Vegetation and soil properties in restored wetlands near Lake Taihu, China

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Abstract  Riparian wetlands are important components of the lake ecosystem, and they play essential roles in maintaining system health. Remediation of degraded lakeshore wetlands is an essential component of lake restoration. A study was conducted to investigate the restoration of lakeshore wetlands, which were converted to rice fields and then abandoned for 2, 5, 10 and 15 years, near Lake Taihu. Soil samples (0–20 cm and 20–40 cm) were taken and plant species were investigated. The carbon content in the soil had increased significantly, rising from 0.71% to 1.85% between 2 and 15 years. Organic matter accumulation improved soil texture, and water stable aggregate content (>0.25 mm) and soil porosity increased. Total nitrogen in the soil increased from 0.06% to 0.13%, and total Kjeldahl nitrogen increased from 124.4 mg kg\(^{-1}\) to 351.5 mg kg\(^{-1}\). Total phosphorus in the soil increased from 0.045% to 0.071%, and the Olsen-P value increased from 5.13 mg kg\(^{-1}\) to 16.0 mg kg\(^{-1}\). Results showed that phosphorous did not increase as much as nitrogen. In the vegetation restoration process, plant species composition moved towards a natural wetland community, and spatial heterogeneity and landscape diversity increased. The richness of plant biodiversity increased rapidly in the first 2 years, then more slowly in later restoration stages. The wetlands recovery process may be complicated by interactions of biota and soil and hydrological conditions.

Keywords  Lakeshore · Wetlands · Restoration · Dynamics · Process · Vegetation · Soil nutrients · Lake Taihu

Introduction

Eutrophication in lakes and reservoirs is a worldwide environmental problem (Vollenweider, 1992), particularly since the 1980s in China due to rapid economic development (Jin et al., 1990). Riparian wetlands are important components of the lake ecosystem, and they play essential roles
for maintaining system health (Naiman & De-camps, 1997). These wetlands are effective buffers, retaining water and nutrients, improving water quality, and providing diverse and dynamic habitats for wildlife (Naiman et al., 1994; Yin & Lan, 1995; Tabacchi et al., 1998; Coveney et al., 2002). Therefore, remediation and restoration of lakeshore wetlands is an essential component of lake restoration.

Due to historical lack of recognition of the ecological value of riparian wetlands, many wetlands were destroyed in the last 50 years. Most of the destruction is a result of conversion to agriculture and other economic uses (National Bureau of Statistics of China, 2001; Chen & Chen, 2002). Approximately 160 km² of riparian areas are cultivated along Lake Taihu (Hu & Jiang, 2004; Xiong, 2004). Losing the buffering capacity of riparian zones enhanced eutrophication, and, in recent years, wetland restoration has been implemented extensively in China (Chen, 2001). Hydrology, soil, and vegetation are interconnected components of wetlands and undergo dynamic changes during restoration. This paper describes soil and vegetation changes in the riparian wetlands and discusses the effectiveness and feasibility of natural restoration. This information will be useful for future wetland restoration efforts.

**Study area, materials and methods**

**Description of study area**

The study area is located at the lakeshore of northeast Lake Taihu. The land in this region is flat with adjacent undulating steep hills. Natural riparian wetlands were changed into paddy fields and other agricultural uses from the 1960’s to 1980’s. After 1988, with a local policy for protecting the lake and an increase in labor costs, some paddy fields were abandoned. Vegetation recolonized these paddy fields, and the weir was destroyed, allowing water to move freely into the wetlands. In investigation years 2003 and 2004, the lake water table was low, so the wetlands were not inundated.

**Field investigation and sampling**

**Experiment design**

Five sections of paddy fields, with an area ~0.15 ha and an age series of 2-, 5-, 10-, and 15-years since abandonment, and a reference wetland were selected in the riparian areas of Lake Taihu in the Dafu Town of Wuxi (Fig. 1). Since it was difficult to find an undisturbed natural wetland as a reference site, an uncultivated and less disturbed 30-year old riparian wetland was chosen. All of the abandoned lands in the study areas were flat and subject to similar hydrological conditions. The age of abandoned sites were...