with the water body during the monitoring period. It can be seen from the figure that TP in the whole lake shows a significant downward trend. Through the investigation of water quality and ecological background value of lake A, the TP of the whole lake is 0.85 ± 0.02 mg / L; After ecological restoration, TP in the whole lake decreased significantly to 0.27 ± 0.01mg/l. After the operation of the ecological restoration project, the TP in the whole lake continues to maintain a downward trend and is basically stable below 0.11 mg / L (class IV standard for surface water).

Time Series Changes of Algal Biomass

With the implementation and operation of the remediation project, algal biomass decreased significantly. In June 2021, the algae density in Lake A was 40.0 ± 6.7 × 104 cells / ml. in September of the same year, the algae density in Lake A decreased to 16.0 ± 1.7 × 104 cells/mL。 There was no significant difference in algae density in space. It can be seen from the time series change of algal biomass (figure. 8) that in shallow lakes, the ecological restoration project has a significant inhibitory effect on algae, which can effectively control algal biomass and improve the ecosystem stability of the lake.

CONCLUSION

This paper mainly studies the treatment effect of ecological restoration project on urban park lakes, and evaluates and studies the eutrophication of urban park lakes. Taking lake A as an example and relying on the ecological restoration project of lake A, this paper pays attention to the change law of physical, chemical and ecological indexes of lake A in the whole process of ecological restoration, and analyzes and summarizes the relationship between physical, chemical and ecological indexes of Lake A; Select appropriate eutrophication evaluation methods to scientifically evaluate the degree of lake eutrophication; This paper studies the test indexes of ecological restoration effect, tests the sensitivity of each index of ecological restoration effect, puts forward a new diagnosis and evaluation method of water quality of shallow eutrophic lakes after ecological restoration, and finally obtains the following conclusions.

Before the implementation of the ecological restoration project, lake A was a typical shallow eutrophic urban park lake with serious pollution. The investigation of water quality and ecological background value of lake A shows that the water quality of lake A is inferior to class V. Through the implementation of ecological restoration project, the water quality of lake a has been better improved and basically stabilized at the class IV standard of surface water; There are no submerged plants in the lake, and the species of Cyanophyta and Chlorophyta are dominant in the algae population. Through the monitoring of phytoplankton community succession, it is found that phytoplankton community in lake A has changed significantly during the implementation of ecological restoration. Phytoplankton in lake A are mainly cyanobacteria and green algae, which are gradually transformed into diatoms, green algae and blue algae. The symbiosis of various algae has improved the diversity of algae. At the same time, the dominant species of phytoplankton community has changed from large-scale colony algae to small-scale individual algae, and the algal biomass has been effectively controlled, indicating that the restoration project has achieved the expected effect in eliminating the hidden danger of water bloom and constructing a reasonable ecosystem community structure.

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