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The Construction and Analysis of Natural Environmental Protection System Based on the Concept of Ecological Balance

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Abstract: With the rapid development of urbanization in China, a series of problems such as urban sprawl, waste of resources and environmental degradation have arisen, and the contradiction between urban development and natural environmental protection has become increasingly prominent. In the context of urbanization transformation and ecological civilization construction, how to actively promote stable economic and social growth and development while achieving effective protection of the natural environment and laying down a basic ecological security pattern for long-term healthy and sustainable urban development is a great challenge for current urban construction and urban and rural planning work. In this paper, we analyze the quality of atmospheric environment, the quality of water environment, and the area change of several ecosystems such as its1 forest ecosystem, wetland ecosystem, and grass ecosystem, and evaluate the landscape level index of ecological zone A using the evaluation index based on the concept of ecological balance, and the results show that the ecosystem of ecological zone A has been damaged, which brings negative impact on the ecological balance, and therefore, it is necessary to protect the natural environment of Ecoregion A in order to maintain its ecological balance.

1. Introduction

Due to the influence of various disasters and anthropogenic disturbances, the landscape pattern of some nature reserves has evolved to a certain extent, and the degree of ecological vulnerability in the region has also changed, leading to a significant reduction in ecological functions such as soil and water conservation and water containment. Therefore, natural environment protection analysis and ecological vulnerability assessment are effective means to manage the natural ecological environment and an important way to promote the ecological green and high-quality development of nature reserves [1].

Research on natural environmental protection under the concept of ecological balance has achieved good results. The development of nature conservation in foreign countries has a history of more than a hundred years, with rich theoretical and practical experience, while in China, although the construction work of protected areas started earlier, the research and application practice for nature reserves is still in the early stage [2]. Nature reserves are a central part of almost all national and international conservation strategies, and they represent a special commitment to the future, or even an ultimate hope in case of environmental destruction and social decline, and an important legal tool for meeting human material and spiritual needs and achieving natural ecological functions [3]. Nature reserves contain natural ecological processes that reflect long-standing interactions and coexistence between humans and the environment, and can provide models for sustainable resource and environmental use that can be applied to other areas [4]. Many studies have revealed the factors and driving mechanisms that influence changes in ecological vulnerability with a view to providing scientific and technical references for ecological management of similar natural environments.

This paper firstly introduces the concept of ecological evaluation as well as proposes evaluation indexes such as ecological sensitivity, ecological resilience and ecological stress based on the concept of ecological balance, then analyzes the quality of natural environment in ecological zone A, and finally evaluates the characteristics of natural environmental changes in each ecosystem in ecological zone A. The evaluation indexes are used to calculate the changes in the natural environmental system index.

2. Basic Overview

2.1. Ecological Evaluation

How the ecological environment is to be evaluated, and the level of development, goodness, and safety of the ecological environment need to be determined by comprehensive ecological evaluation. Academic research on comprehensive ecological evaluation includes two main ideas, one is ecological safety assessment and the other is ecological risk assessment. Ecological safety assessment can help us identify and improve the unsafe influences that exist in the ecological environment, and provide safeguards and support for the healthy development of the ecosystem. Ecological risk assessment, on the other hand, helps us to discover the risks existing in the ecological environment and the ways and means to avoid them [5, 6].

The domestic research on ecological evaluation was mainly focused on the definition of the concept in the early days, and along with the deepening of the research, the construction of the comprehensive ecological evaluation system was gradually completed, the relevant models and evaluation contents for conducting comprehensive ecological evaluation were further studied, and the research topics were continuously refined, and through the construction of the comprehensive ecological evaluation system, combined with the characteristics of developing countries, the relevant research on comprehensive ecological evaluation was rapidly Development. As an important part of national governance, ecological environment needs to be progressed in continuous research, so as to protect the natural environment without delaying social and economic development [7, 8].

2.2. Evaluation Indexes Based on the Concept of Ecological Balance

Ecological sensitivity evaluation index: Fractional dimensional inverse (FD) and topographic index (TI) are selected to measure the size of ecological sensitivity depends on the size of the sensitivity value of evaluation factors such as fractional dimensional inverse and topographic index and their weights, the higher the value of fractional dimensional inverse and topographic index, the more sensitive the ecosystem is, and the more sensitive the ecosystem is, the greater the possibility of its potential ecological vulnerability [9].

Ecological resilience evaluation index: ecological resilience is the ability of the ecosystem to recover to the original state or close to the original state after external disturbance, which is related to the stability of the internal structure of the ecosystem, and the maximum patch index (LPI) and the connectivity index (CONNECT) are selected to construct the ecological resilience to build the evaluation model [10].

Ecological stress degree evaluation index: three indexes are measured by landscape fragmentation degree (FN), patch density (PD), and separation degree (SPLIT) [11]. Fragmentation is widely used in ecological vulnerability evaluation studies, the more fragmented the landscape is, the greater the pressure it is under; the role of patch density and fragmentation is basically the same, the greater the value, the higher the degree of landscape fragmentation and the greater the spatial heterogeneity; the greater the separation, the greater the pressure on ecological landscape succession [12].

The evaluation model of ecological vulnerability index is as follows.

$$Q_i = K_i \cdot M_i / N_i \tag{1}$$

Based on the intrinsic connection between landscape information and ecosystems, the regional ecological vulnerability integrated index (RVI) is constructed based on the proportion of ecological vulnerability Qi to the area of landscape types, which is essentially a visual representation of the ecological vulnerability index of each type of landscape and integrally indicates the spatial distribution characteristics of the ecological vulnerability of a certain region [13, 14]. The calculation formula is.

$$RVI_i = \sum_{i=1}^{n} \frac{A_i}{A} Q_i \tag{2}$$

In the above formula, Mi is the sensitivity of type i landscape, Ni is the is resilience of type i landscape, Ki is the pressure degree of type i landscape, Ai is the area of type i most viewed, and A is the area of all most viewed types.

3. The Current Situation of Natural Environment Quality in Ecological Zone A

3.1. The Current Situation of Atmospheric Environment Quality

As shown in Figure 1, the change of air quality in this eco-region in the past 6 years, the total industrial emissions in eco-region A showed an increasing trend in these years, with the highest point being 46.8 billion cubic meters in 2020, and the total SO2 emissions always exceeded the total NOx emissions during 2015-208. The total SO2 and NOx emissions decreased steadily between 2019 and 2020, with SO2 emissions being 1,984 tons and NOx emissions being 2,251 tons in 2020, with SO2 emissions being lower than NOx emissions.

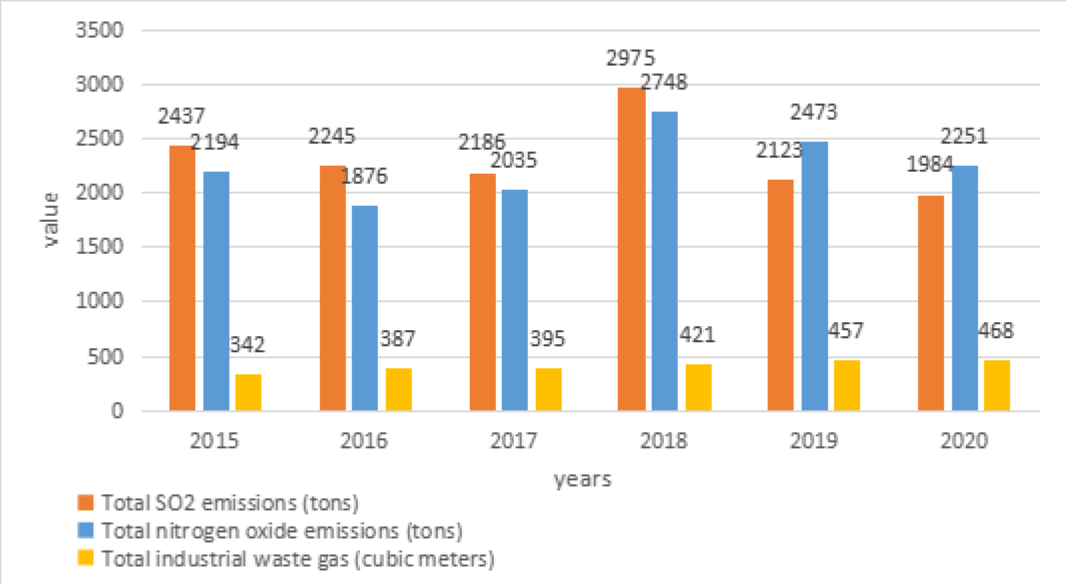

Figure 1. Changes in the quality of atmospheric environment

3.2. Current Situation of Water Environment Quality

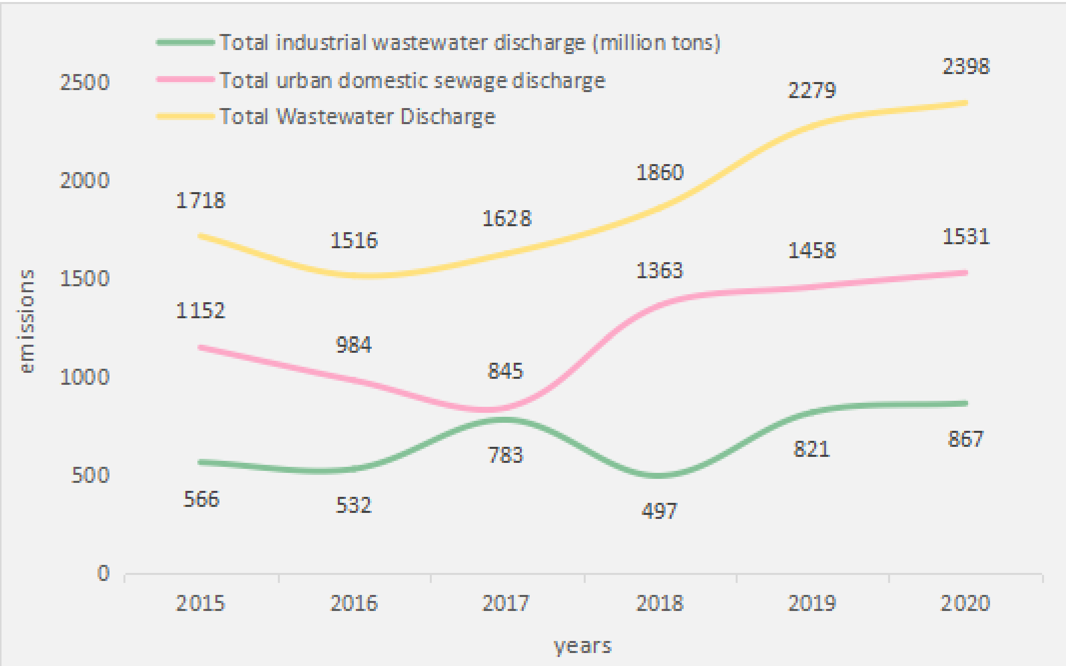

Figure 2. Trends of wastewater discharge

As shown in Fig. 2, the trend of wastewater discharge in the ecoregion in the past six years, the total amount of wastewater discharge in the ecoregion shows a steady increasing trend, maintaining at about 29 million tons in the past two years. The industrial wastewater discharge is increasing day by day. The discharge of COD and ammonia nitrogen in wastewater discharge is very similar. The main sources of both are urban domestic sewage, mostly sewerage fecal sewage and washing sewage. The COD and ammonia nitrogen contents in industrial wastewater discharge are gradually decreasing, while the COD and ammonia nitrogen contents in agricultural wastewater discharge remain stable.

4. Analysis of Natural Environment Changes Based on the Concept of Ecological Balance

4.1. Characteristics of Natural Environment Changes under Each Ecosystem

Based on the national ecosystem I, II, II classification system and land cover data, the total area and proportion of various ecosystems in ecological zone A in 2011, 2014, 2017 and 2020 were obtained.

Table 1. Ecosystem composition

	2011		2014		2017		2020	
	Area	Proportion	Area	Proportion	Area	Proportion	Area	Proportion
Forest Ecosystem	36748	59.73	37256	60.24	37682	60.47	31571	48.36
Scrub Ecosystem	12403	21.52	12487	21.77	12532	22.19	13364	30.51
Grassland ecosystems	634	1.35	658	1.39	683	1.42	965	2.37
Wetland Ecosystems	242	0.41	263	0.45	288	0.48	275	0.47
Desert Ecosystems	228	0.39	214	0.37	206	0.36	251	0.43

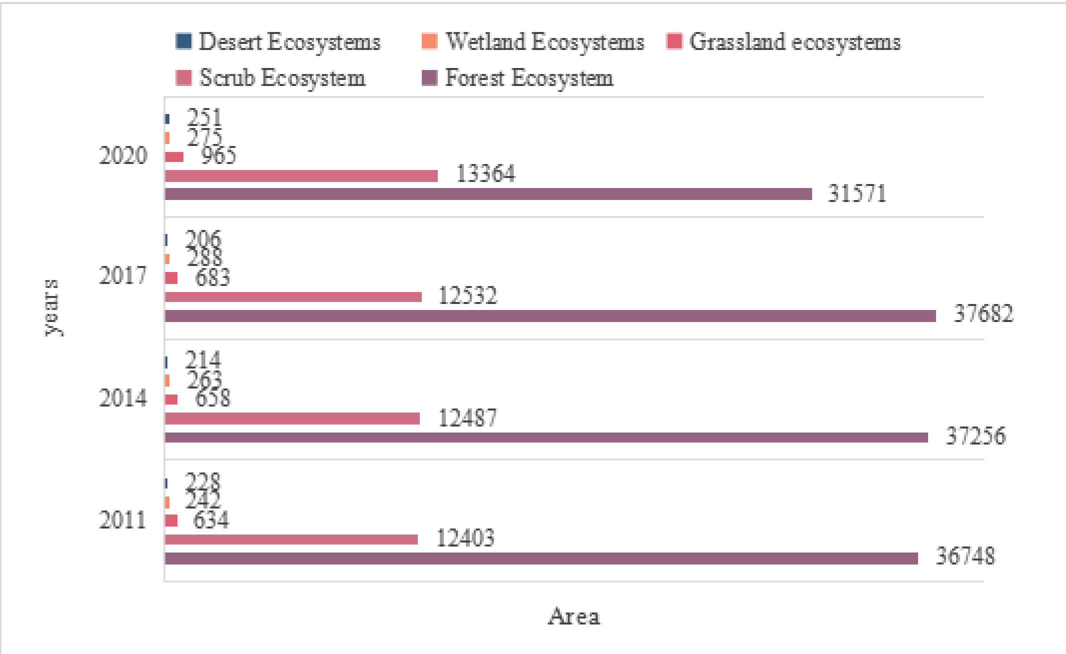

Figure 3. Area of each ecosystem

As Table 1 and Figure 3 show the area and proportion of each ecosystem in ecoregion A.

In general, the area of forest ecosystem among the ecosystems in ecoregion A from 2011 to 2020 showed a trend of first increasing and then decreasing, among which the increasing trend from 2011 to 2017, the area increased in 2014 was 37256 km2, which was 0.51% more than that in 2011; the area increased in 2017 was smaller, the area increased in 2017 compared with 2014 was 426 km2, an increase of only 0.23% compared to 2014; while the area of forest ecosystems decreased from

2017 to 2020, with a decrease of 6111 km2, a decrease of 12.11% compared to 2017; in general, the area of forest ecosystems from 2011 to 2020 is decreasing, and the area of forest ecosystems in 2020 decreased in total compared to 2011 5177 km2, which is 11.37% less than 2011.

The landscapes of broad-leaved forests, coniferous forests and shrublands show a large area of collapse and displacement, showing a trend of fragmentation and fragmentation, forest vegetation is seriously damaged, landscape dispersion increases sharply, while a large number of disturbance patches are generated, landscape heterogeneity is enhanced, shape changes are frequent and intense, and the occurrence of material flow, information flow and energy flow within the forest ecosystem is rapidly transmitted, leading to its resistance to external disturbances The ability of the forest ecosystem to resist external disturbance is reduced, which is reflected in the fragmentation of the landscape matrix and fragmentation of patches, and the restoration ability of the ecosystem is reduced. The ecosystem's functions of water containment, soil conservation, and climate regulation are significantly reduced [15, 16].

Forest ecosystems are habitats for many plants and animals, and are also natural refuges for them when certain natural disasters occur [17]. Geological disasters destroy a large amount of forest vegetation and water areas, causing the loss of some habitats suitable for the habitat of plants and animals to flourish, and the frequent occurrence of geological disasters also changes the internal structure and function of migratory pathways, with consequent changes in the distribution and quantity of water resources, severely damaging the composition and structure of biodiversity and increasing the risk of biodiversity decline [18].

The area of the scrub ecosystem in the ecosystem of ecoregion A from 2011 to 2020 showed an increasing trend, increasing by 84 km2 from 2011 to 2014, 0.25% more than in 2011; the increase from 2014 to 2017 was 45 km2, 0.42% more than in 2014; the increase from 2017 to 2020 was larger, increasing by 832 km2, an increase of 8.32% from 2017; the scrub ecosystem increased by a total of 961 km2 from 2011 to 2020, an increase of 8.99% from 2000.

Grassland ecosystem showed an increasing trend in area during the 10 years from 2011 to 2020, increasing from 634 km2 in 2011 to 965 km2 in 2020, with an increase of 331 km2 in 2020 compared to 2011, an increase of 1.02% compared to 2011.

The wetland ecosystem showed an increasing trend from 2011 to 2020, with an increase of 33 km2 in 2020 compared to 2011, an increase of 0.06% compared to 2011; the wetland ecosystem decreased in 2020, but the area was still increased compared to 2000.

The desert ecosystem has a decreasing trend from 2011 to 2017, with a decrease of 4 km22 in 2014 compared to 2011, which is 0.02% less than 2011; while the area of desert ecosystem increases from 2017 to 2020, and in general, the area of desert ecosystem is increased from 2011 to 2020, with an increase of 23 km2 in 2020 compared to 2011, which is 0.04%.

4.2. Change of Natural Environment System Index

Table 2. Change of ecological landscape level index

	FD	FN	SPLIT	SHDI	CONTAG
2000	1.127	0.06	13.54	1.34	65.18
2010	1.582	0.27	76.48	1.83	52.94
2020	1.135	0.14	15.71	1.28	61.33

From Table 2, it can be found that in the last 20 years from 2000 to 2020, the five indices of fractional dimensional inverse (FD), fragmentation (FN), separation (SPLIT), and diversity (SHDI) showed a trend of first increasing and then decreasing, and the spreading degree (CONTAG) showed a first decreasing and then increasing situation. In terms of sub-dimensional examples, the ecology of the study area was weakly disturbed by human in 2000 and 2020. In terms of fragmentation, the landscape fragmentation degree in 2010 was 0.27, indicating a high degree of landscape fragmentation in this ecological study area. In terms of separation degree, in 2000 and 2020, the separation degree was lower than 20, indicating that the landscape showed a trend of large patchy distribution, and in 2010, the separation degree was greater than 70, and the most view showed an obvious fragmentation distribution pattern. The overall results show that the level of ecological diversity in the study area is on the rise, and the area difference between different ecological landscape types is small and the proportion tends to be balanced. In terms of aggregation, the connectivity index was above 60 in 2000 and 2020, indicating that the landscape connectivity was good in both years, and the connectivity index in 2010 decreased from 65.18 in 2000 to 52.94, a decrease of 12.24, indicating that the fragmentation of the former dominant landscape increased and the connectivity decreased rapidly, which seriously threatened the survival and migration of plants and animals in the study area. This has had a negative impact on the stability of the ecosystem.

5. Conclusion

The heavy industry-driven industrial structure of most cities has caused serious environmental pollution and resource waste problems, such as persistent haze and dust storms in the north and acid rain and water pollution in the south, all of which make the relationship between cities and nature appear increasingly fragile and the conflict between urban development and natural environmental protection intensifies. It is especially important to coordinate and harmonize the relationship between urban and rural construction and natural environment protection in the whole region, and to carry out effective nature conservation planning and construction management. Based on this, this paper evaluates the natural environment of the ecosystem in Eco-region A and analyzes the need to implement effective natural environment protection measures to ensure the ecological balance of Eco-region A and maintain the harmonious development of human and nature.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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