

Beijing's Wetland Environment Research Based On RS Technology

Gong Hui-Li¹

Ph.D., Professor, Dean

105# West Sanhuan North Road. Beijing. 100037, China

GongHL@263.net

Zhao Wen-Ji²

Ph.D., associate professor, Department head

zhwj12150729@sina.com

Zhang Zhi-Feng³

Master student, The Capital Normal University

flyfeng-01@163.com

Abstract: The absolute area of wetland accounts for 0.3% of the whole Beijing. We have studied the current environmental situations of Beijing's wetland and the changes in the key wetland supported by Remote Sensing(RS) technology. The result shows that the areas of wetland are reducing year by year and the quality of ecological environment is dropping year by year. At last, we analyze the factors that influence the change of wetland and propose some constructive suggestions according to current problems existing in Beijing's wetland.

Keywords: Artificial wetland, Remote sensing, Wetland recovery.

1. Introduction

Generally speaking, Beijing's terrain is high in the Northwest and low in the southeast. The types of wetland are various, and its environmental difference is remarkable, furthermore, the bio-diversity is relatively abundant. All these types of wetland form a unique ecological landscape. It is the first time to investigate and study on a large scale the wetland environment beyond the memory of men in Beijing. The study is significant to Beijing.

2. Monitoring Study of Beijing's wetland Environment

1) Classification of Beijing's Wetland

In order to make the study go on wheels, we firstly consulted the wetland classification system in 《 wetland convention 》^[1] and the ones^{[2][3]} adopted at present in the course of wetland investigation and monitoring in china and we considered the characteristics of the RS image. Then we classified Beijing's wetland (see Table1).

¹ Foundation Item: Open foundation of the Beijing key lab; Natural Science Foundation of Beijing(NO. 200000511) ; Natural Science Foundation of Beijing(60032003)

Table 1. Classified system of Beijing's wetland

First class	Second class	Third class
Natural	river	perennial river
		Seasonal river
		overflow valley
		River valley
Artificial wetland	City lake	perennial freshwater lake
		Seasonal freshwater lake
	reservoir	large-sized reservoir
		medium-sized reservoir
		Minitype reservoir
	pound	pound
	paddyfield	paddyfield
Artificial canal	Artificial canal	



Fig.1. TM fake color composite image

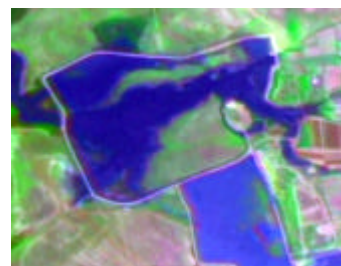


Fig.2. Fusing image of Landsat-TM and Indian-IRS

2) Application of RS Technology

We chose several kinds of RS data as the following: Landsat-TM data in October 1998 and May 2002 separately, Indian satellite IRS data in May 2000 and IKONOS data in June 2001. Multi-sources remote sensing images fusion^{[3]-[6]} was adopted in this work. Fig1 and Fig2 are the images before and after fusing. It is the most scientific to fuse two different sensor images in the same time in theory, but in fact, it went contrary to our wishes. So TM in 2002 and Indian IRS in 2000 or TM in 1998 and Indian IRS in 2000 had to be fused. This would lead to the inaccuracy of the result. The good solution was to draw the vector graphs combining the function of GIS's superposition analysis with the analysis of the fusion image's tone and texture according to the principle of spectrum characteristic variance.

3). Current Wetland Environmental Situations Research

We had obtained the data of Beijing's wetland areas in 2002 by the technologies of RS and GIS (see Table2). In addition, we had got a large amount of data about the water quality through field survey supported by GPS technology. The result isn't mentioned here by reason of time.

Table 2. The area of Beijing's wetland in 2002(ha.)

wetland	Area (ha.)
river	13821.47
City lake	684.40
Reservoir	20874.84
pound	7194.53
Artificial canal	2869.55
Paddy field	646.34
dyke	84.52
Total areas	46175.65

The rivers flow from the Northwest to southeast as a whole in Beijing. On the fusion image, the rivers look like a crooked band. At present, natural and high quality rivers mainly distribute on the upriver area of miyun reservoir. They are the key wetland that we should pay more attention to investigating and protecting. One of them, Bai river whose total areas are about 485.78 hectares has graceful natural environment. The land use that locates in the floodplain on both sides of riverbed is mainly cultivated land. The type of soil in this basin is mainly brown soil and eluviation brown soil of mountainous region. There are mainly such plant communities as the following in river wetland: hydrophytic plant, wetland plant, shrub and little arbor.

City lakes mainly distribute in the city zone. On the IKONOS fusion image, their geometry characteristics are obvious, water's tone is indigo and their image structure is homogeneous. Vegetation is mainly artificial lawn and artificial forest in most parks, the reed, little cattail and cattail only distribute in several parks. The water in most city lakes is so turbid that

its transparency is very low. And the degree of nutrient enrichment of water is relatively high. The reservoirs are mainly distributed in the mountainous areas that locate in the north and west of Beijing. On the fusion image, they have artificial dams, the water's tone is blue and their image structure is also homogeneous. The water is limpid, and the degree of nutrient enrichment of water is relatively low.

The artificial canals distribute in the plain between the reservoirs and the cities. On the fusion image, they wind gently to the cities with clear border and same width, and their color is blue. The artificial canals have several sections. Jingmi canal has an area of 196.15 hectares, Cao river canal, 563.30 hectares, Yongding river canal, 48.33 hectares and White river canal, 176.51 hectares.

Pounds distribute in the place near to water areas. 84.6% of the pounds distribute in Changping, Shunyi, Tongzhou, Daxing and Pinggu. In addition, paddy field distribute sporadically in the place near to water areas, and the dykes distribute in the reservoirs and some rivers.

4) Change Research of Key Wetland

1. Change research of key reservoir

As live drinking water of Beijing stems mainly from Miyun reservoir, Guanting reservoir and Huairou reservoir at present, it is significative to study their dynamic change. Through the monitoring of RS, comparing the water area in 2002 with that in 1998, the areas of Miyun reservoir, Guanting reservoir and Huairou reservoir have been respectively reduced by 42.0%, 23.9% and 4.9% (see Table 3).

Table 3. The statistics of three reservoirs' area in 1998 and 2002(ha.)

	Miyun reservoir	Guanting reservoir	Huairou reservoir
1998	15843.12	9965.61	569.85
2002	9185.52	7586.73	541.78
change	-6657.60	-2378.88	-28.07
Percentage	-42.0%	-23.9%	-4.9%

2. Change research of widgeon lake

The environmental value of Wild-duck lake is outstanding. It is a unique and typical wetland in Beijing and so is it in the whole North China. As we can see from Table4 that, comparing the wetland resources of wild-duck lake in 2002 with that in 1998, the areas of water, pounds and paddy field have been respectively reduced by 53.2%, 59.9% and 66.6%, on the contrary, the wetland meadow and dykes have respectively increased by 104.6% and 682.7%. There are mainly the two following reasons: Firstly, the rainfall is so abnormally low in the Wild duck's lake areas in recent years that the shallow layer of groundwater drops and the water resources quantity that is gathered reduces. This point has been proved from fig2, the graph of annual precipitation and annual evaporation capacity in Yanqing county from

1998 to 2000. Secondly, the lack of rainfall aggravates the serious lack of water resources. River is intercepted to store the water and irrigate in order to meet the exigence of industry and agriculture, which causes the conservation storage of the reservoir to reduce.

Table4. Form of the analysis of wetland area change in Beijing Widgeon-lake from 1998 to 2002(ha.)

	water	meadow	paddy field	pound	dyke
1998	2105.59	580.05	803903.68	244.16	11.75
2002	985.51	1186.59	26.88	98.10	91.95
Change	-1120.08	606.53	-53.52	-146.06	80.20
percentage	-53.2%	+104.6%	-66.6%	-59.9%	+682.7%

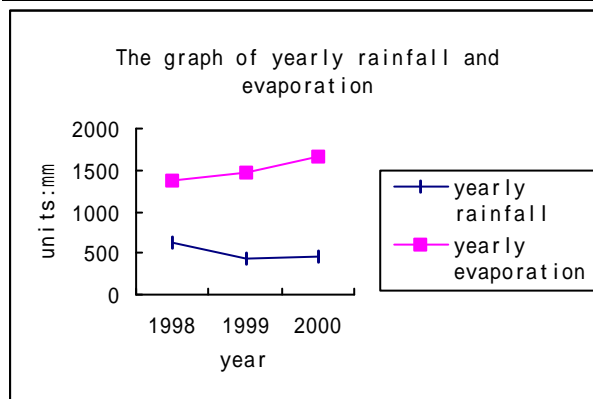


Fig.3. The graph of Yanqing county's annual rainfall and evaporation in 1998-2000.

3. Conclusion

The following problems are found from this work. The total amount of Beijing's wetland water resources has decreased much more than ever before, the ecological environment around wetland has begun to change, too. Irregular tourism exploitation causes the destruction and threat to wetland environment. The protection of wetland is unfavorable and the management is weak.

As the coming of "Green Olympic Games" in 2008 and the further development of Beijing's economy and society, the protection of Beijing's wetland and bio-diversity has been extremely urgent. Some measures to protect and recover wetland are proposed as the following.

Reinforce the study of Beijing's wetland, including wetland scientific monitoring, wetland protection and recovery study, wetland environment change and the study of the influence to adjacent environment, the study of recovery engineering construction, etc.

Actively actualize some wetland protection and recovery demonstration project construction, such as retreating herd to return grasses, retreating cultivation to return bottomland, wetland diversity protection and

perching area recovery, the transmigrant project in the key wetland protection area and so on, and we should prepare ourselves for long-term planning, implementing progressively step by step.

Strengthen the protection management system. We shall abide by the national laws and regulations about wetland and existing national policy about wetland protection and using. It is indispensable to constitute the laws and regulations about wetland protection and using that is adapted to the reality of Beijing in order to restrain wetland environment from being destroyed and polluted. And it is necessary to set up the environmental influence appraisal system and the ecological benefits compensation system.

Especially construct several representative wetland demonstration bases. Construct them to become the window of wetland protection in the capital and even in the whole country, the gene storeroom of bird species, the propaganda and education base of bio-diversity protection and the ideal place for citizen appreciating birds, getting ecological civilization baptism and going back to nature.

Acknowledgement

To the completion of my paper, I have appreciation in my heart to these friends, Xie Zhi-Ru and Jia Ping who have given me sincere help and advice. Meantime, I am grateful to Wildlife Protection and Nature Protection Region Management Station of Beijing Forest Bureau for its great support and help.

References

- [1] CHEN Jian-wei and HUANG Gui-lin, 1995. wetland classification system of china and the discussion of division index, *J. Forestry Resource Management*, (5):65 ~ 71.
- [2] HE Shan-chun, ZHU Wen-zhong, and WU Xiao-long, etc, 2002. Research on the resources and classification of wetlands in Anhui, *J. Journal of Anhui University Natural Science Edition*, 26(2):103 ~ 106.
- [3] ZHOU Qian-xiang, JING Zhong-liang, and JIANG Shi-zhong, 2002. Comments on research and expectation of multi-source information fusion for RS images, *J. Journal of Astronautics*, 25(3) : 89 ~ 94.
- [4] Luo R C and Kay M G, 1989. Multisensor Integration and Fusion in Intelligent Systems, *J. IEEE Trans on SMC*, 10(5) : 905 ~ 912.
- [5] JIA Yong-hong, LI De-ren, and SUN Jia-bing, 2000. Data fusion techniques for multi-sources remote sensing image, *J. Remote Sensing Technique and Application*, 15(1): 41 ~ 44.
- [6] Bartl R, Pinz, 1992. Information Fusion in Remote Sensing: Land Use Classification, *R. Proc IAPR TC7 Workshop Delft 7 ~ 9 Sept.*