

# Spatial Analysis of Ecological Corridors in Giant Panda National Park Based on GIS

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**Abstract:** As one of the national park pilot areas, the main goal of The Giant Panda National Park is to protect the authenticity and integrity of the natural ecosystem which is centered on the giant panda. Because of the large scope of national parks, it is necessary to plan ecological corridors reasonably to protect the integrity and authenticity of the ecological environment. Based on the GIS system, this paper analyzes the ecological environment of giant pandas living in The Giant Panda National Park and processes the information from the spatial scale. Using the cost-distance analysis tool to analyze the corridors with the method of least cost, 12 ecological corridors within the research scope were accumulated. An ecological corridor model planning and construction with the purpose of the giant pandas have been proposed, and the writer also discusses how to promote the construction of ecological corridors when developing Ecotourism at the same time in the national park. Then point out the management of ecological corridors of The Giant Panda National Park.

**Keywords:** The Giant Panda National Park, Ecological corridor, Spatial analysis, GIS system.

## 1. Introduction

National parks are the management mode of nature reserves that our country is currently trying to explore. The establishment of national parks to protect our country's representative and important ecosystems is of great significance to biological protection and management of nature reserves. With the change and influence of human activities, the fragmentation of biological habitats generally occurs.

The construction of corridors is a way people use to reduce the fragmentation of the ecological environment. Ecological corridors refer to the types of corridors that are composed of ecological structural elements and have the functions of protecting biodiversity and maintaining ecological environment services [1]. At present, the ecological corridor theory has been widely used in the field of biological protection [2]. According to the local conditions, different types of ecological corridors are simulated and constructed, and the identification of potential ecological corridors for wild animals is conducive to optimizing the overall protection and management system of the region [3]. Studying the construction of ecological corridors in national parks is conducive to protecting our country's unique and rare ecosystems and endangered species, and protecting the integrity and primitiveness of their habitats.

## 2. Organization of the Text

### 2.1. Research Content

The Giant Panda National Park (pilot area) is the main distribution area of rare species represented by giant pandas. Promoting the research on the construction of ecological corridors in the Giant Panda National Park can contribute to the improvement of the national park system. At present, few studies are exploring the minimum cost path of wildlife life behaviors dominated by giant pandas, and there is a lack of research on the protection levels of ecological corridors that are compatible with the national park system. For ideas at

different levels, on the premise of protecting the integrity and primitiveness of the animal living environment, find a reasonable way to build ecological corridors in national parks, and strive to make ecological corridors play the greatest role in ecology, transportation, economy, etc.

### 2.2. Research Methods

#### 2.2.1. Gis Analysis Technology

GIS is a computer system for managing and analyzing spatial data, providing strong technical support for analyzing and observing data through visual expression. Factor layer overlay is an intuitive method, which can combine different types of factors such as the social, economic, and natural environment for spatial overlay analysis. Through GIS technology, the spatial state after comprehensive overlay can be analyzed, and different types of ecological corridors can be simulated. The way of network connection [4].

#### 2.2.2. Least-cost Path Theory

The least-cost path method is a method of applying a geographic information system to evaluate and determine potential ecological corridors. By comparing the actual discrete path of the target species with the minimum cost analysis, the set of resistance values of the target species that is closest to the actual movement route is determined [5]. The least-cost path method is a commonly used ecological corridor planning method. The path or area with a small cost distance is preferentially selected for corridor planning. The least-cost path method can be used to construct linear corridors and strip corridors [6]. Through the corridor analysis, the total cumulative cost range between the two target species in different habitat patches was obtained. After setting the highest cumulative cost value, the banded pixels in the interval are identified as corridors, and the displayed corridor is the minimum cost corridor [12].

### 2.3. Research Plan

Collect the data of the Giant Panda National Park, and use the GIS system to superimpose the existing distribution area data of the target protected species. Combined with data and

literature, the degree of habitat fragmentation of protected species in the study area was analyzed, the distribution area and potential range of protected species were analyzed, the source of target species distribution patches was obtained, and the current status layer was superimposed for cost distance analysis. The minimum cost distance was used to analyze the cumulative cost obtained by weighted superposition in the GIS system, and the range of constructible ecological corridors with giant pandas as the target species was obtained through the analysis. According to the analysis results, an ecological corridor model was constructed. Suggestions on the management and operation of ecological corridors within the building.

### 3. Literature References

#### 3.1. Overview of Ecological Corridor Research

##### 3.1.1. Ecological Corridor Theory

The concept of the greenway was first proposed in 1959, which was an earlier period of the evolution and traceability of ecological corridors [7]. In 1995, John Linehan et al. took the forest area of central New England as an example to put forward the theory that greenway planning should consider regional biodiversity, and take wildlife protection and corridors as the theoretical framework for comprehensive greenway system research [8]; Forman proposed to analyze the relationship between spatial pattern and ecosystem by using the theory of patch-corridor-matrix, and it is considered that patch, corridor and matrix are the components of landscape [9]. In the 1990s, Jacky Girel et al. proposed a study on the impact of building a steam corridor on biodiversity [10], and there were already studies on landscape planning and ecological networks at that time [11]. Since 2000, the number of ecological corridor research journals and literature has gradually increased, and the overall number has increased steadily.

##### 3.1.2. Application Cases of Ecological Corridors

With the increasing attention to the fragmentation of the natural environment, ecological environmental protection organizations in many countries have recognized the importance of building ecological corridors to protect and restore biodiversity [12]. There are already ecological corridor construction projects in China, such as the Asian Elephant Protection Corridor in Xishuangbanna, southern Yunnan. Since the completion of the 17km-long corridor, Asian elephants have carried out six cross-border activities through this corridor until the end of 2006. The ecological corridor built on the border of Laos has made an effective contribution to the protection of Asian elephants [13]. Before the construction of the China-Russia Tiger Corridor, which was jointly built with Russia, due to the fragmentation of the habitat of Siberian tigers, the migration path was hindered by low-concealed village farmland. Due to the fragmentation of the habitat of Amur tigers, the migration path is hindered by the villages and farmlands with a low degree of concealment. The number of activities has increased [14]. In addition, domestic ecological corridor-related cases include the Eastern Himalayan Corridor in cooperation with India.

#### 3.2. Overview of National Park Research

##### 3.2.1. National Park Theory

National parks originated in the United States and were put forward by George Catlin in 1832, calling on the government to protect the natural and human resources of the western

Indians, and to maintain the native nature of local resources through the establishment of national parks [15]. According to IUCN's description and combined with scholars' viewpoints, it can be roughly concluded that a national park is defined as "a large-scale protected area with the main goal of protecting the integrity of the ecosystem and native natural resources, providing leisure, recreation, science and education functions that do not affect the protected resources, and allowing future generations to see the original intact natural state of the protected area." The establishment of national parks and the effective protection of protected areas have been generally recognized and implemented.

##### 3.2.2. China's Unique National Park System

At present, many countries have established national parks. Due to different national conditions, environment, resources, and other factors, the management system of national parks has also changed. Compared with the United States, which formed a national park system earlier, our country's national park management mechanism is more complex, and it also faces the problem of overlapping protected area labels. The same area may have "national key scenic spots", "national forest parks" and "geological parks" at the same time." and other labels, which makes the classification of protected areas unclear, and the management efficiency of protected areas with conservation value is affected by multi-head control.

#### 3.3. Relationship between Ecological Corridors and National Parks

The definition of national parks proposed in the "Overall Plan for Establishing a National Park System" is "based on strengthening the protection of the authenticity and integrity of natural ecosystems", which proves that one of the main management goals of national parks is to protect the integrity of ecosystems [16]. The realization of the biological protection goals of national parks is not simple, and there are still many difficulties in protecting the authenticity and integrity of the ecosystem. The ecological environment barrier effect will hurt ecological protection. Factors such as roads will lead to fragmentation of protected species habitats, hinder gene exchanges, and produce avoidance effects. Ecological corridors can strengthen the connection between blocked wildlife habitats, which is beneficial to the habitat and reproduction of protected species. The planning and construction of ecological corridors must strictly abide by the relevant regulations and guidelines of national parks. At present, most ecological corridors have multiple functions. While ecological protection functions are paid attention to, their original diversified functions such as recreation and cultural preservation cannot be used. Ignore.

### 4. Research Process

#### 4.1. Study Site

The giant panda national park pilot is one of the 10 national park pilot areas that have been approved in China. In addition, the Giant Panda National Park is also a pilot area with a larger area and a more complex management physique among the national park pilots, with a total area of 27,134 square kilometers, accounting for 70.66% of the national giant panda habitat area [18]. The fragmentation of giant panda habitats can be achieved by building ecological corridors to integrate giant panda habitats and improve the integrity of the ecological environment.

## 4.2. Habitat Changes of Giant Pandas

In the 1960s, four giant panda nature reserves were established in Sichuan, and Taibai Mountain Nature Reserve was established in Shaanxi. From the 1960s to the 1980s, the total population of giant pandas in the habitat area decreased significantly. With the strengthening of protection awareness and the significant increase in the area of giant panda habitats in protected areas, the total number of giant pandas has shown an upward trend since the 1990s. By around 2010, there were 63 giant panda nature reserves in China, covering 85% of the giant panda habitat area, and the total number of protected areas accounted for about 50% of the national total [19]. At present, giant pandas are mainly distributed in the five mountains system of the Sichuan, Shaanxi, and Gansu provinces. The distribution range of the pilot area of the Giant Panda National Park is in line with this. However, due to the scattered distribution of the suitable ecological environment for giant pandas within the range, many small patches are isolated. Habitat fragmentation will affect the protection of giant pandas [20].

## 4.3. Analysis of the Construction Scope of Ecological Corridors

In the final draft of the Giant Panda National Park (for comments) released by the State Forestry and Grassland Administration in October 2019, Chapter 5 Giant Panda Protection and Habitat Restoration protects the wild population of giant pandas. Build a giant panda ecological corridor.

### 4.3.1. Data Collection and Organization

Table 1. Data sources

type of data	Data Sources
Elevation data	Chinese Academy of Sciences Computer Network Information Center Scientific Data Center, National Basic Geographic Information System, Map (DEM Digital Elevation Map), Landsat TM Remote Sensing
other data	The Fourth National Giant Panda Survey [ 21], WWF Giant Panda Conservation Research Report [ 22], "Giant Pandas in Sichuan: The Fourth Giant Panda Survey Report in Sichuan Province" [ 23]

The research scope is consistent with the planning scope in the overall plan for the Giant Panda National Park (draft for comments), and ArcGIS 10.2 is selected as the main operating platform for data processing, analysis, and mapping, and other software and platforms assist in the data processing. With the help of the DEM digital elevation data in the geospatial data cloud, it is converted into raster data with a spatial resolution of 30M, and the giant panda national park and its boundaries are transformed and expressed from the original topography to digital simulation.

### 4.3.2. Preliminary Model Construction

are a total of 1509 giant panda trace points in the Giant Panda National Park operated on the ArcMap platform, and there is a 0.65% error with the overall planning text. Combined with the fourth national giant panda survey report and the population description of giant pandas in Sichuan, according to the overall planning content, there are about 18

habitat patches in the pilot area, of which the number of giant pandas in six patches is greater than 100, and the number is less than 30. There are two populations between 100 and 10 populations with a population of less than 30. The giant panda trace points are abstracted into several giant panda habitat patches through density analysis. The patches are divided into three levels: I, II, and III according to the size of the population. The number of giant pandas in the habitat patch of level I is greater than 100, the number of levels II is between 30 and 100, and the number of levels III is less than 30, and the giant panda source patch is obtained. picture. Convert the source patch features to a raster. According to the evaluation of the five items of the slope, slope aspect, surface cover, road cover, and bamboo cover, the cost value is reclassified. Taking Table 2 as an example, the reclassification assignment is obtained.

Table 2. Slope Cost Value Reclassification

Slope Cost Value Reclassification	Slope interval	habitat selection	cost value
1	0°-10°	It May be affected by human activity	4
2	10.00001-20°	Less space utilization	0.8
3	20.00001-30°	The high space utilization ratio	0.5
4	30.00001-40°	The highest proportion of space utilization	3
5	40.00001-50°	The general space utilization ratio	6
6	50.00001-90°	The small space utilization ratio	9

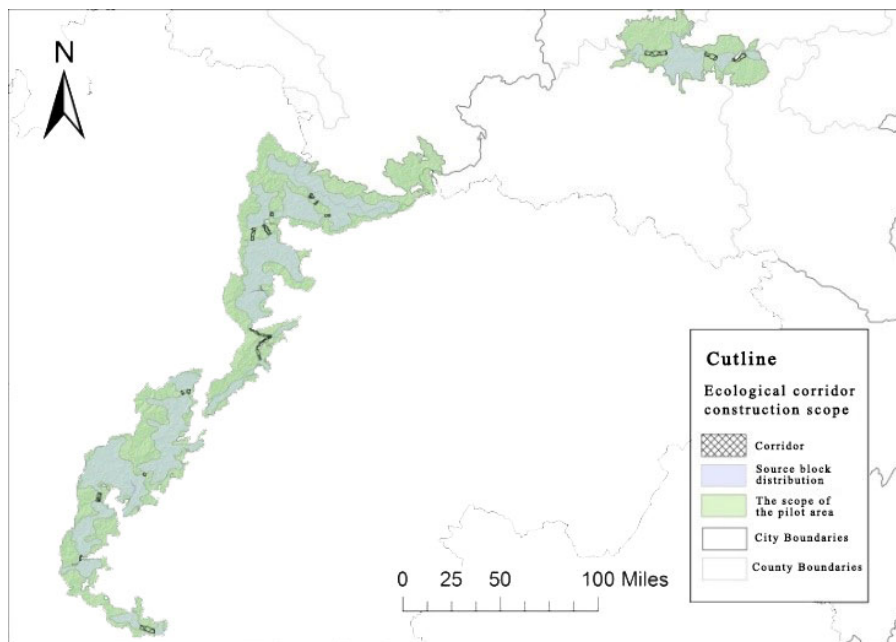
the above five influencing factors are reclassified and assigned cost values; a weighted superposition is carried out. Through literature review, it is found that the behavior of giant pandas is highly correlated with the distribution of edible bamboo, the type of land cover, and human disturbance, followed by the slope aspect. Therefore, the results after reclassification are weighted and superimposed, and the weights of the five items of data obtained in the weighted superposition are allocated from high to low, namely, the distribution cost of edible bamboo is 35%, the coverage cost is 25%, the road cost is 20%, the slope cost is 15%, The aspect cost is 5%, and the cost distance model from each source data is obtained.

### 4.3.3. Scope of Potential Ecological Corridor Construction

After preliminarily constructing the cost distance model by weighted superposition of various cost values, the 18 giant panda population distribution source blocks were analyzed to obtain their respective cost distances. Each group of adjacent

source blocks is used to form a cost accumulation grid, and the accumulated cost value of giant pandas moving to the source within the range is obtained, paving the way for the construction of minimum cost ecological corridors. Use the spatial analysis tool corridor analysis to load two cost distances to obtain the proposed corridor map. Due to a large amount of data, only the cost value is divided into ten

categories and displayed as a reference display. In the actual calculation, the cost corridor value is divided into 30 categories and displayed. The 19812-21146 cost value with the lowest cost value is selected as the corridor planning area. After concluding, the construction range of 17 ecological corridors with giant pandas as the main target species is roughly drawn, as shown in the following figure:



**Figure 1.** Construction location of ecological corridors

Since the 17 ecological corridors constructed are mainly based on theoretical models, it is necessary to make a choice based on whether the construction range of the selected corridors in the pilot area is feasible. According to the overall planning of the Giant Panda National Park (draft for comments) [ 24], the number of ecological corridors in the pilot area is limited and reduced by mountain system or county name, combined with the surface coverage. , Ecological corridors with high vegetation coverage, far away from cultivated land, and moderate corridor density should be reserved. Finally, it is recommended to build 12 ecological corridors.

## 5. Conclusions

Ecological corridors have a protective effect on ecosystems of great value and significance. Studying ecological corridors with giant pandas as the target species is conducive to strengthening the authenticity and integrity of the ecosystem with giant pandas as the core. In this paper, taking the Giant Panda National Park as the research scope, the giant panda population within the research scope is divided into 18 source patches with the help of the GIS system. The cost path method was used to discuss the suitable construction locations of the least-cost ecological corridors, and 12 ecological corridors with giant pandas as the target species were obtained. There are also unconsidered factors in the research of this paper, and there is no thorough research on the construction method and management issues. It is hoped that future research will continue to improve and improve credibility and accuracy.

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