

Differences of ecological functions inside and outside the wetland nature reserves in Sanjiang Plain, China

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Abstract: Conservation effectiveness of wetland nature reserves is determined by both the management intensity inside the reserves and the hydrological status outside the reserves. Therefore, differences of ecological functions inside and outside the reserves are an integrated indicator for assessing conservation effectiveness. Based on the land use map created from Landsat-TM satellite image and 1:50000 Digital Elevation Model (DEM) data in the study area, the catchments that belong to the wetland reserves were determined as their hydrological sensitive zones by SWAT (Soil and Water Assessment Tool) hydrological model. The ecological function indices of wetland reserves and their corresponding hydrological sensitive zones were calculated through expert consultation and value assessment on wetland ecosystem service functions. The results showed that the ecological functions of national wetland reserves were better than those of local reserves in general. However, the wetland ecological functions of hydrological sensitive zones of the former were not always better than those of the latter. Meanwhile, clustering analysis showed that the wetland ecological functions of several adjacent reserves in Nongjiang-Bielahonghe watershed were similar. But correlation analysis found that there existed a remarkable positive correlation between the wetland ecological function indices of local reserves and their hydrological sensitive zones.

Key Words: wetland ecological function; wetland nature reserve; hydrological sensitive zone; management intensity; conservation effectiveness

Wetland is one of the most important ecosystems in the world. It has prominent significance in not only maintaining the regional and global ecological balances, but also providing living environment for wild animals and plants^[1]. However, wetland has become one of the badly destroyed ecosystems along with the fast development of social economy and population. As a result, wetland functions lost most, especially its ecological benefit^[2]. China has made some progress in wetland protection and management. There are great differences in protection and management effects between different wetland reserves in China since the management invests and types of wetland reserves in China were various.

Wetland reserve is a special terrestrial reserve. The protection effect has been impacted by its management intensity as well as by the hydrology outside the wetland reserve. Because

of the characteristics of its location (water area) and protective objects (migratory birds), compared with other reserves such as forests, it is bad to exert close management on wetland reserve^[3]. Therefore, to realize the effective management and sustainable development of wetland reserve, pertinent measures should be put forward based on scientific assessment on ecological functions of wetland reserve and nearby hydrological sensitive zones^[4–7]. The function assessment of a single wetland has been mostly studied^[8,9], while there has been very few comparison study for wetland reserves with different scales in a region. Especially, the wetland ecological function of the nearby hydrological sensitive zones and its impacts on wetland reserves fell into a gap.

Sanjiang Plain is one of the biggest freshwater wetland distribution zones in China. At the same time, wetland loss here

is the most rapid because of human behavior^[10,11]. Wetland reclamation was stopped and the compensatory wetland reserves were to be rebuilt in Heilongjiang Province in 1998. These acts have had some effect on wetland decrease in Sanjiang Plain. 68 wetland reserves had been founded in Heilongjiang Province by the end of 2003. There were 24 reserves (1.558×10⁶ hm²) in Sanjiang Plain, which accounted for 35.9% of the wetland in the whole province^[12]. These facts indicated that the government of Heilongjiang Province indeed increased wetland reserve foundation, but they could not testify that each wetland reserve had been protected well. In fact, those small reserves were in a bad status, and the nearby lands were reclaimed severely. Therefore, it could be helpful to better understand the reserve management effects that wetland ecological function of different magnitude reserves and its nearby hydrological sensitive zones were assessed at first. Then the relations between wetland reserves and their surrounding environment could be discussed in order to protect and manage wetland resources at a basin or regional scale.

1 Study area

The study area is in the hinterland of Sanjiang Plain, which is subjected to the Jiansanjiang Department of Heilongjiang Agricultural and Cultivable Bureau. It is located on the common boundaries among Fujing, Tongjiang, Fuyuan and Raohe (132°31'26"E–134°22'26"E, 46°49'42"–48°13'58"N), and in the junction of Heilongjiang, Songhuajiang and Wusulijiang rivers with an area of 12300 square kilometers. The annual mean air temperature is 1–2°C and the annual rainfall ranges from 500 to 600 mm. The region is flat with a mean elevation of 60 m. There are 7 wetland reserves in the study area, including 2 national and 5 local reserves.

2 Materials and methods

2.1 Land use classification

In this study, the Landsat TM image (resolution: 30 m), taken on June 4th, 2004, was used as the main source to estimate the land use. The supplementary data for study were one 1:50000 topographic map provided by the National Geomatics Center of China and one 1:100000 irrigation map. The image was imported into the image processing software, ERDAS IMAGINETM (ERDAS, Atlanta, GA), and geo-corrected. The land use was mapped by revised classification process using ERDAS 8.5 and ArcGIS 8.1. The primary wetlands in this study area were swamp, swamp meadow and wet meadow. Swamp meadow was mainly composed of acetabuliform wetlands, centered with ponds. They were easily distinguished with wet meadow since they had upper water. Furthermore, they were also distinguished with swamp easily because of their shape and isolation (Table 3).

2.2 Confirmation of hydrological sensitive zones

Confirmation of the impact range around the wetland reserve is the precondition to further discuss the relationship between the wetland reserve and its impact district. As a general rule, the administrative boundary, on which the study area was located, or the assumed buffer was regarded as the extension of the impact district around the wetland reserve^[13]. However, the wetland reserve was the core part of the wetland ecosystem. The boundary of the wetland ecosystem should be then regarded as the impact range around the wetland reserve instead. Hydrological factor was the key factor of the impact range confirmation. The watershed boundary of the wetland ecosystem was therefore regarded as the extension of the impact district around the wetland reserve, named the hydrological sensitive zone. The watersheds of the 7 wetland reserves were obtained by using 1:50000 DEM data and SWAT^[14] hydrological model which was based on Arcview3.2 software. Then they were regarded the ranges of hydrological sensitive zones (Fig. 1).

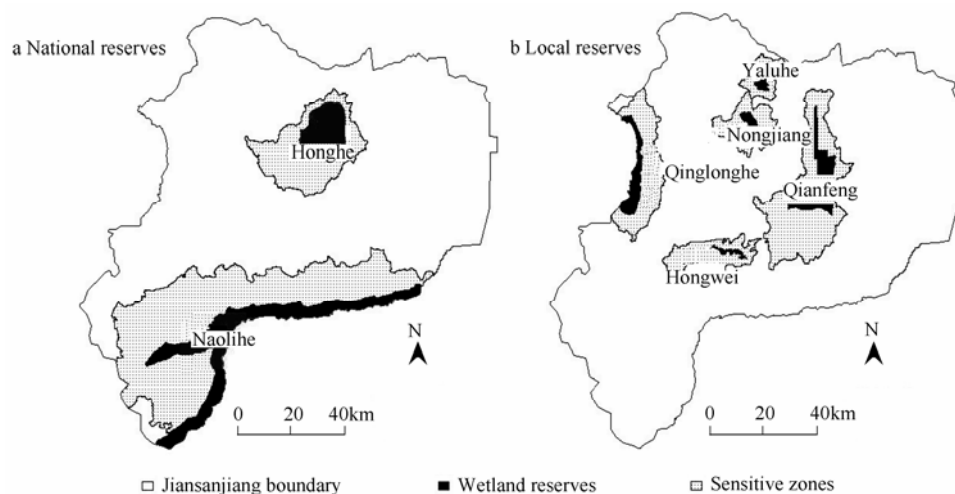


Fig. 1 Location of wetland nature reserves and their hydrological sensitive zones

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