

Study on ecological conservation planning of Xianyue Park in Xiamen City, China

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Abstract. The paper discusses the current situation and existing problems of ecological restoration and tourist infrastructure development of Xiamen Xianyue Park located in Xiamen Island, China. Issues of ecosystem restoration and landscape improvement, restoring habitats, and ecosystem management system are analyzed. Options of further optimization of the tourist-targeted infrastructure are proposed, which take into account the ecological system and landscape pattern optimization, promotion of ecotourism, and implementation of the ecological management system. The particular solution envisages the park zoning with three primary zones (ecological protection, ecological buffer, and general activity zones) and five secondary ones (scenic landscape, ecotourism, religious activity, buildings and structures, and entertainment zones). By integrating the ecological principles into other land use objectives, taking full advantage of the park ecological and cultural heritage, and improving its ecological management, it is expected to provide the ecological restoration of the park under study and optimize its contribution to the regional economic and social development.

1. Introduction

Conservation planning involves the development of measures to guide long-term management of species and their habitats within the constraints posed by different types of land and resource use. The goals of a conservation planning document may include: incorporating human land uses while avoiding harm to resources; preserving, enhancing, or restoring habitats; aiding the recovery of sensitive species; restoring natural hydrologic and geomorphic processes; mitigating impacts on biological resources; or integrating ecological principles into other land use objectives.

Within the framework of urban garden ecosystem restoration, city parks become increasingly important for the urban society harmonization. As an integral component of urban landscape and a symbol of modern civilization, the ecological conservation and construction of urban parks are aimed at improving the ecological environment and urban life quality, increasing urban biodiversity, and harmonizing the urban social relations. As an integral component of Xiamen city, Xiamen Xianyue Park is vital for the urban ecosystem. However, in recent decades, Xiamen city faced severe environmental problems, as by-products of quite impressive achievements in its economic and social development. The explosive urban development and construction led to erosion of the park mountains, creeping penetration of construction sites into the park land, and gradual deterioration of the unique park environment. On the other hand, Xianyue Park, as an important green space in Xiamen Island, is lacking in the forest type and landscape diversity, as well as is too scarce of ecological and cultural artefacts,



which deteriorates its image of the “ecological civilization pillar” of Xiamen City. This necessitates a further comprehensive development of Xianyue Park, keeping in pace with the state-of-the-art requirements of ecological protection planning, finalization of the building line (i.e., the line set with respect to the frontage of park, which is fixed by the municipal regulations, statute, deed/contract and beyond which no buildings of any kind can be erected), strict building line management, implementation of zoning control, and restoration of the natural landscape.

2. Analysis of the present situation of Xianyue Park

Xiamen Xianyue Park (Figure 1) is located in the central part of Xiamen Island and is related to Huli and Siming administrative districts. Being nearly in the downtown of the city of Xiamen, the park is located to the east of Fuxia Road, is adjacent to the Hi-tech Development Zone, Xikao Shugang Road, Dongdu port area, a new urban area to the south, Linxian Yue Road, Lake Industrial Zone to the North. The park is surrounded by more than 10 residential land plots, and is adjoined by the port, industrial areas, villas, schools, and consulates.



Figure 1. Geographical location of the study object

2.1 Xianyue Park status quo

Xianyue Park includes five natural mountains, namely Xianyue, Xian Dong, Songbai, West, and Bee Mountain, and other hills, which form the mountain belt park with the highest point of 212 meters above the sea level and have the total area of 233.13 hectares protected by the building line restrictions. At present, there are 4 km-long ridge tour line and 21 km-long walking road, the main attractions being Goddess of Mercy Temple, Tianzhuyan Temple, the Land temple, Century Peace Park, Xianyue Shan Cultural Square and a number of viewing platforms^[1]. Relying on the most important traditional culture of Xianyue Mountain for the Fujian Faith and the Fujian culture. In September 2008, Xianyue Mountain Land Temple was opened under the guidance of Xiamen Minnan (South Fujian) Culture Research Association, where the first Fujian Cultural Festival and Fujian Culture Forum were held. Since 2009, the fairy mountain Fujian faith is officially recorded as Fujian Province and Xiamen City intangible cultural heritage. According to the survey, the whole forest coverage rate of Xianyue Park is more than 80%. The present vegetation type is mountain forest. The dominant species are *Pinus massoniana*,

Acacia mangrove and *Pinus massoniana*, *Acacia* mixed forest, with the local distribution of mountainous shrub, orchard, evergreen vegetation, while the species diversity is relatively low.

2.2 Protection and Development of Xianyue Park

2.2.1. Ecological environment protection and construction

Xiamen City is a subtropical evergreen broad-leaved forest, but for historical reasons, the original forest of Xianyue Park has been destroyed long ago. Although the coverage of existing forest vegetation has been greatly improved, the secondary forest represented by *Pinus massoniana* and *Acacia* has become the main forest types, thus lacking in diversity. The forest structure being so limited, the ecological function of the forest ecosystem is declining, the stability of the ecosystem is poor, while its ability to resist the invasion of alien species is also low and prone to forest pests.

2.2.2 Tourism development and cultural construction

Xianyue Park has a convenient location and transportation, as well as many other advantages, but not enough scenic spots, picturesque places or tourism projects. The available tourism projects are quite simple and take no account of the natural landscape advantages, thus reducing the opportunities for attracting more tourists and developing the respective infrastructure. As an important municipal park and public green space in Xiamen Island, Xianyue Park attracts many visitors, but fails to play its due role in the environmental culture, ecotourism, and nature perception education. The ecological and cultural connotations of the park have not been fully acknowledged and used, due to the lack of ecological and cultural artefacts, which drawbacks hinder its positive impact on the dissemination of environmentalistic values. Therefore, the ecological civilization fails to keep its pace with the explosive economic development of the region and requires an urgent support.

2.2.3 Park land management and system construction

Xianyue Park relies on four natural mountain ranges, the major ones being Xianyue Mountain and Xiandong Mountain. The park land is close to the urban construction area, while the absence of an ecological buffer zone between the park and construction area, such as protection forests, makes it very susceptible to negative effects of the urban development. After twenty year since the park's establishment, its boundaries are still affected by the development of urban development, the borderline mountain constantly suffers from encroachment (penetration), and the land area keeps shrinking. Since 1995, the mountain area of Xianyue Park has been reduced by about 12.04 hectares, which mainly corresponded to the forest zone. The conflict of interests of the urban construction and park protection is becoming more and more prominent. The management system is outdated, while the legal supervision fails to provide the sustainable development of Xianyue Park.

3. Planning strategies and objectives

Based on the above analysis of current situation and the existing problems of ecological protection and development of Xianyue Park in Xiamen City, this study presents three schemes of constructing the landscape pattern, cultural artefacts, and management related to the ecological system. They are aimed at the optimization of tourism environment of Xianyue Park, comprehensive account of all advantages of the park ecological culture significance, and improvement of the ecological management, in order to create a scenic environment with distinctive ecological benefits. The plan envisages a gradual implementation of the ecological conservation cordon (building line) in Xianyue Park via the primary ecological restoration stage and a secondary long-term improvement stage, with a strict boundary control and zoning supervision, enhancing the legal regulation and environmental supervision, restoring the damaged mountains and the ecosystem. It is also envisaged to develop the park ecological management and protection system, scientifically substantiate the ecological value and status of Xianyue Park, and realize the coordination between Xianyue Park Ecological Zone and the city urban construction authorities.

4. Ecological functional zoning and conservation planning

4.1 Ecological function zoning planning

The ecological functional zoning is based on the regional environmental sensitivity, the importance of ecological service function, the similarity and difference of ecological environment characteristics, and so on^[2]. The ecological functional zoning Xianyue Park is provided according to the characteristics of its environment and management, based on the geographical environment, land use, ecosystem type and ecological service function. The purpose of zoning is to highlight the ecological functions and requirements of different ecological units, and provide a transparent guidance for their ecological protection.

According to the principles and methods of ecological functional zoning, Xianyue Park is subdivided into three primary and five secondary ecological functional areas, which are described in detail in Table 1 and depicted in Figure 2, while the respective landscape types and functional characteristics are presented in Table 2.

4.2 Biodiversity Conservation Planning

Biodiversity conservation planning is the prerequisite for improving the ecosystem function of the urban ecological park. Its stability and maintenance are very important for the sustainable development of the regional social economy. Human activities are the most direct disturbing factors that cause the loss of park biodiversity^[3]. The conservation of the biodiversity of Xianyue Park should be carried out according to the ecological principles, including such levels as: landscape, community, population, species, etc.

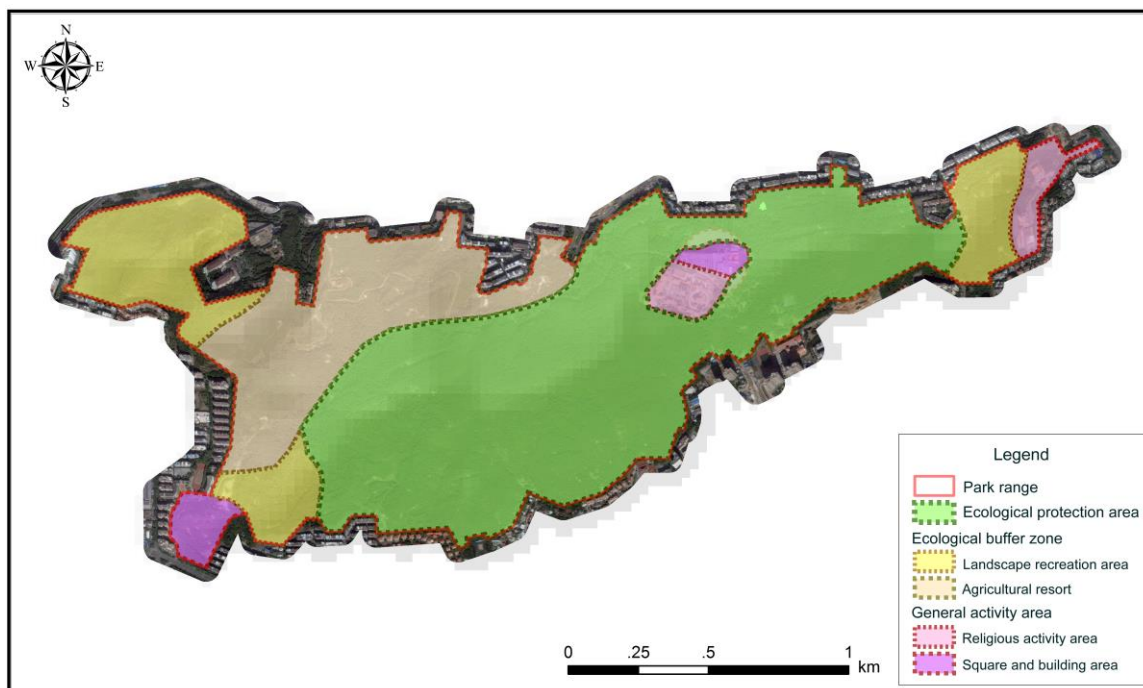


Figure 2. Ecological protection zoning map of Xianyue Park.

The protection and construction strategy of the conservation plan of Xianyue Park includes three aspects: (1) optimizing the overall pattern; (2) coordinating the process of human intervention and naturalization; and (3) creating a reasonable plant community. On the other hand, the conservation planning envisages: (1) propelling forest form reconstruction projects, the focal point is ecological conservation region which belong to ecological function subarea. (2) improving maintenance management to further improve covering area and overall ecological level of the park, enriching vegetation types and

near-natural to highlight plant diversity and community diversity. (3) enhancing conservation of wild animals and perfecting current resources survey of wild animals, then protecting the ecological environment of their habitat.

5. Ecological and cultural construction planning

The term “ecological culture” pertains to the common development of humans and nature. It is the concept linking natural and social relations, which implies a pursuit of ecological balance and sustainable development in the process of transforming the objective material world. It advocates the harmonious coexistence of man and nature, close-to-nature life pattern and civilized morality, so that people really understand, respect, protect and enjoy the nature^[4]. The urban ecological park is an important portal for people to get closer to nature and perceive its unique and irreplaceable role and status in the ecological and cultural systems^[5].

In recent years, Xiamen has been actively propelling the national ecological civilized values. In this respect, Xianyue Park has a great potential in the development of ecological culture and education with its abundant historical humanistic resources and natural sceneries. The latter supply favorable opportunities and space to promote ecological cultures and advocate the respective perception to edify a harmonious coexistence between man and nature, to educate the general public and tourists on the ecological culture, advocating the environment-friendly and healthy concept of life.

NO.	Functional zoning		Area (hm ²)	Basic ecological functions	Protection requirements
	Primary zone	Secondary zone			
1	Ecological protection zone	/	133.58	Natural mountain and forest ecosystem protection	To allow low-intensity (easy) landscape tours and the necessary landscape infrastructure to be built, requiring special management to exert ecological functions, and minimizing human disturbance
2	Ecological buffer zone	Landscape recreation area	42.83	Improve the ecological environment, the formation of urban built-up area to the mountain ecological protection zone transition buffer area	Allow moderate intensity recreational activities, ecological education and experience, and appropriate infrastructure to prevent large-scale construction activities from damaging the overall ecosystem
		Agricultural resort	40.70		
3	General activity area	Religious activity area	9.09	To provide visitors with a variety of recreational, entertainment, and religious ritual activities	Allow high-intensity recreation, entertainment, should strengthen the management of tourists and green management, to prevent the occurrence of forest ecological risks
		Square and building area	6.92		

Table 2. Functional characteristics of each landscape functional zone

Functional zone	Landscape type	Landscape features	Functional characteristics	
			Ecological function	Usage function
Ecological protection area	Habitat patches	It should have a complex hierarchical structure and diversity of near-natural vegetation covered by the ground. The landscape is natural.	It has the ecological function as habitat, "source and sink" landscape, the ability of self-maintenance and natural evolution, strong natural ecological function	Only limited usage
Ecological buffer zone	Ornamental woodland, ecological agriculture plaque	A simple semi-artificial or artificial vegetation-covered ground with ornamental-oriented structures; or artificially introduced fruit trees The landscape is semi-natural.	Has the ecological function as the sink, the barrier and the filter, has certain natural ecological function	With a proper number of relatively static leisure activities, recreational function
General activity area	Buildings, squares, event facilities	Hard or semi-hard ground/soil is required for buildings, structures and artificial infrastructure, which are mainly used for human activities. The landscape has artificial features.	The natural ecological function is very feeble, or even has a negative interference	With a variety of recreation, education, religion, cultural functions

According to the distribution of scenic spots and natural and cultural landscape resources in Xianyu Park, its zoning implies its subdivision into forest landscape recreation, forest tour and sports, religious cultural experience, ecological agricultural resort, and ecological forest zones. By strengthening the ecological and cultural infrastructures, developing ecotourism activities, the construction of ecological civilization education base, improve the park-supporting infrastructure management, through these four aspects to enhance ecological and cultural connotations, and enhance the ecological awareness.

6. Construction planning of ecological management system

Based on the analysis of the existing problems in the management and system structure of Xianyu Park, this study attempts to optimize the ecological system structure, ensure the sustainable health of the ecological environment and the complete realization of the service function. The particular recommendations can be reduced to the following ones:

Firstly, to protect the building line as the basis for the implementation of the building line management system. In compliance with the "Xiamen City ecological building line planning", which implements the relevant provisions and requirements for the ecological cordon (building line) of Xiamen city, it prohibits rigidly the unordered pervasion into urban lands and encroachment into park land. At the same time, the establishment of Xianyu Park ecological protection responsibility system, will clearly define the responsibilities of relevant departments and streets, labor division mechanism, to achieve the "three-in-one" principle for sharing the responsibility, measures and results.

Secondly, based on the ecological function zoning, the space control requirements should be strictly defined. This work is organized by Xiamen Xiongyue Park Management Office in cooperation with relevant functional departments, in order to formulate regulations on the management of Xianyu Park. It clearly stipulates the spatial management and ecological protection requirements of three types of ecological functions such as ecological protection zone, ecological buffer zone and general activity area. The development strength and behavior of different functional zones should be controlled. The environmental supervision of Xianyu Park and management of public facilities should be improved, with an emphasis made on environmental pollution and sanitation issues.

Thirdly, to promote the tourism environment capacity as the basis, innovation capacity control management. According to the principle of ecological capacity safety, ecological protection planning needs to consider the capacity of Xianyu Park ecosystem to the overall scale of its functional system. In this study, the tourism environment capacity of Xianyu Park is estimated as 20,220 person per day. In accordance with the park tourism environmental capacity calculation results to strengthen the management of tourists, the resource and environment monitoring system should be renovated and adjusted for the under- and overload conditions to strengthen the respective control measures.

7. Conclusions

In this paper, the ecological conservation planning of the Xiannyue urban ecological park of Xiamen City is presented, which feature the following three aspects:

- (1) Designation of ecological functional conservation zoning. According to the differences of the dominant functions in different areas of the park and the control requirements of different ecological units, the functional zoning is defined and the main ecological functions and protection requirements of each zone are determined, which provide a proper guidance for the ecological conservation and functional management of the park.
- (2) The ecologic culture-related construction planning is proposed, by which Xianyu Park will be subdivided into respective five zones (scenic landscape, ecotourism, religious activity, buildings and structures, and entertainment zones).
- (3) Enactment of the ecological management system. The ecological management system, which is based on the "cordon/building line management, space control and capacity regulation", ensures a rational and sustainable utilization of the park resources and environment, harmonious coexistence and synergetic development of humans and nature.

References

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