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Analysis of Disturbance Factors in Zhalong Wetland Landscape Dynamics

Yuqing Yang[1], Adu Gong[1,3], Yuhong Zhang[2],Yanling Chen [1] and Tingting Zeng[1]

[1] Faculty of Geographical Science, Beijing Normal University, No.19, XinJieKouWai St., HaiDian District, Beijing 100875, P. R. China.
[2] Faculty of Geographical Science,Harbin Normal University,No.1,ShiDa Road, LiMin Economic Development Zone, Harbin 150025, P. R. China.
[3,*]Email: gad@bnu.edu.cn

Abstract. Based on remote sensing image data and meteorological data, this paper analyzes dynamic landscape disturbance factors of zhalong wetland through landscape pattern index and other methods, the results show that: (1) In recent 40 years, zhalong wetland landscape type pattern space, landscape fragmentation phenomenon is more serious.(2) The total area of swamp continues to decrease, and the bare land and cultivated land also show a decreasing trend, but the grassland and water area increase.(3) The temperature fluctuation, precipitation change and the government's policy of building railways and ditches have a profound impact on the landscape pattern of wetland.(4) At the early stage of the study, zhalong wetland landscape dynamic influencing factors are mainly natural factors such as temperature and precipitation;Since the 1990s, human activities such as government building of railways, highways, ditches and other factors have gradually increased the impact on wetland landscape dynamics.

1. Introduction

The evolution of landscape dynamic spatial pattern and the analysis of disturbance factors are the hot issues in the field of geography and ecology. As early as 1979, zhalong wetland was rated as a provincial nature reserve, designated as a national one in 1989, and listed in the "world important wetland list" in 1992.In recent decades, with the rapid progress of social economy and the continuous improvement of urbanization, the quantity and quality of wetland area in zhalong area have been greatly reduced, and the biodiversity and sustainable development of wetland have been seriously affected. Therefore, it is urgent to analyze wetland changes and interfering factors.

Taking zhalong region as the research object, based on remote sensing and GIS technology, with 1979, 1989, 2016, the third phase of remote sensing image data and meteorological data from 1979 to 2016 on the basis of data source, and statistical methods to analyze the landscape pattern index of landscape dynamic change and rainfall, air temperature, the relationship between the factors such as roads, canals, discusses the influence factors of zhalong wetland landscape changes in recent years (relevant academic research shows that 1989 is the abrupt change point of the zhalong wetland landscape dynamic process [1]).

2. Research Area and Data

Zhalong wetland is located in qiqihar city, heilongjiang province, bordering lindian, fufu and tailai counties. Located in the lower reaches of wuyuer river and the eastern songnen plain, the longitude and latitude are respectively 123 °46'~124 °36' and 46 °51'~47 °13'(Figure 1). Zhalong wetland is located in the mid-latitude area, which is the most primitive and complete wetland ecosystem preserved at the

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same latitude in northern China. It covers an area of 2,100 square kilometers, of which 1,240 square kilometers are wetlands.

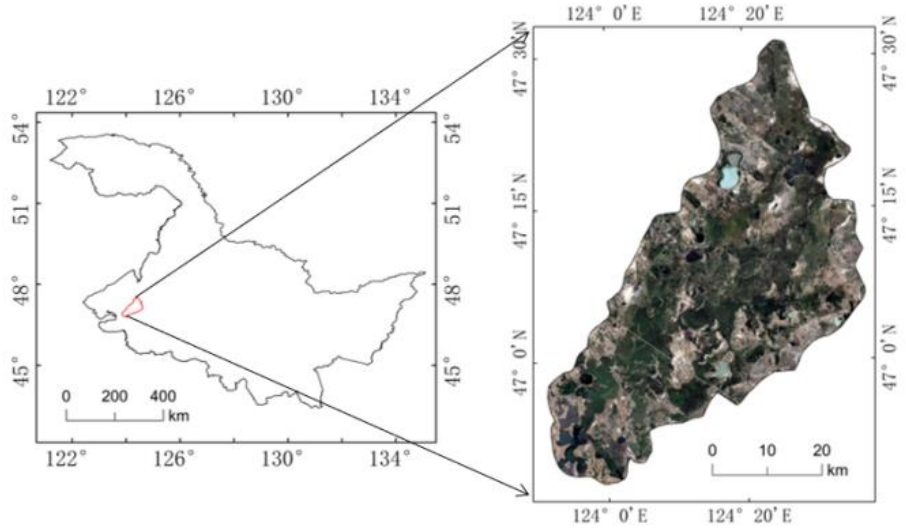

Figure 1. Overview of the research area and remote sensing images

Remote sensing image data used in this study are shown in Table 1, which are downloaded from the website of teaching and research office and geospatial data cloud (http://www.gscloud.cn/).Meteorological data mainly in qiqihaer city in heilongjiang province meteorological sites in 1979-2016 data set value of the month, from the China meteorological network (http://cdc.cma.gov.cn/home.do).

Table 1.Zhalong wetland remote sensing image parameters

Number	Date Acquired	Sensor Type	Spatial Resolution
1	1979.08.24	Landsat3 MSS	30m
2	1989.08.09	Landsat5 TM	30m
3	2016.04.16	Landsat8 OLI	30m

3. Research Method

3.1. Image Classification

According to the accuracy requirements of this study and the prior knowledge of staff, this study selects the maximum likelihood method in supervised classification for classification. It first obtains the probability of each pixel belonging to each category, and then assigns the pixel to the group with the largest corresponding probability value. Then, the results of classification are manually identified, categories combined and other operations. According to the research purpose of this paper, images are divided into 6 categories: swamp, water, cultivated land, village, grassland and bare land.

3.2. Landscape Pattern Index

Landscape pattern index is to divide the study area into various landscape patch units according to different ecological structures, and then analyze each characteristic index of spatial landscape pattern in the study area quantitatively. Its main indicators are: landscape separation, interference intensity naturalness, landscape diversity, dominance, fractal dimension and so on. Based on the research purpose, the landscape pattern parameters calculated in this paper include patch type area, landscape type percentage, landscape separation degree and landscape diversity [2].

3.3. Statistical Method

In this paper, mann-kendall(m-k) test is used to test the abrupt change of temperature and precipitation data in zhalong area from 1979 to 2016.Manmann Kendall test is one of the main research methods on the trend of change and mutation of time series. It can determine the exact year of mutation, which is less affected by human activities, and can reach a high quantitative level. Moreover, it has a wide range of detection, which is very suitable for the analysis and inspection of hydrological and meteorological data.

4. Result Analysis

Three phases of remote sensing images were classified by the maximum likelihood method in supervised classification.The classification results are shown in Figure 2.

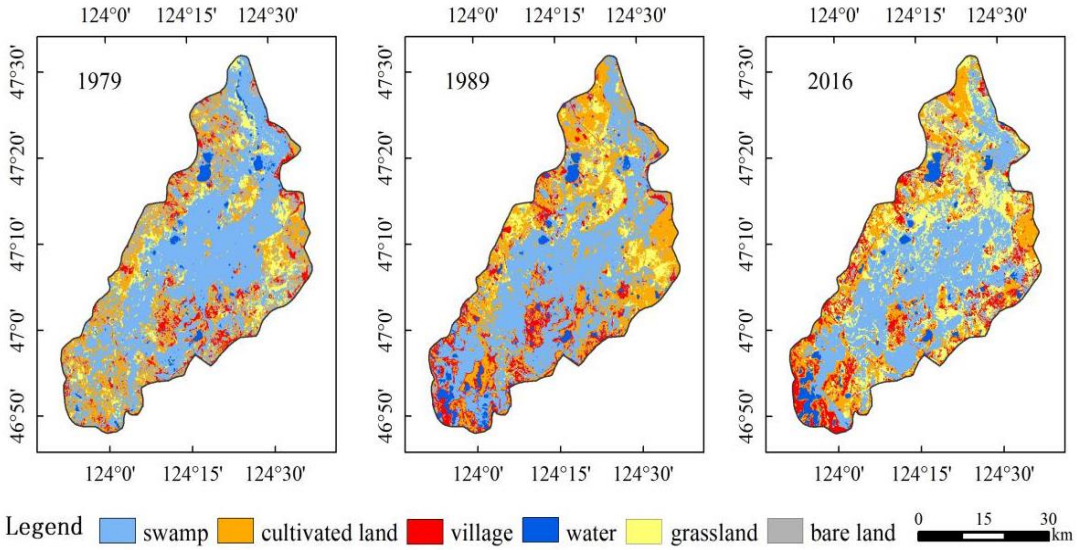

Figure 2. Classification results of zhalong district supervision

4.1. Analysis of Dynamic Changes of Landscape

Fragstats4.2 software is used to calculate the landscape pattern index of classified images, and the results are as follows:

4.1.1. Wetland landscape type conversion analysis. As can be seen from Table 2, the area of swamp in 1979 was 109128.05hm2, accounting for about 48% of the total area of zalong area; in 1989 and 2016, the area of swamp showed a decreasing trend; in 2016, the area of swamp was 83591.41 hm2, accounting for only 37% of the total area. The change of grassland and water is obvious, among which the grassland has increased from 21165.29hm2 in 1979 to 53439.82hm2 in 2016, and the water has increased from 5416.91hm2 in 1979 to 8945.69hm2 in 2016, which is related to the local policies of building ditches and widening water sources. Since 1989, zhalong wetland as a national nature reserve, the area of villages and towns has not changed greatly, accounting for about 11%.The area of bare land decreased from 13878hm2(6%) in 1979 to 10512hm2(5%) in 2016. Some bare land was transformed into grassland under the combined action of external forces such as climate change and human factors [3].

Table 2. Landscape type changes of zhalong wetland in different years

Landscape Index	Patch Type Area (hm^2)			Percentage of Landscape Type		
Year	1979	1989	2016	1979	1989	2016
Swamp	109128.05	95304.64	83591.41	48.48	42.34	37.14
Grassland	21165.29	41748.68	53439.82	9.40	18.55	23.74
Cultivated Land	49700.79	45679.15	42429.50	22.08	20.29	18.85
Villages	25802.67	22900.41	26156.82	11.46	10.17	11.62
Bare Land	13878.12	10691.09	10512.04	6.17	4.75	4.67
Water	5416.91	8754.95	8945.69	2.41	3.89	3.97

4.1.2. Analysis of spatial variation of wetland landscape. According to the classification results supervised by Figure 2, it can be seen that at the early stage of the study, the swamp in the landscape types of zhalong area were concentrated, Other land types were mostly distributed in the surrounding area of zhalong area. From the images of 1989 in the middle of the study, it can be seen that the water content in the south of zhalong area increased significantly, while the grassland area in the north increased significantly. In the later period of 2016, landscape fragmentation was serious, especially in the northern and central zhalong areas. According to relevant information, since 1990, under the decision of water conservancy departments at all levels and local governments in zhalong district, various water conservancy projects and national roads and railways at all levels have been built inside the wetland, which seriously damaged the integrity of zhalong wetland environment.

Table 3.Landscape index list of zhalong in different years

Index / Year	DIVISION	SHDI
1979	0.85	1.42
1989	0.82	1.42
2016	0.92	1.55

The larger the degree of separation index, the higher the degree of separation, that is, the landscape is more fragmented.It can be seen from the table that, compared with 1979 and 1989, the degree of separation index increased significantly in 2016, and the degree of separation of wetland landscape was obvious.The greater the diversity index is, the higher the degree of fragmentation will be, and the greater the uncertainty information will be.

4.2. Annual Average Temperature, Precipitation Changes

From 1979 to 2016, the overall temperature in zhalong area showed an upward trend. Figure 3 shows that the average annual temperature in zhalong area has increased by 0.024℃ in recent years. From the distribution trend, in the early 1980s, the annual temperature change in zhalong area was relatively large, and in the late 1980s to the early 21st century, the annual temperature change in zhalong area was relatively small, the temperature during this period may be in the warm period of the whole research period.

Zhalong area belongs to semi-arid area and the distribution of precipitation is unbalanced. In this paper, the precipitation anomaly percentage in zhalong region from 1979 to 2016 was calculated. When the precipitation anomaly percentage is positive, the precipitation reaches the standard. When it is negative, the precipitation is not up to the standard. From 1979 to 2016, the precipitation in zhalong area was seriously substandard around 1979 and 1996, but the temperature basically showed an upward trend, which may lead to an increase in evapotranspiration and damage the wetland ecosystem (Figure 3).

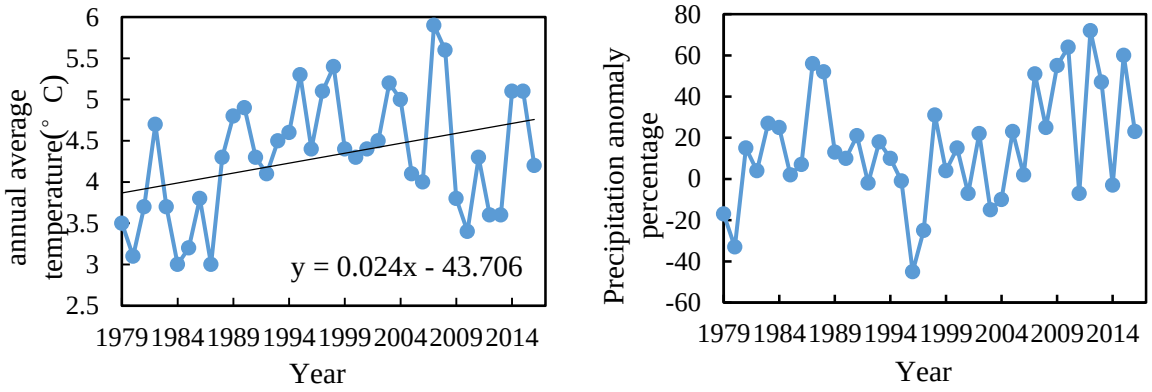

Figure 3. Schematic diagram of annual temperature change and precipitation anomaly in zhalong region from 1979 to 2016

4.3. Abrupt Change Detection of Temperature and Precipitation

Mann-kandall method was used to test the meteorological data of zhalong wetland.

The results of the temperature trend test (Figure 4) show that: the average annual temperature of zalong wetland is in a process of increasing, and has a significant increase trend since 1987. It passed the 0.05 significance test (U0.05=1.96) from the mid-1990s to 2012, and even passed the 0.001 significance test (U0.001=2.56).According to the position of the intersection of UF (k) and UB (k) curves, it was determined that the annual average temperature increase in zhalong wetland was an abrupt behavior, mainly starting from 1988[4].

From 1985 to 2008, the precipitation of zhalong wetland showed a decreasing trend, but this trend was not significant and did not pass the 0.05 significance test. From 2008 to 2016, it showed an increasing trend, and the trend was not significant.According to the intersection of UF (k) and UB (k) curves, the annual precipitation of zhalong wetland showed abrupt changes in 1979, 1989, 1991 and 2009(Figure4).

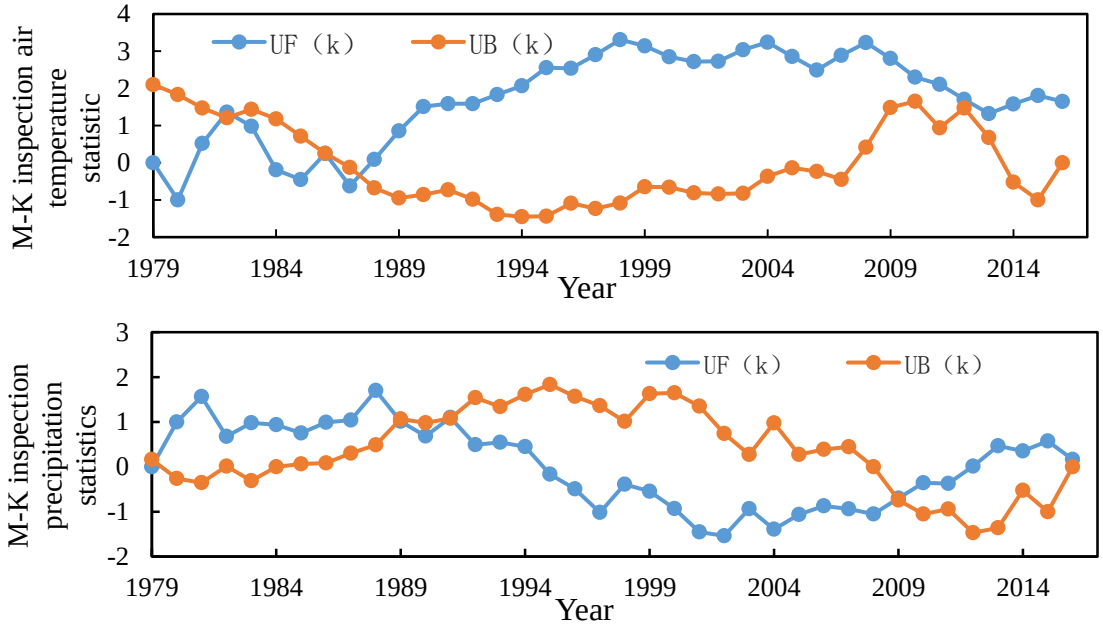

Figure 4. Average temperature and precipitation curve of zhalong wetland from 1979 to 2016

4.4. Human Factor Analysis

With the development of social economy and urbanization, the area around zhalong is more seriously

affected by human beings. In 1980, zhalong wetland inside only 301 national road from the north through; In 1986, tele highway bridge was completed and qidu highway was completed. In 1992, national highway 301 was changed. From 1990 to 2000, the construction of roads in and around the wetlands reached a peak, including village-tun roads in several core areas. Moreover, various levels of water conservancy departments and local areas in zhalong area to build a variety of major water conservancy facilities. These roads and ditches are being built and put into use, which seriously damage the environment around the wetlands and affect the normal growth of wetlands.

5. Summary

According to the analysis of disturbance factors of zhalong wetland landscape dynamics in this paper, it can be seen that: 1. From 1979 to 2016, the wetland landscape of zhalong wetland changed greatly in terms of quantity and spatial distribution. Wetland area always accounts for the highest proportion, with the passage of time, the number of decline trend, the spatial distribution to the southwest shift. The area of grassland and water bodies increased significantly, the area of cultivated land and bare land decreased slightly, and the area of villages and towns remained basically unchanged.2. In recent 40 years, the average temperature in zhalong area has shown an upward trend. Since 1980, the dual effects of continuous temperature rise and precipitation decrease in zhalong area have changed the climate environment in zhalong area and affected the landscape dynamics of wetlands.3. Since the 1990s, railways, highways, ditches and large-scale water conservancy projects have been built in and around zhalong wetland, seriously damaging the natural hydrological model and landscape spatial structure of the wetland, and increasing the fragmentation and separation degree of the wetland landscape.

6. References

[1] Zhang Yuhong, Su Liying, Yu Wanhui, Zhang Hongyun. Dynamic change characteristics of zhalong wetland landscape [J]. Acta geographica sinica.2015, 70 (1) :131-142.
[2] Liu Di, Cao Chunxiang. Remote sensing diagnosis of wetland changes -- a case study of ordos gulls national nature reserve in Inner Mongolia [M]. Master's thesis of the university of Chinese academy of sciences.2017.
[3] Khaled H Hamed. Trend detection in hydrologic data: The mann-kendall Trend test under The scaling hypothesis [J].Journal of Hydrology.2008, 349(3):350-363.
[4] Zhen Shuo, Dong Liqin, Zheng Rudin, Yao Pengju. Landscape pattern and changes of ruoergai plateau swamp in 2007 and 2016 [J]. Wetland science.2017, 15(4):522-525.