

## THE WETLAND TYPES, FUNCTIONS AND CONSERVATION IN CHINA

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**ABSTRACT:** According to preliminary statistics, there are  $9.4 \times 10^6$  ha of mire,  $8.0 \times 10^6$  ha of lake,  $2.1 \times 10^6$  ha of salt marsh,  $2.7 \times 10^7$  ha of shallow sea (0 – 5m), and  $3.8 \times 10^7$  ha of paddyfield, their total area amounts to  $8.45 \times 10^7$  ha. Wetland consists of natural wetland system and man-made wetland system. According to hydrology, landform, soil and vegetation etc., natural wetland can be divided into the following types: marine, esturine, riverine, lacustrine, palustrine subsystems. On the basis of the wetland bottom compound, waterlogged state and vegetation forms, it can be subdivided into 26 wetland classes. Man-made wetland can be subdivided into 4 wetland classes. Wetland is a unique landscape in the earth and one of the most important living environment with rich resources and many functions. At present, 262 different types of Wetland Natural Reserves have been established in China, in which 7 Wetland Nature Reserves have been listed in international important wetlands of "The Wetland Convention".

**KEY WORDS:** wetland type; wetland function; wetland conservation; China's wetland

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Wetland is an important landscape existing almost all over the world. In China, wetlands are distributed everywhere from frigid-temperate zone to tropical zone, from littoral to inland, from plain to plateau and mountains. Some of the wetlands share the same characteristics of other countries, and some are unique, such as the wetlands in Qinghai-Xizhang(Tibet) Plateau. The definition and classification of wetland is still under exploration and discussion. Although there is no internationally accepted and unified definition and classification for wetland, it is necessary to take after the experiences of international companions to smooth the research exchange and cooperation internationally.

### 1 DEFINITIONS OF WETLAND

XU Qi *et al.* defined wetland as the soil which is moisten by under-ground water or is permanently or temporarily soaked by ground water(XU, 1995). This definition emphasizes that water is a key role in wetland formation.

According to HUANG Jin-liang and CAI Shu-ming's definition, the wetland is the area between land and water, where underground water usually is laying in or near ground, or have shallow water on the ground. Its soil is imperfectly drained aquatic soil or undeveloped soil. Vegetation is hydrophyte, hydrophilous plant or even lack of plant(HUANG and CAI, 1995). The key

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words of this definition include accumulated water, soil and plant.

LU Jian-jian presented his wetland definition of China in 1996: terrestrial regions with vegetation more than 60% of hydrophilous plant, and epicontinental sea under 6 metres to sea level, including abundant water region whether natural or artificial, salt-water or fresh-water in inland and outflow river regions (except the water area with a depth over 2 metres in dry season), no matter the water is stationary, temporary or permanent.

The key words of LU Jian-jian's definition are vegetation, soil and the waterlogging extent (degree). Wetland must have one of the following conditions:

- 1) At least dominant hydrophyte or hydrophilous plant grow periodically.
- 2) Basal land is dominated with imperfectly drained organic soil.
- 3) Bottom land is not soil, waterlogged and at least retains high water level in plant growing season per year (LU, 1998, 1990).

We think that only LU Jian-jian's definition is close to Chinese wetland status among the above-mentioned wetland definitions, but it is somewhat insufficient, for example, salt mire is not included in the definition.

We believe that wetland is the permanent or temporary waterlogged area (the depth of which doesn't exceed 2 meters) in land, or overwet area, including the epicontinental sea in which water depth is less than 6 meters in low tide, and forms a unique ecosystem with biological community. Wetland must meet with one of the following conditions:

- 1) There are hydrophyte, hydrophilous plant or salt plant community.
- 2) Base land is dominated with aquatic soil.
- 3) Bottom land is not soil, but it is waterlogged and has activities of waterfowl.

## 2 TYPES, CHARACTERISTICS AND DISTRIBUTION OF WETLAND

China is located in the southeast of Eurasia continent, which has  $9.60 \times 10^6 \text{ km}^2$  of land and

$3.00 \times 10^6 \text{ km}^2$  of sea to be managed. Geography coordinate is  $4^\circ 15' - 53^\circ 31' \text{ N}$ ,  $73^\circ 40' - 135^\circ 05' \text{ E}$ . From south to north it spans 50 latitudes, and strides across five climate zones including tropical zone, sub-tropical zone, warm-temperate zone, temperate zone and frigid-temperate zone. From east to west it spans 52 longitudes, and strides across humid region, semi-humid region, semi-dry region and dry region. From a boundless stretch of the Northeast China Plain, the North China Plain to the Yunnan-Guizhou Plateau and the Qinghai-Xizang Plateau, landform types are complicated and rare in the world. Especially the uplift of Qinghai-Xizang Plateau not only formed high-frigid climate, but also had the important effect on the Chinese climate. China has complete, numerous types and large area of wetlands in Asia because of its complicated geographical environments and divers climate conditions. According to preliminary statistics, there are  $9.4 \times 10^6 \text{ ha}$  of mire,  $8.0 \times 10^6 \text{ ha}$  of lake,  $2.1 \times 10^6 \text{ ha}$  of salt marsh,  $2.7 \times 10^7 \text{ ha}$  of shallow sea (0–5m), and  $3.8 \times 10^7 \text{ ha}$  of paddyfield, their total area amounts to  $8.45 \times 10^7 \text{ ha}$ .

### 2.1 The Principle and Basis of Wetland Classification

Chinese scientists have taken over decades to research mire and shore, then they have presented their classification system.

Wetland is developed by watered environment, and water condition is confined by landforms, climate and water sources. Permanent moist or waterlogged land develops special procedure and types of soil and vegetation, so it is difficult to reflect wetland primary attributes and characters based on single-factor. Therefore the synthetic and systemic classification of wetland is necessary for wetland research.

Considering the scientific nature and feasibility of synthetic classification system of wetland, it is important to insist on the following three principles: 1) to combine synthetic principle with generating principle; 2) to combine dominant factors with assistant ones; 3) to combine quantitative analysis with qualitative analysis.

Based on the above-mentioned principles, when we

set up classification system, we should not only analyse water-quality, water source supplement, landform types, soil and vegetation character, but also consider wetland developing process and developing character; different research units may adopt different quantitative classification marks, and chose necessary assistant or quantitative indexes under the unification of classifications.

## 2.2 Wetland Synthesis Classification System

HUANG Jin-liang and CAI Shu-ming first presented that wetland could be classified into three wetland systems including river, lake and man-made wetlands which is based on the formation causes in Jianghan-Dongting Plain wetland classification, then, on the basis of river, lake's seasonal changes of water level, it was classified into different wetland classes further, and classified to types further more according to soil, vegetation and ground material composition.

XU Qi *et al.* classified wetlands into two groups: natural wetland and man-made wetland, and subclassified into three grades: group, class and form. When necessary, it could be classified further into sub-group, sub-class and sub-form etc.

LU Jian-jian advanced, in book *Chinese Wetland*, that the Chinese wetland could be classified into 22 types based on the Ramsar Convention definition. LU Jian-jian believed that natural wetland can be divided into marine wetland, lake-river wetland and mire wetland system (LU, 1998), then into 8 subsystems, 31 forms, and man-made wetland is divided into 4 forms.

The classifications mentioned above are helpful to the further research and realization of wetland, and beneficial to set up the classification system of China.

We advance that wetland can be divided into three grades: system, class and form based on the primary investigation, the information and reference of abroad classification system (COWARDIN, 1992; LIU, 1997; National Wetlands Working Group, 1988). If it is necessary, we can divide the different classification grade into sub-system, sub-class and sub-form.

Primarily, wetland consists of natural wetland system and man-made wetland system. In natural wetland system, on the basis of synthetic characters including similar hydrology, landform, soil and vegetation etc., it can be divided into the following types: marine, estuarine, riverine, lacustrine, and palustrine subsystems.

Wetland class is a middle-unit in wetland classification. On the basis of the wetland bottom compound, waterlogged state and vegetation forms, natural wetland can be subdivided into 26 wetland classes; man-made wetland can be divided into field-pond subsystem and 4 wetland classes (Table 1). Wetland type is the base unit. Wetland class can be subdivided into different types, according to dominant plant (animal) forms and types of components.

Table 1 The wetland classification in China

System	Subsystem	Class
Natural wetland system	Marine	Shallow sea water
		Subtidal aquatic vegetation
		Intertidal unvegetated mud sand or salt flat
		Intertidal mire
		Rocky marine shore
		Sandy mud marine
		Mangrove
		Coral reef
		Coast salt water lake
		Coast freshwater lake
	Estuarine	Gulf estuary
		Delta wetland
	Riverine	Permanent river and stream
		Seasonal and irregular flowing river and stream
	Lacustrine	Permanent freshwater lake
		Seasonal and irregular flowing freshwater lake
		Permanent saltwater lake
		Seasonal and irregular flowing saltwater lake
Man-made wetland system	Palustrine	Grassy mire
		Moss mire
		Shrub swamp
		Forest swamp
		Wet meadow
		Freshwater spring
		Warmwater wetland
		Saline mire
Man-made wetland system	Field-pond	Paddyfield
		Fish-shrimp pond
		Reservoir
		Salt field

### 3 FUNCTIONS AND BENEFITS OF WETLAND

Wetland is a unique landscape in the earth and one of the most important living environment with rich resources and many functions.

#### 3.1 Having High Bio-productivity

The mean net primary production of freshwater mire is  $6\text{t}/(\text{ha}\cdot\text{a})$ , with highest production near  $100\text{t}/(\text{ha}\cdot\text{a})$ . It was calculated that plant bulrush (*Typha latifolia*) produced about  $70\text{t}/(\text{ha}\cdot\text{a})$ , submerged plant (*Potamogeton crispus*) produced  $40\text{t}/(\text{ha}\cdot\text{a})$ , and mangrove plant (*Bruguiera sexangula*) produced  $30\text{t}/(\text{ha}\cdot\text{a})$ . Therefore, the primary yield per year of herbage and wooden plant in wetland is fairly high. But, the primary production per year about high-yield crop corn now, is only  $60\text{t}/(\text{ha}\cdot\text{a})$ . To reach this output, a vast of fertilizer, pesticide, and a great deal labor forces are needed to be put in.

#### 3.2 Providing Food Stuffs and Raw Materials to Mankind

Wetland provides plentiful organism resources, which supply green foodstuff (provision, vegetable, fruit), aquatic product (fish, shrimp, crab, shellfish), medical plant, textile plant, forage plant and lumber, fire wood and peatland etc. Of the raw material in making paper in China, reed accounts for 26% of paper-making raw stuff. Peatland reservation is up to  $5.0 \times 10^9\text{t}$ , which can be extensively used in industry, agriculture, energy, medicine and environmental protection etc.

#### 3.3 Being the Most Important Freshwater Resources for Mankind

Data show that the freshwater reserves of lake is about  $2.249 \times 10^{11}\text{m}^3$  in China, and the freshwater reserves of mire is about  $1.0 \times 10^{10}\text{m}^3$ , which mainly distributed in dense-populated and well-developed eastern China. So it is closely related with living and developing conditions.

#### 3.4 Adjusting Flow, Controlling Floodwater, Resorting Sediment and Detoxification

Wetland vegetation increases the rate of roughness of the ground, and reduces flowing velocity of floodwater, and reduces flood peak water level at the lower reaches of a river. Taking Caizhuizhi Station of the Raoli River in the Sanjiang Plain as an example, due to the functions of wetland's vegetation, the river's flood peak in summer is reduced to half of that in the Baoqing Station of the upper reaches of this river (relative flow), and the flood season postponed. Lacustrine wetland in the middle reaches of the Changjiang (Yangtze) River has much more effect on adjusting river's flow than other functions. In heavy rainfall years, the lakes in the Jiangnan Plain can receive over  $1.5 \times 10^{10}\text{m}^3$  incoming water. The average of lake runoff amount (capacity) per year in Dongting Lake is  $3.276 \times 10^{11}\text{m}^3$ , and it can adjust water capacity of  $1.87 \times 10^{10}\text{m}^3$ . The average runoff capacity per year in Pongyang Lake is  $1.457 \times 10^{11}\text{m}^3$ , and can adjust water capacity of  $3.22 \times 10^{10}\text{m}^3$  in high water-level year. In recent years, enclosing lake to make cropland in lacustrine wetland has weakened each lake's floodwater adjustment along the Changjiang River, this is one of the reasons for tremendous floodwater in the Changjiang River in 1998.

Data show that there are many hydrophyte, including emerged plant, floating-plant and submerged plant which absorbs pollutant and detoxification in wetland. Experiments indicate that reed (*Phragmites australis*) purifies 96.06% of Al, 92.78% of Fe, 94.54% of Mn, 80.18% of Pb, 100% of Be and Cd. Reed, which can absorb toxicant, contains heavy metal  $1.0 \times 10^5$  times higher than that in the water. The reed, when is cropped, leave the water and bring toxicant away. Thereafter reed purifies water, preserves soil environment and eliminates the latent threatening to human being. Hence, hydrophyte, saying reed, cattail (*Typha latifolia*), hyacinth (*Eichhornia crassipes*) etc., are successfully used to deal with sewage, purify water and protect wetlands.

### 3.5 Preventing Storm and Controlling Soil Erosion

Wetland vegetation (including mangrove) is a natural barrier to protect estuary and coastline, weaken storm and surf. Mangrove protects the banks by reducing wave and reveitment and increasing silt. Experiments indicated that mangrove, with 50 meters in wide, can reduce 1m high wave to 0.3m. The water flow velocity in mangrove is only 1/10 of that in tide water channel, because of the resistance of mangrove to tidewater. The deposition velocity of sediment in mangrove is 2 – 3 times faster than that in nude neighbor beach.

Xiamen region suffered 12-grade typhoon in August. 23, 1959. The sea dam in Qingjiao Village, due to mangrove destruction, was burst and inundated 7m. But in Longhai County, the sea dam in Liaodong Village is in a whole skin, because of mangrove' protection.

### 3.6 Being Gene Bank of Species

Statistics suggest that recorded vascular plants in wetland is about 1642 in China(ZHAO,1995). The biodiversity is usually expressed in the number of species. Species density is species number in a unit area, and shows species diversity. Wetland plant density is 0.0056 species/km<sup>2</sup> in China, which is twice as much as plant density (0.0028 species/km<sup>2</sup>) in China, and is higher than Brazil (0.0046 species/km<sup>2</sup>), which is the most plentiful flora section in the world.

It is proved that wetland cultures the important gene, which will determine the development of national economy. The high-yield paddy bred by YUAN Long-ping, which drew attentions all over the world, is the result of hybridization between common wildness paddies in wetland and cultured paddies. In addition, wetland preserves the Chinese proper plant *Metasequoia* etc, which is Tertiary plant. Calculation figures out that there are about 100 – 150 vascular plants which are in severe danger in the wetlands of China.

There are about 1500 recorded species of vertebrates in the wetlands of China(WANG,1995), which includes the Chinese alligator(*Alligator sinensis*) —

“paleontology living fossil” and *Lipotes vexillifer*, *Acipenser sinensis* and the endangered birds: *Grus japonensis*, *G. Leucogeranus* and *G. Nigricollis* etc.

### 3.7 Adjusting the Around Environment

Wetland is the product of natural environment, and has the feedback onto environment. It benefits to human living conditions and sustainable development around wetlands.

After comparison of wetlands and ploughed farms, it is concluded that the reflectivity in wetland exterior is higher than that in fields, and the hot flux quantity in mire is less than that in field after reclamation. The average daily air temperature in mire is 1 – 2°C lower than that in field, and the average daily relative humidity is 7% – 13% higher than that in fields, i. e. the mire has “cold and moist effectiveness”. Because wetland is rich of water and is of strong plant evaporation, the evaporation in mire is 1 – 2 times higher than that in water. The exchange of heat and water in horizontal direction can moisten and milden the environment. To take Bosten Lake in Xinjiang Region as an example(MA, 1991), lake adjusts the air temperature in vicinities obviously, and the closer to the lake, the more efficient the effects (Fig. 1).

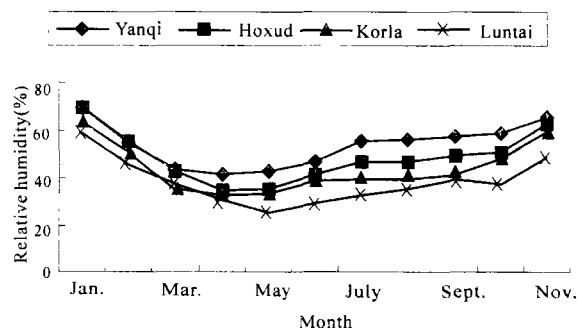


Fig. 1 Comparison of relative humidity between mire region and nearby counties

## 4 WETLAND NATURE RESERVE

At present, 262 different types of Wetland Nature Reserves have been established in China, of which 7 Wetland Nature Reserves, Xianghai in Jilin Province,

Zhalong in Heilongjiang Province, Poyang Lake in Jiangxi Province, Dongting Lake in Hunan Province, Bird Island in Qinghai Province, Dongzhaigang in Hainan Province and Mai Pu in Hongkong have been listed in international important wetlands of "The Convention on Wetland of International Importance Especially as Waterfowl Habitat", namely "Wetland Convention". Those wetlands mainly protecting wild animal (rare waterfowl) are managed by State Forestry Administration; other departments including National Environment Protection Agency, the Ministry of Agriculture, National Ocean Administration also set up and manage a series of Wetland Nature Reserve.

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