



Review

China's coastal wetlands: Conservation history, implementation efforts, existing issues and strategies for future improvement



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ABSTRACT

China has approximately 5.80×10^6 ha coastal wetlands by 2014, accounting for 10.82% of the total area of natural wetlands. Healthy coastal wetland ecosystems play an important role in guaranteeing the territory ecological security and the sustainable development of coastal zone in China. In this paper, the natural geography and the past and present status of China's coastal wetlands were introduced and the five stages (1950s–1970s, 1980s–1991, 1992–2002, 2003–2010 and 2011–present) of China's coastal wetlands conservation from the foundation of the People's Republic in 1949 to present were distinguished and reviewed. Over the past decades, China has made great efforts in coastal wetland conservation, as signified by the implementation of coastal wetland restoration projects, the construction of coastal wetland nature reserves, the practice of routine ecological monitoring and two national wetland surveys, the promulgation of local wetland conservation statutes and specific regulations, the coordination mechanism to enhance management capacity, the wide development of coastal wetland research and public participation, and the extensive communication to strengthen international cooperation. Nonetheless, six major issues recently emerged in China's coastal wetland conservation are evidently existed, including the increasing threats of pollution and human activities, the increasing adverse effects of threaten factors on ecosystem function, the increasing threats of coastal erosion and sea-level rising, the insufficient funding for coastal wetlands conservation, the imperfect legal and management system for coastal wetlands, and the insufficient education, research and international cooperation. Although the threats and pressures on coastal wetlands conservation are still apparent, the future of China's coastal wetlands looks promising since the Chinese government understands that the sustainable development in coastal zone requires new attitudes, sound policies and concerted efforts at all levels. The major strategies for future improvement of China's coastal wetland conservation include: exploring effective measures in response to major threaten factors; improving the conservation and compensation system for coastal wetlands; strengthening coastal wetland legislation and management; increasing funds for coastal wetland conservation and research; and strengthening coastal wetland education and international cooperation.

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1. Introduction

The wetlands in China include 5 types in 34 variations, covering coastal wetlands, rivers, lakes, marshes and artificial wetlands (Liu et al., 2011). The area of wetlands accounts for 5.58% of territorial area of China, which is slightly lower than 6.0% of the world average level (An et al., 2007; Wetland China, 2014). Healthy natural wetland ecosystems play an important role in the sustainable development of China. The coastal zone of China comprises an area of more than three million square kilometers and possesses an 1800 km coastline stretching across tropical, subtropical and temperate zones (Cao and Wong, 2007). Coastal wetlands are ecosystems of complex interaction between terrestrial and marine processes, which may act as geochemical trap and “green filter” for terrestrial pollutants. It was estimated that more than 70% of large Chinese cities were located in coastal zone and coastal development played a leading role in the national economy, accounting for 55% of its gross domestic product (Wang, 1992). Over the past decade, the continuing increase in population coupled with economic growth, rapid urbanization and infrastructure development in coastal zone of China have resulted in great changes in coastal wetland ecosystems (Sun, 2014), which significantly influenced the territory ecological security and the sustainable development of coastal zone.

Although the Chinese government has conducted the first national wetland resources survey during 1995–2003, the untimely information is unfavorable for the current conservation and management of wetlands since the rapidly economic and social development has brought notable changes to China's wetland ecology in the past decade. In order to get the dynamic information on wetland resources, the Chinese government conducted the second national wetland resources survey during 2009–2013. In the first half of 2014, the related survey information was formally promulgated one after another. Thus, the synthesis studies on the latest survey information of coastal wetlands are favorable for getting the accurate variations of wetland ecology and making or improving wetland conservation and administration policies.

In this paper, the conservation history of China's coastal wetlands was reviewed and the latest information on coastal wetlands (including natural geography, present status, implementation efforts and existing issues) was provided by analyzing the two national wetland resources survey data comparatively and studying the related research data or reports systemically. It should be pointed out that the data used in this paper before the first national wetland resources survey were reliable and valid because all of them were cited from authoritative research articles or official authoritative reports issued by the State Forestry Administration of China, the State Oceanic Administration of China, the Ministry of Environmental Protection of China, the Fishery Bureau of the China Ministry of Agriculture, the Wetland China, and the Ramsar

Convention on Wetlands. The objectives of this paper are to: i) systematically introduce the conservation history, implementation efforts, and policies or measures taken by the Chinese government for the people from institutions of scientific research and organizations of conservation abroad, and ii) to timely provide the information on dynamic variations of China's coastal wetlands in the past decade. Particularly, the issues existing in current coastal wetland conservation and management were pointed out and the strategies for future improvement were put forward.

2. Natural geography of China's coastal wetlands

2.1. Geographical distribution of coastal wetlands

China's wetlands are unevenly distributed among 7 wetland regions: i) the northeast region dominated by freshwater marshes; ii) the Xinjiang–Inner Mongolia region by saline lakes and swamps in dry climate; iii) the Qinghai–Tibet plateau region by alpine lakes and marshes; iv) the Yunnan–Guizhou plateau by subalpine lakes; v) the middle–lower Yellow River region by rivers and coastal wetlands; vi) the middle–lower Yangtze River region by lakes, rivers and coastal wetlands; and vii) the south and southeast regions by rivers and coastal wetlands (Fig. 1a). According to the second national wetland resources survey conducted during 2009–2013, the total area of China's wetlands is 53.60×10^6 ha, including 46.67×10^6 ha natural wetlands. Compared to the first national wetland resources survey conducted during 1995–2003, the country lost 3.38×10^6 ha natural wetlands, with a total loss rate of 9.33% (Wetland China, 2014). Of the total area of natural wetlands, 21.73×10^6 ha are marshes and swamps, 8.59×10^6 ha are lakes, 10.55×10^6 ha are rivers, and 5.80×10^6 ha are coastal wetlands (Wetland China, 2014), which account for 40.68%, 16.09%, 19.75% and 10.85% of the total wetlands area, respectively (Fig. 1b). The coastal wetlands are mainly distributed in 11 provinces of Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi and Hainan, in which the area of coastal wetlands of Shandong and Guangdong provinces accounts for 37.55% of the total coastal wetlands area (Fig. 1a,c). Coastal wetlands in China generally can be divided into two groupings. One part is located to the north of the Hangzhou Bay. In this part, the Bohai Sea coast and the Jiangsu coast have sandy or silty wetlands while the Liaodong Peninsula and Shandong Peninsula have rocky beaches. The other part is located to the south of the Hangzhou Bay. In this part, the coasts are mainly rocky, including the major river deltas, such as the Yangtze River Delta, the Qiantang River–Hangzhou Bay, the Jin River estuary–Quanzhou Bay, the Pearl River Delta and the North (Beibu) Gulf (Niu et al., 2009).

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