Environmental Characteristics of World Heritage Sites Based on High Resolution Remote Sensing Data: A Case Study of Hailongdun, Guizhou Province

Youzhi An1,2,* and Fujun Ma1,2
1School of Geography and Resources, Guizhou Education University, Guiyang 550018, China
2Guizhou Provincial Key Laboratory of Geographic State Monitoring, Guiyang 550018, China

*Corresponding author: anyouzhi@163.com

Abstract. In this study, by using descriptive statistical analysis and the method of setting up multiple study areas for comparison, with the help of high spatial resolution remote sensing interpretation data, the spatial distribution characteristics of land use in the study areas of World Heritage occurrence environment are studied. The results show that: (1) the mean value of each occurrence environment of Hailongdun World Heritage site is small, the degree of patch fragmentation is large, and the corresponding standard deviation is large, which is caused by the large difference of patch size. (2) The area of residential land, industrial and mining storage land, special land, cultivated land and forest land in Hailongdun World Heritage site is increasing from the core area, buffer area, Hailongdun village to the village boundary, which is in direct proportion to the area change of each environment.

Keywords: World Heritage Site, Occurrence Environment, Hailongdun

1 Introduction
At the beginning of the establishment of the world heritage site, the establishment of the core area and buffer area is considered, but generally speaking, the scope is small, and there are residents living in it, and the establishment of the reserve organization, etc., which will conflict with the scope of the original administrative divisions, so it is necessary to study the environmental characteristics of the world heritage site[1-5]. Through the study of the characteristics of the surrounding environment, in order to better protect the ecological environment of the world heritage site[6-8]. The existing research data mainly used Landsat satellite data with low spatial resolution. The spatial resolution of Landsat satellite data is 30 meters, starting from a larger scale of research. However, for the residential land of world heritage sites, it is necessary to use data with relatively high resolution, so as to improve the research accuracy[9-10]. In this study, by using descriptive statistical analysis and the method of setting up multiple study areas for comparison, with the help of high spatial resolution remote sensing interpretation data, the spatial distribution characteristics of land use in the study areas of World Heritage occurrence environment are studied.
2  Research Area and Data

The world heritage site of Hailongdun is located in Gaoping (Figure 1). Gaoping, as the first world cultural heritage site in Guizhou, has a profound historical and cultural heritage. There are cultural relics of Hailongtun and its affiliated yangmacheng, yangechi, Yangshi Tusi tomb, Gaoping Yayuan and other Boshou Tusi, as well as revolutionary cultural relics of Gaoping gun house, bridge, Jintang Red Army tomb, renjiang paizidong. As a 4A level scenic spot, Hailongtun site and Boshou Tusi city are beginning to show their charm. Gaoping, as a provincial ecological civilization demonstration town, is rich in beautiful ecological resources. Huichuan outdoor fitness trail and legendary star sky camp had become a new place for eco-tourism. Gaoping, as a new gateway to the north of Zunyi downtown, enjoys convenient transportation. Chongqing Guiyang railway, Sichuan Guizhou railway, Lanhai expressway, Zunyi Suiyuan expressway, Zunyi 1st ring road, national highway G210 and provincial highway S207 pass through the area. The urban road network in Gaoping Industrial Park, with Zunlong express line, Huichuan Avenue and Park Avenue as the backbone, Criss Cross. Gaoping, as the main battlefield of national economic and Technological Development Zone, has three modern parks, Gaoping Industrial Park, port science and technology city and Lijiawan logistics park. Therefore, it is necessary to study the occurrence environment of world heritage sites. Compared with Landsat TM and other data, the research data using high-resolution remote sensing satellite interpretation data is more conducive to the study of small-scale world heritage sites and their occurrence environment.

![Study area map of Hailongtun](image)

Fig. 1 Study area map of Hailongtun

3  Research Methods

3.1  Descriptive Statistical Analysis

Descriptive statistical analysis can improve the accuracy and practicability of the study by systematically analyzing the land use types in the study area, in order to understand the specific data characteristics clearly. According to the statistics of the patch number, total patch area, minimum patch area, maximum patch area, average patch area and standard deviation of patch area, the overall spatial characteristics of land use in the study area can be analyzed.

3.2  Comparative Analysis

In the past, most researches focused on the core area of the world heritage site, and the environment around the world heritage site also plays an important ecological function. It is necessary to understand the ecological environment and its basic characteristics of the world heritage site through comparative analysis, so as to facilitate tourism development and protection planning of the world heritage site. The research scope set in this study includes the village boundary of four villages,
namely the core area of Hailongdun World Heritage site, the buffer area of Hailongdun World Heritage site, the Hailongdun village where Hailongdun World Heritage site is located, and the buffer area of Hailongdun World Heritage site. Through the comparative analysis of different research areas, the focus is to analyze the spatial distribution characteristics of residential land, industrial and mining storage land, transportation land and other human activities land, as well as the spatial distribution characteristics of ecological environment land such as forest land and garden land.

4 Running Regulation Schemes in Different Seasons

4.1 Descriptive Statistical Analysis

Table 1. Descriptive statistical analysis of the environmental patches in Hailongdun World Heritage Site

| Study Area        | Number of patches | Total patch area (hm²) | Minimum patch area (hm²) | Maximum patch area (hm²) | Average patch area (hm²) | Standard deviation of patch area |
|-------------------|-------------------|------------------------|--------------------------|--------------------------|--------------------------|---------------------------------|
| Core area         | 70                | 245.79                 | 0.01                     | 148.88                   | 3.51                     | 17.76                           |
| Buffer area       | 963               | 2537.86                | 0.01                     | 509.99                   | 2.64                     | 17.48                           |
| Hailongtun Village| 1024              | 3037.65                | 0.01                     | 549.65                   | 2.97                     | 19.56                           |
| Village boundary  | 2704              | 6674.20                | 0.01                     | 549.65                   | 2.47                     | 13.46                           |

According to table 1, the number of patches in the core area, buffer area, Hailongdun village and other environments of Hailongdun World Heritage site is gradually increasing with the expansion of the research area, from 70 in the core area to 2704 in the village boundary, and the patch area is also increasing with the increase of the number of patches. Due to the limitation of two decimal places, the minimum patch area value is too small, and the minimum patch area of each occurrence environment range is assigned as 0.01 hm². Because the study area is located in the mountainous area, the fragmentation of the plot is large, so the largest patch area is small. The mean value of each range of occurrence environment is small. The degree of patch fragmentation is large, and the corresponding standard deviation is large, which is caused by the large difference of patch size.

4.2 Spatial Distribution Characteristics of Land Use
According to Table 2 and Figure 2, the area of residential land, industrial and mining storage land, special land, cultivated land and forest land are mainly counted for each type of environmental land use in Hailongdun World Heritage site. Generally speaking, the area of residential land, industrial and mining storage land, special land, cultivated land and forest land in Hailongdun World Heritage site is increasing from the core area, buffer area, Hailongdun village to the village boundary, which is in direct proportion to the area change of each occurrence environment. But the change of area proportion is not always an increasing trend. Specifically, the proportion of residential land and special land in the core area is relatively small. The residential land is located in the core area and has not been completely moved out. The special land mainly serves the needs of the world heritage tourism activities in Hailongdun. In the core area, there is still a part of arable land, but the forest land still accounts for the main proportion, accounting for 84.85%. Compared with the core area, the area of residential land in the buffer zone has increased, the area of special land is declining, and the area of cultivated land is increasing. Although the area of forest land still accounts for the main proportion, the proportion is reduced to 68.29%. Compared with the buffer zone, the main land use areas of Hailongdun village are similar, because the buffer zone is mainly in Hailongdun village and part of several surrounding villages. In the core area, buffer area and Hailongdun village, the industrial and mining storage land is 0, which indicates that Hailongdun World Heritage site is well protected. In the peripheral village boundary, compared with the first three areas, the area of residential land has
increased significantly, industrial and mining storage land has appeared, the cultivated land has been increasing, but the area of forest land has been declining, down to 60.42%. Therefore, the core area, buffer zone and Hailongdun village of Hailongdun World Heritage site are well protected, but the growth of residential land in the main Hailongdun village should be controlled. In addition, it is necessary to consider the topographic characteristics and small watershed characteristics of Hailongdun World Heritage site, and the combination characteristics of the landscape and forest fields of Hailongdun World Heritage site as a whole.

5 Conclusion

Based on the high spatial resolution remote sensing interpretation data, this study studies the spatial distribution characteristics of land use in the study areas of the world heritage by setting up multiple study areas to compare. The main conclusions are as follows:

(1) The number of patches in the core area, buffer area and Hailongdun village of Hailongdun World Heritage site increased with the expansion of the research area. The mean value of each range of occurrence environment is small, the degree of patch fragmentation is large, and the corresponding standard deviation is large, which is caused by the large difference of patch size.

(2) The area of residential land, industrial and mining storage land, special land, cultivated land and forest land in Hailongdun World Heritage site is increasing from the core area, buffer area, Hailongdun village to the village boundary, which is in direct proportion to the area change of each environment. But the change of area proportion is not always an increasing trend.

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