Study on Evaluation of Ecological Service Function of Qinghai Lake National GeoPark

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Abstract: The evaluation of ecological service functions of geoparks with important ecological status can scientifically reflect and recognize the environmental functions and value of geological parks which is of great significance for the sustainable development of geoparks. Qinghai Lake National Geological Park has an important ecological status. In this paper, an evaluation system is constructed to evaluate the ecological service function of Qinghai Lake National Geological Park. The evaluation shows that the ecological service function value of Qinghai Lake National Geological Park is 4.2776, and the score of each function are: environmental regulation function 2.0073, geological relics and ecological protection function 1.2588, scientific research and science education function 0.4393, tourism function 0.3148, economic function 0.1683, material production function 0.0891. The Qinghai Lake National Geological Park still has a lot of room for development in the function of science education, tourism and economic functions, and needs to be further optimized and improved.

Keywords: Geological park; Ecological service function; Evaluation; Qinghai Lake

1. Introduction

Today, as the global ecological environment is deteriorating, the establishment of geoparks is of great significance in restoring the ecological environment system and protecting the earth. The original intention of the construction of the geological park is to protect the precious geological relics and the ecological environment in which they depend. Protecting the ecological environment is the basic requirement for the function of the ecosystem services. Therefore, the realization of ecological service function is in consistent with the original intention of park construction (Gao Yan, 2013). However, currently there's few literature on the eco-environmental problems of geoparks and the ecological service functions of geoparks, which is. Researches on this area should be further strengthened.

Qinghai Lake National Geological Park is located in Qinghai Province on the northeastern margin of the Qinghai-Tibet Plateau in western China. The park is divided into four sub-areas, Erlangjian Park, Shadao Park, Bird Island Park and Fairy Bay Park, with a total area of 292.8km^2. Qinghai Lake is the largest inland plateau salt lake in China. It is located at the intersection of the alpine region of the Qinghai-Tibet Plateau, the arid northwestern region and the eastern monsoon region. It not only has complex and diverse landscape types, but also has an extremely important ecological status. It is an important water body that maintains the ecological security of the northeastern Qinghai Plateau and a natural barrier to control the spread of desertification in the west to the east. The ecological environment of Qinghai Lake affects the sustainable development of the social economy in Qinghai Lake. Based on this, it is of great significance to pay attention to the ecological environment of Qinghai Lake National Geological Park and to study the protection,

utilization and sustainable development of Qinghai Lake Geopark under the background of ecological service function.

2. Identification of ecological service function of geoparks

The key for scientific evaluation of the ecological service function of the geological park is to scientifically and rationally select evaluation indicators and construct an ecological service function evaluation system for the geological park. This study uses the following three steps to screen the evaluation indicators.

2.1 Reference to the representative classification system of ecological service functions in China and oversea countries

Ecosystem service functions can be described, measured and valued. Due to their different understandings and starting points, there are many classification methods for ecosystem service functions. At present, there are mainly four classification systems at home and abroad (Table 1). The Millennium Ecosystem Assessment (MA), implemented by the United Nations, has a simple and clear classification system that is easy to understand and widely used and improved.

Table 1 Representative ecological service function classification system in China and world

Classification system	Types
Costanza（1997）	Climate regulation, disturbance regulation, atmospheric circulation, regulation of water environment, provision of water resources, control of sediments and erosion, recycling of nutrients, treatment and utilization of waste, formation of soil, pollination, provision of raw materials, biological defense and management, habitat , production of food, genetic resources, entertainment, culture
Daily（2000）	provides three basic categories of living and producing material foundations, maintaining life systems and providing life enjoyment
MA（2003）	Regulatory services, supply services, support services, cultural services
OuyangZhiyun (1999)	Regulating climate, soil ecological service functions, biodiversity generation and maintenance, organic matter production and ecosystem products, pollination, reducing natural disasters, purifying the environment, and controlling the balance of biological species

2.2 Reference to the ecosystem service function of the same type of landscape

Because of the different types of ecosystems, the ecological service functions they play are also different. Therefore, the ecological service functions of the specific geoparks should be analyzed and identified. The landscape ecosystem of Qinghai Lake National Geological Park has various types, mainly including lakes, wetlands, rivers, grasslands, deserts and other landscape types of ecosystems. According to previous studies on the ecological service functions of these similar landscape ecosystems, it is easy to identify the ecological service functions of these landscape ecosystems in Qinghai lake geological park.

2.3 Combining the functional characteristics of the geopark

Since its establishment, the Geopark has shouldered a mission different from the general tourist attractions. Many scholars have analyzed their functional characteristics (Table 2). The Ministry of Land and Resources has classified the geological heritage resources in the formulation of the Technical Requirements

for the Planning of National Geoparks. In addition to the categories with scientific research value, the word "landscape" is added to the landscape resources, highlighting the unique ornamental value and tourism value of geological park.

Table 2 Research on the function of geoparks by scholars at home and abroad

Researcher	Year	The function of the Geopark
Alfred et al.	2012	Promote the economic development of the region in the future, especially through the development of ecotourism to improve the living standards of local people.
Gao Yan	2013	Supply service, mediation service, support service, socio-economic and cultural functions
Liu Jia	2016	Environmental protection functions such as geological heritage protection; humanities service functions such as scientific research, cultural inheritance, publicity and promotion; economic development functions such as tourism industry, population employment, regional economy, transportation and so on
Yi Ping, Fang Shiming	2014	Ecological function: conserving water sources, maintaining water and soil, purifying air, regulating climate, improving soil protection of vegetation and forests, maintaining biodiversity, and balancing ecosystems Social and economic functions: tourism income, per capita disposable income, tourism products and services, popularization of earth science knowledge, planning project investment contribution, scientific research results transformation, new jobs, tourists' satisfaction with services
Jiang Jianjun Shen wei zhi	2006	Protecting the natural environment, protecting geological relics, promoting social spiritual civilization construction, scientific research and popularization of scientific knowledge, new ways of using geological resources, developing local economy, and coordinating a new model of social economy

3. Evaluation of ecological service function of Qinghai Lake National Geological Park

3.1 Evaluation System Construction

Based on the above information and experts' opinions, combined with the characteristics and actual situation of Qinghai Lake National Geological Park, the material production function, environmental regulation function, geological relics and ecological protection functions, scientific research and education functions and tourism functions six criterion layer indicators (B6), the geological heritage typicality, diversity and other 22 factor indicators (C22) are selected to form the ecological service function evaluation index system of Qinghai Lake National Geopark (Table 3).

Material production function: The ecosystem of Qinghai Lake National Geological Park provides a large number of agricultural products and raw materials for human beings.

Environmental regulation function: The regulation and buffering effect of the Qinghai Lake National Geological Park ecosystem on the environment, including hydrological regulation, climate regulation, wind and sand fixation, pollution purification, soil conservation, etc.

Geological relics and ecological protection functions: Qinghai Lake National Geological Park protects its rich geological heritage landscape resources and its surrounding ecological environment.

Scientific research and education function: Due to the unique scientific environment and biological value of Qinghai Lake, Qinghai Lake has attracted the attention of researchers and organizations at home and abroad. At the same time, it also has the function of popularizing environmental education for surrounding residents, ordinary people, tourists, and primary and middle school students.

Tourism function: Qinghai Lake National Geological Park is an ideal eco-tourism place and the most important brand tourist attraction in Qinghai Province.

Economic function: Qinghai Lake National Geological Park shoulders an important historical mission of promoting local economic development and promoting employment among surrounding residents.

Table 3 Evaluation System of Ecological Service Function of Qinghai Lake National Geological Park

Target layer	Criterion layer	Indicator layer
Ecological Service Evaluation System of Qinghai Lake National GeoPark A	Material production function B1	Food production C1
		Raw material production C2
	Environmental regulation function B2	Hydrological regulation C3
		Climate regulation C4
		Wind prevention and sand fixation C5
		Pollution purification C6
		Soil retention C7
	Geological heritage and ecological protection function B3	Typicality and diversity of Geological heritage C8
		Biodiversity C9
		Protection investment C10
		Protection management measures C11
	Scientific research and education function B4	Research institution C12
		Number of research projects C13
		Number of research papers C14
		Science Education Facilities C15
		Science Education Activity C16
	Tourism function B5	Landscape aesthetic value C17
		Tourism product structure C18
		Tourist facility conditions C19
		Drive local economic development C20
	Economic function B6	Promote the improvement of community public facilities C21
		Promote community employment C22

3.2 Determination of evaluation indicator weight

Expert evaluation process: The experts and scholars oriented in the study of geology, ecology, environmental science, biology, tourism management and geopark research were invited from Qinghai University, Qinghai Normal University, Qinghai University for Nationalities, Institute of Salt Lake Research, Chinese Academy of Sciences, Northwest Institute of Plateau Biology, Chinese Academy of Sciences, etc. to conducted a back-to-back comparative evaluation of the weights of the evaluation indicators of the Qinghai Lake National Geopark Evaluation System. Since experts and scholars in various fields have cognized the weights of indicators from their respective subject areas and have different perceptions of the importance of indicators, the Delphi method was used to conduct two rounds of feedback and tracking analysis on the comparative evaluation of index weights.

Data processing process: The analytic hierarchy process is used to evaluate the index weights, and the target layer index judgment matrix, the criterion layer index judgment matrix, and the indicator layer index judgment matrix are respectively constructed. Experts are asked to compare the importance of each evaluation index in the matrix using the "1-9" scale method. The final evaluation matrix is analyzed by the software yaahp, and the index weights under each layer are established.

3.3 Evaluation results

The indexes in the ecosystem service function evaluation system were converted to scores and quantitatively evaluated by the Likert scale. The scale is divided into 1-5 points and 5 levels. Experts are asked to evaluate the assignment according to the performance of each indicator, multiply the evaluation scores of each indicator by their respective weights. And then all the item values are adding together to obtain the evaluation value of the ecological service function of Qinghai Lake Geopark (Table 4).

From the perspective of the value of the six functions evaluated, the order is as follows: environmental regulation function> geological relics and ecological protection function> scientific research and education function > tourism function > economic function > material production function. The value of environmental function is the largest, which is in line with the important ecological and environmental significance of Qinghai Lake National Geological Park, followed by geological relics and ecological protection function, which is highly compatible with the purpose of geological park construction. Geological relics and geological environment conservation is the primary purpose of the Geopark (Zhang Jianping, 2013). In addition, the Geopark emphasizes scientific research, science education which also plays an important role in developing tourism and promoting local economic development. The value of material production function is the smallest, but it plays a non-negligible role in maintaining the ecological chain structure.

Table 4 Evaluation result of ecological service function of Qinghai Lake National Geological Park

Target Layer	Evaluation Result	Criterion Layer	Evaluation Result
Ecological service function of Qinghai Lake National GeoPark	4.2776	Material Production Function	0.0891
		Environmental adjustment function	2.0073
		Geological heritage and ecological protection function	1.2588
		Scientific research and education function	0.4393
		Tourism Function	0.3148
		Economic Function	0.1683

4. Analysis and discussion on the ecological service function of Qinghai Lake National Geological Park

4.1 Environmental regulation function

The environmental regulation function is the most important function of the ecological service of Qinghai Lake National Geological Park. In the inland arid regions, water bodies are essential for temperature regulation and humidity regulation through atmospheric evaporation. The Qinghai Lake water body plays a significant role in regulating the arid climate of the inland plateau. The Qinghai Lake area is the main source of water source in Qinghai Province. It is an important channel and barrier for China's water vapor cycle and an important water body for maintaining ecological security in the northeastern part of the Qinghai-Tibet Plateau. It is also a natural barrier to control the spread of desertification in the west to the east. Therefore, it is called the “climate regulator” and “air humidifier” in the northwest of China. The lake body has received certain industrial wastewater, farmland water and domestic sewage from Gangcha, Haishu, Tianjun, Gonghe and other places as well as various tourist pollutants such as waste water and waste generated by tourists. Through the self-environmental purification and the artificial environment restoration, currently the water pollution and eutrophication in the lake is in slight degree.

4.2 Geological heritage and ecological protection function

The Qinghai Lake National Geological Park integrates various geological relics such as lakes, marshes, river springs and deserts. The geological heritage is fully developed, and the precious heritage left by nature is well preserved in Qinghai National Geological Park. Qinghai Lake region is rich in biodiversity. The wild animals and plants in this region show the characteristic of large variety, wide distribution, high economic and scientific research value. There are 163 species of birds such as bar-headed geese and brown-headed gulls; there are more than 20 kinds of animals such as fish, red deer, lynx, and wild yak. The naked carp in Qinghai Lake is the most famous carp. What’s more, there are more than 620 wild seed plants in this region (Zhao Hongli, 2003). In 2008, Qinghai Province implemented the ecological environmental protection and comprehensive treatment project of Qinghai Lake Basin. The implementation of a series of protection management projects has greatly promoted the protection of geological relics and ecological environment.

4.3 Scientific research and education function

Due to the unique scientific and educational value of Qinghai Lake for its unique ecological environment and biodiversity, Qinghai Lake has attracted wide attention of scholars and organizations at home and abroad. Many universities and research institutes have carried out research on geological heritage investigation and evaluation, geological park planning and tourism development planning in Qinghai Lake; carried out the analysis and evaluation of ecological habits of migratory bird in Qinghai Lake, and vegetation sample surveys, water quality surveys and researches on the patterns of bird migration in Qinghai Lake etc. Experts and scholars have published a large number of research papers on different research fields in Qinghai Lake.

The Qinghai Lake Scenic Area Protection and Utilization Administration has published a series of science education books, edited a series of popular science videos, established the “National Science Education Base”, the Social Practice Base of the Department of Biological Science and Technology of Tsinghua University, and the Geological Teaching Practice Base of Qinghai University and carried out a series of work in science education. But there is still much room for development for the scientific education of tourists, primary and secondary school students.

4.4 Tourism function

Qinghai Province is named after Qinghai Lake. Qinghai Lake can be view as the image representative of Qinghai Province. Qinghai Lake is a destination-type tourist scenic spot in Qinghai Province. It is now positioned as a World Heritage-type plateau lake tourist attraction, and its tourism revenue accounts for a large part of Qinghai Province's tourism revenue. Grasslands, lakes, sand, blue sky, white clouds, migratory birds, fish schools, these natural landscapes perfectly combined together to show the natural beauty of Qinghai Lake. Meanwhile, the scriptures, herders, monasteries, historical sites, military sites and various cultural events show the cultural beauty of Qinghai Lake and the aesthetic value of the landscape is extremely high. At present, tourism products in Qinghai Lake are mainly based on natural tourism, and the structure of tourism products is relatively simple. There's still a large room for the further development of other eco-tourism products such as fish watching and bird watching, cultural tourism products such as history, folklore, religion, military and festival activities, scientific research and science education and tourism products. It's necessary to optimize the structure of tourism products and enhance the attractiveness of tourism. The tourism service facilities can only maintain the tourism development needs under the existing conditions, and there is still some room for realizing the satisfaction of tourists.

4.5 Economic function

There are a certain number of farmers and herdsmen living around the park. The development of park tourism has played a certain role in promoting the economic development of surrounding communities. The park also carried out work in the common development of parks and localities, such as investing funds to support the development of social welfare undertakings such as local education and culture, supporting the employment of herdsmen, carrying out environmental remediation of the towns and villages in the scenic spots, and restoring local grassland, controlling desertification, etc. However, most of these are "blood-transfusion"-type assistance. There's few "hematopoietic" assistance such as encouraging local herders to carry out tourism business activities. The community residents have low participation in planning, decision-making and management of the geopark. Therefore, these measures have make less contribution to the local economic development, the improvement of community public facilities, and the employment of community residents. It is necessary to further strengthen the coordinated development and harmonious development of the park and community.

4.6 Material production function

The material production functions of Qinghai Lake National Geological Park mainly include primary production of vegetation, animal products and aquatic products (salmon). Different types of vegetation provide synthetic materials for the development of animal husbandry through photosynthesis. Qinghai Lake Wetland is the main pastoral area and animal product improvement base in Qinghai Province. 24% of population live on animal husbandry, 29% of the grassland livestock in the province are concentrated in this area. Animal husbandry plays a very important role in the national economy of Qinghai Lake wetland. The total output value of animal husbandry in the region accounts for about 90% of the total agricultural output value, and the income from animal husbandry accounts for 96% of the rural economic income (Yu Wenzheng et al., 2005). Qinghai Lake Naked Pelican (commonly known as squid) is the dominant fish resource in Qinghai Lake and the most important economic fish in the fishery production of the lake. Its distribution accounts for more than 95% of the total fish resources in the lake. It is a fish resource and indicative species with plateau characteristic in Qinghai Lake. Due to climate change and the decline of the water level in

Qinghai Lake, the living environment of squid has been threatened. Coupled with the large number of human fishing, the squid resources have been greatly reduced. In order to curb the decline of fishing resources, the Qinghai provincial government has released a ban on fishing and started fish breeding. The implementation of these policies has achieved obvious results and the "water, fish, bird" ecological chain in Qinghai Lake has been restored and improved.

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