

# Problems and Development Countermeasures for the Status of Shenzhen Nature Reserves

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**Abstract:** With the rapid development of Shenzhen City in Guangdong Province, a series of problems such as the reduction of natural resources and environmental degradation have emerged. Only by exploring the balance between urban development and ecological conservation can sustainable development take place. As the core carriers of ecological construction, nature reserves have the role of maintaining the normal functioning of natural ecosystems, providing shelters for the survival of species, and preserving species and genetic diversity. This paper will describe the current situation of nature reserves in Shenzhen and the problems of habitat fragmentation, invasive plants disturbing the ecological balance, and marine ecosystems being polluted, and discuss the countermeasures for the development of nature reserves in Shenzhen with respect to these problems.

**Keywords:** Shenzhen; natural protected area, ecological environment, ecological protection, development countermeasures

## 1. Introduction

In 2019, the General Office of the Central Committee of the Communist Party of China (CPC) and the General Office of the State Council issued the Guiding Opinions on the Establishment of a System of Natural Protected Areas with National Parks as the Mainstay, pointing out that a natural protected area is a land or sea area that has been legally delineated or recognized by all levels of government for the implementation of long-term protection of important natural ecosystems, natural monuments, natural landscapes, as well as the natural resources, ecological functions, and cultural values that they carry. Natural protected areas are categorized into three main groups: national parks, nature reserves and natural parks.<sup>[1]</sup>

Liu Zengli, Hu Lile and others believe that natural protected areas are the core carriers of ecological civilization, with high ecological value and rich species diversity, and play an important ecological benefit such as water conservation, soil conservation and wind and sand control.<sup>[2]</sup>

## 2. Status of natural protected Areas in Shenzhen City

### 2.1. Overview of Shenzhen

Located in southern China, Shenzhen is a seaside city situated in the southern part of Guangdong Province. It is located south of the Tropic of Cancer, between 113°46' and 114°37' east longitude and 22°27' and 22°52' north latitude. It is bordered by Daya Bay and Dapeng Bay to the east; Pearl River Estuary and Lingding Sea to the west; Shenzhen River to the south and Hong Kong; and Dongguan and Huizhou to the north. The sea area connects the South China Sea and the Pacific Ocean.

Shenzhen covers an area of 1997.47km<sup>2</sup> with an average elevation of 70-120m. The topography of the region is high in the southeast and low in the northwest, with low mountains dominating in the southeast, hills in the center and northwest, and impact plains in the southwest. The zonal vegetation of Shenzhen is tropical evergreen monsoon rainforest and southern subtropical monsoon evergreen broad-leaved forest. Natural resources such as mountains, water, forests, fields, lakes, grasses and oceans are complete, with the greening coverage rate of the built-up area reaching 45%, the per capita area of public green space being 16.01m<sup>2</sup>, and the forest area being 797km<sup>2</sup>, with the forest coverage rate reaching 40.21%.<sup>[3]</sup>

## **2.2. Status of natural protected areas in Shenzhen City**

(1) The construction of forest and wetland parks is better. The ecological environment is at a relatively healthy level, and the ecological landscape and ecological recreational functions of forest parks and wetland parks are good; In recent years, Shenzhen has built a number of new coastal parks, beach parks, forest parks and wetland parks. So far 921 parks have been built in Shenzhen.

(2) Continuous greening of the national territory and healthy forest ecosystems. Shenzhen has established a high-standard ecological forest-viewing belt, constructing green landscape belts near 19 high and fast highways and railroads, with a total construction mileage of 475 kilometers and a construction area of about 120,000 acres. By the end of 2022, there will be a total of 25 natural protected areas in the city's terrestrial area, whose area accounts for 23.91% of the total terrestrial area of Shenzhen. With the Le Duc Azalea Sea, the waterfront cityscape as well as the Wutong Mountain Hairy Cotton Azalea Sea and other characteristic landscape boutique projects, the quality of forests is maintained at a high level. The relevant departments strictly prohibit the transplantation of large natural trees and old and valuable trees, and strictly care for old and valuable trees.

(3) Shenzhen has planted 50,000 general seedlings and completed more than 40 rural greening and beautification projects. It has actively promoted the construction of three-dimensional greening and established a three-dimensional greening standard system.

(4) Shenzhen has completed the construction of more than 2,400 kilometers of greenways, with a density of more than 1 kilometer/square kilometer and a high quality of greenways. In 2022, 368 kilometers of new greenways will be built and renovated, and 248 kilometers of hiking trails will be country trails. There is no lack of boutique greenways that are popular with the public and have become new hotspots for eco-tourism and leisure vacation.

## **3. Problems and deficiencies**

### **3.1. Habitat fragmentation and uneven regional ecological quality**

Habitat fragmentation is the process by which large blocks of continuous naturally occurring natural habitat are separated into many small habitat patches by other unsuitable habitats as a result of human activities and disturbances. <sup>[4]</sup> Since the late 1970s, Shenzhen has been developing and building at a rapid pace, and has become a modern city with a small land area, high density, and mega size. However, the development and construction of the city has caused pollution to the local ecological environment. In the case of the Mangrove Nature Reserve in Futian District, Shenzhen, for example, mangrove forests have been reduced in size, fragmented in habitat and damaged in ecosystem due to the impacts of human activities and urban construction. According to the research analysis of Cai Weibin and Li Zhen <sup>[5]</sup>, the southern subtropical gully rainforests and southern subtropical monsoon evergreen broad-leaved forests in Yantian District of Shenzhen City are mostly distributed along the gully, which is narrow and long, and the center area of their community patches is small and the edge area is large. Mangrove communities that were originally distributed in bands along the coastal zone have become fragmented communities, strongly fragmented and transformed to other matrix patches. Patrol roads constructed in the middle of mangrove wetlands have caused ecological blockages, insufficient ecological connectivity between structured green spaces, and gradual isolation and fragmentation of ecological space.

Uneven ecological quality between regions. There are differences in environmental protection and ecosystem services between different urban areas in Shenzhen. Urban areas such as Luohu, Futian and Nanshan districts have better green infrastructure, while urban areas such as Guangming, Longhua and Pingshan districts lack ecosystem services.

### **3.2. Invasive plants disturb the ecological balance and affect the restoration of natural forests**

As the window of China's opening to the outside world, Shenzhen is subject to frequent international trade and high mobility of people, and is therefore subject to more serious plant invasions. At present, there are 258 species of invasive plants in 200 genera and 63 families within the land area of Shenzhen, with Leguminosae, Asteraceae and Gramineae being the three major families that account for a relatively high proportion of all plant families. Comparing the four categories of relevant national policies and regulations, nearly half of the invasive plants mentioned in the four batches of invasive organisms listed by the Ministry of Environmental Protection (MEP), the National Forestry Quarantine Pests List by the

Forestry Bureau (FB), and the List of Exotic Species under State Key Management (First Batch) by the Ministry of Agriculture and Rural Affairs (MAA), were found in Shenzhen.<sup>[6]</sup> These alien invasive plants are characterized by a wide variety of species, wide distribution, and heavy damage. According to the results of the survey, the most serious alien invasive plants in Shenzhen are *Mikania micrantha*, five-clawed golden dragon, lantana, water hyacinth, South American wedelia, and petal-less sea mulberry, etc., of which *Mikania micrantha* and five-clawed golden dragon are the most widely distributed and the most harmful.<sup>[7]</sup> *Mikania micrantha* reproduces well and spreads quickly. Large areas of vegetation are covered by *Mikania micrantha* dragons, resulting in the death of such vegetation due to the lack of access to sunlight for photosynthesis, which is very destructive to the vegetation. *Mikania micrantha* secretes and releases a number of chemosensory chemicals that penetrate the soil through the plant's root system, inhibiting the growth of indigenous plants, destroying vegetation and affecting the restoration of natural forests. The invasive plants mentioned above are highly adaptable to their habitats, and their invasion leads to the death of indigenous plants, a decline in the biomass of ecosystems and the formation of mono-preferred communities, resulting in a significant reduction in the biodiversity of the areas where the populations have spread and disturbing the ecological balance.

### ***3.3. Damage to marine ecosystems and coastal ecological environments***

At the end of the 20th century, in order to vigorously develop the city, Shenzhen City carried out large-scale activities such as land reclamation and swidden farming. Although it has effectively alleviated the contradiction between economic development and the shortage of construction land, it has also resulted in the disappearance of large areas of coastal wetlands, serious damage to the characteristic coastal wetland ecosystem, and a decline in the quality of the marine ecological environment. Damaged marine ecosystems are concentrated in the western nearshore waters. According to statistics, at present, Shenzhen waters are seriously polluted water area has reached 549km<sup>2</sup>, accounting for about 51.9% of the total area of Shenzhen waters, almost all of which are distributed in the western waters of Shenzhen, where the land enclosure is concentrated. The current major pollutants in the western waters of Shenzhen Bay and the Pearl River Estuary are inorganic nitrogen, reactive phosphates, suspended solids and coliform bacteria.<sup>[8]</sup> The artificial shoreline created by land enclosure has altered the properties of the natural shoreline, destroying the intertidal ecosystems that depended on the original natural shoreline, destroying fish spawning grounds and disrupting fish migratory patterns. These disruptions have resulted in simple biomes with a homogenous composition and reduced diversity. At the same time, the alteration of the mudflat habitat has disrupted the original natural ecological balance and reduced the benthic community.

Apart from that, the quality of seawater in Shenzhen Bay and the Pearl River Estuary is poor and eutrophic. The study showed that in 2019, the average eutrophication index of Guangdong's nearshore waters was (4.10±13.99), with an index range of 0.00-156.66. Among them, the average eutrophication index in spring was (2.48±7.40) with an index range of 0.00-46.74. The average eutrophication index for the summer season was (5.63 ± 17.60). The index ranged from 0.00 to 156.66. Overall, the level of eutrophication in Guangdong's near-shore waters is highest in summer, followed by fall, both showing moderate eutrophication; the level of eutrophication in spring is relatively low, showing mild eutrophication.<sup>[9]</sup> It can be seen that Shenzhen Bay and the Pearl River Estuary have a high degree of eutrophication and the waters of the sea are seriously pollute

## **4. Future development countermeasures and recommendations**

Jia Zhangke's film aesthetics has always been in a dynamic process of change, from "underground production" to "mainstream society", from the first film "Xiao Shan Goes Home" to "Three plays in Hometown", from the "World" after release to the "Mountains May Depart", Jia Zhangke's film style has always maintained concern for the real society. However, with the constant changes of society, Jia zhangke's career and thoughts also change with The Times and social development. He said, "I am not immutable. I should take pictures of myself at this moment, even if I am not thoughtful and not fully understood."

### ***4.1. Building ecological networks and restoring ecosystems to their original state***

It is the construction of good ecological networks that can restore ecosystems to their original state. Ecological network is a network structure system composed of "ecological source - corridor - node", originated from the green corridor system in Europe and the United States, based on the theory of

landscape ecology, and its stable and efficient network structure mode can promote the internal material and energy flow, which is an important means of ecological system restoration and protection.<sup>[10]</sup> Habitat fragmentation seriously affects biological survival and species diversity. It is recommended that habitat connectivity be improved and regional ecological protection and restoration of ecological corridors be undertaken to promote the effective dispersal of species and increase population densities. It is also necessary to strictly implement the State's policy on the management of red lines for ecological protection and to strengthen management.

In response to the problem of uneven ecological quality in the region, a territory-wide park should be built to construct a territory-wide recreational network system that is compatible with urban development. Furthermore, green infrastructure should be improved in all urban areas of Shenzhen, especially in remote ones.

#### ***4.1.1. Increase testing of species introductions and risk assessment of exotic species***

As the scale of foreign trade in the country's largest large and medium-sized cities in the city, the introduction of foreign fine varieties in Shenzhen is inevitable. In introduction of species, quarantine must be intensified, with risk assessment. Exotic species should be introduced prudently by taking into account the economic and ecological aspects perspectives, etc., thereby preventing the invasion of alien plants.

Raise public awareness of invasive plants and guide public participation and cooperation. Relevant departments should strengthen the research on biological invasion, clarify the invasion pathway of alien species, the harm brought about by invasion, etc., and at the same time, utilize various media to carry out publicity, education and scientific popularization to the public, raise the public's awareness of prevention, and encourage and guide the public to participate in the prevention and control of invasive plants in accordance with the law.

#### ***4.1.2. Control of already invasive plants using physical means, chemical means and biological control***

Concentrate time and control crews on extensive manpower removal of invasive plants, pulling up as many invasive plants as possible before the onset of the rainy season or the peak growing season of invasive plants. In addition to this, it can be combined with the use of chemicals such as herbicides to spray large areas of noxious plants. Biological control, on the other hand, utilizes natural enemies of invasive plants to control their spread. For example, insects, pathogenic fungi, bacteria, pathogens, nematodes, herbivores or other higher plants can inhibit the growth, development and spread of invasive plants to some extent.

#### ***4.1.3. Establishment of an information base on control methods and technical information on invasive alien plants***

The information on invasive plants and control methods at home and abroad should be collected and organized as a knowledge and technology reserve.

### ***4.2. Restoring the ecology of near-shore waters and strengthening the management of the marine ecological environment***

#### ***4.2.1. Repairing damaged natural shorelines and carrying out shoreline ecological restoration projects***

Measures such as beach conservation, vegetation restoration and promotion of siltation and beach preservation can be taken to enhance the ecological nourishment function of the coastline. Beaches should be maintained. If a beach is in insufficient sand supply, artificial replenishment should be made, so as to restore its original natural resilience and capacity. Planting mangroves and windbreaks on seawalls and carrying out phytoremediation to form an "aquatic-semi-terrestrial-terrestrial" plant community structure can promote the seawalls to fulfill the function of a complete ecosystem, promote the formation of waters within the seawalls, improve and repair the ecology of the coastline, and build a harmonious and healthy wetland ecosystem.

#### ***4.2.2. Conservation of marine living resources and marine biodiversity***

The stock enhancement and release should be implemented. Enhancement and release refers to the use of artificial methods to release eggs, larvae or adults of aquatic organisms, such as fish, shrimp, shellfish and algae, into natural waters, in order to increase the number of marine populations and improve the structure of the biological community in the waters, so as to achieve the purpose of

increasing fishery resources, improving the water environment and restoring the ecological balance<sup>[11]</sup>. According to the actual situation of the water bodies in Shenzhen waters, increasing the release of corresponding aquatic animals and utilizing the filter-feeding effect of fish can reduce the pollutant content of seawater, expand the vitality of the ecosystem of the water bodies, improve the marine ecosystem, improve the habitat of the organisms, improve the marine ecosystem, and protect the diversity of the marine organisms.

#### **4.2.3. Conduct scientific analysis and assessment of marine ecological restoration and improve the monitoring and evaluation system of the marine environment**

Field in situ observation techniques are utilized to carry out ecological restoration projects in coastal zones, and the emerging technology of low-altitude remote sensing by unmanned aerial vehicles (UAVs) can be used to study and monitor the oceans. Low-altitude remote sensing by unmanned aerial vehicles (UAVs) is a technical means of data collection and monitoring of target areas from low altitudes by means of UAV platforms equipped with various sensors. This technology is based on the principle of remote sensing, and utilizes the images acquired by UAVs, LIDAR point clouds and other data to extract and analyze the feature information.<sup>[12]</sup> The technique can be combined with other data sources to get more comprehensive data. In addition, research should be conducted on the numerical simulation technology of environmental impacts of coastal zone ecological restoration projects, paying attention to the development and application of wave, tidal current, sediment, water quality and ecological models.

Relevant government departments should establish a scientific monitoring and assessment system to provide timely feedback on the marine environment and strengthen marine ecological early warning and extreme disaster warning.

## **5. Conclusions**

Shenzhen is located in China's South China Sea, since the reform and opening up has been rapid development, become a mega economic center city. However, urban development and construction and dense population have also caused serious damage to the ecological environment. The natural protected areas in Shenzhen serve as a representation of the city's environmental problems. The damage and imbalance of ecological environment will hinder the sustainable development of the city, and the environmental protection can not be delayed. Therefore, the development of Shenzhen cannot be separated from the management of ecological space and the restoration of ecological environment.

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