

Study on Wetland Resources Protection in Shandong Province

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Abstract: With the development of economy, the global environmental problems become more and more serious, people pay more and more attention to wetlands, and wetland research has become a hot spot. Due to the blind development of wetlands for a long time, the area of wetlands and wetland resources are decreasing day by day. This paper analyzes the general situation and main problems of wetland resources in Shandong Province, and puts forward some suggestions on protection of wetland resources in Shandong Province.

1. Introduction

All over the world, the three major ecosystems are wetlands, forests and oceans. Wetland, as an important ecosystem, is closely related to human survival and sustainable development [1]. In recent years, with the worsening of global warming, environmental deterioration and disaster intensification, the role of wetlands has become increasingly prominent, and the voice of wetlands protection has become increasingly loud. Wetland ecological restoration and reconstruction has become a hot issue in the front research of international wetlands [2]. Blind development and over exploitation of wetlands have led to changes in people's understanding of wetlands, and wetlands have become the focus of global attention and research hot areas [3, 4]. At present, there are many researches on ecological restoration and reconstruction, protection and management of degraded wetlands at home and abroad. The research on the restoration and reconstruction of wetland ecosystem in our country is later than that in other countries, and the main research objects are lakes and coastal shoals [5,6]. At present, the basic research and scientific and technological support for wetland protection in our country are relatively weak, especially in the aspects of wetland monitoring, restoration, function, succession law and so on, which are lack of systematicness and depth, difficult to serve for the decision-making of wetland protection and management, and restrict the development of wetland protection and management [7]. In view of this, this paper discusses the status of wetlands in Shandong Province and protection recommendations.

2. General situation of wetland resources

2.1 Meaning of wetland

Due to the increasing importance of environmental issues, wetlands have been mentioned many times and given different explanations. The broad definition of wetlands is given in the Wetlands Convention: "means natural, man-made, long-term or temporary swamps, peatlands, water areas, still water, flowing water, fresh water, brackish water, saline water, including water areas with a depth of not more than 6 meters at low tides" [8]. Narrow definition: "An area where the ground is too wet or where water is often collected and where wetland organisms grow" [9]. Wetlands function in many ways: biodiversity conservation, runoff regulation, water quality improvement, climate regulation, supply of food and industrial raw materials, tourism and leisure. Generally speaking, wetlands have the following characteristics: wetlands formed by the presence of water, whether at the surface or in the roots of plants; wetlands usually have soil conditions that are different from the adjacent highlands and are mostly hydroponic; wetland vegetation consists of plants suitable for a humid environment. Because of its wide range of wetlands, clear concept, clear definition, and more in line with the actual situation of the development of wetlands, it has been widely used in our country. Wetlands are the common wealth of human beings, which play a vital role in maintaining regional and global ecological balance and providing living space for wildlife.

2.2 Wetland function

Wetland has many functions and benefits

2.2.1 *Natural disaster preparedness*

Wetland wetlands and aquatic plants can reduce or stop the flow of water erosion, so as to achieve protection of the river embankment.

2.2.2 *Biodiversity conservation function*

The unique hydrology, soil, climate and other environmental conditions of the wetland provide special habitats for many rare and endangered animals and plants, which make these species to reproduce and survive normally in the less disturbed environment.

2.2.3 *Ecological functions of wetlands*

Wetland is the basis of biodiversity, maintaining the stability and balance of ecosystem, and is also the cradle of life. Because of its unique soil, hydrology and climate conditions, wetland provides special habitat for many plants and rare and endangered species to live and thrive in a relatively suitable environment.

2.2.4 *Regulation function*

Wet ground is used to regulate climate and flood. It is called "natural reservoir". This wetland is a huge reservoir, which can store too much water during rainstorms and river floods, evenly draining precipitation and mitigating floods. For example, Poyang Lake south of the river water, north of the Yangtze River south. In the 1950s, the maximum inflow was $4.85 * 10^6 \text{m}^3/\text{s}$, and the maximum outflow from the lake was $2.24 * 10^6 \text{m}^3/\text{s}$, with a decline rate of 53.8%. During the dry season, water stored in wetlands can replenish surface run off and groundwater, thereby alleviating drought.

2.2.5 *Providing tourism resources*

Wetland tourist area with pleasant climate, fresh air, comfortable environment, visitors can dive

here, swimming, bird-watching, boating, fishing, is an ideal place for sightseeing holidays.

2.3 Distribution of wetland

The wetlands in Shandong Province are mainly distributed in the Yellow River Delta, Laizhou Bay, Jiaodong Peninsula and Lakes in the southwest of Shandong Province, among which coastal and inland beaches, river wetlands, lake wetlands and swamps account for a large proportion, and constructed wetlands account for a high proportion. At present, the wetland area in Shandong Province is in a dynamic change, and its overall distribution characteristics are: rich in wetland resources, many types; uneven distribution of wetland resources, high proportion of coastal and inland shoals; natural wetlands showing a downward trend, artificial wetlands showing an upward trend; Nansi Lake wetlands and the Yellow River Delta are important wetland resources. According to the survey, Shandong Province has rich wetland resources, complete types. The proportion of coastal and inland beach wetlands in the total area of wetlands in Shandong is 14.497%; the proportion of river wetlands in the area of wetlands is 15.727%; the proportion of lake wetlands in the area of wetlands is 7.058%; the proportion of marsh wetlands in the area of wetlands is 0.004%; the proportion of trunk channel wetlands in the area of wetlands is 0.370%; the proportion of ditch wetlands in the area of wetlands is 20.585%; the proportion of pit wetlands in the area of wetlands is 21.170%; and the proportion of salt field wetlands in the area of wetlands is 11.448%. Proportion of different types of wetlands in Shandong (Figure 1-1).

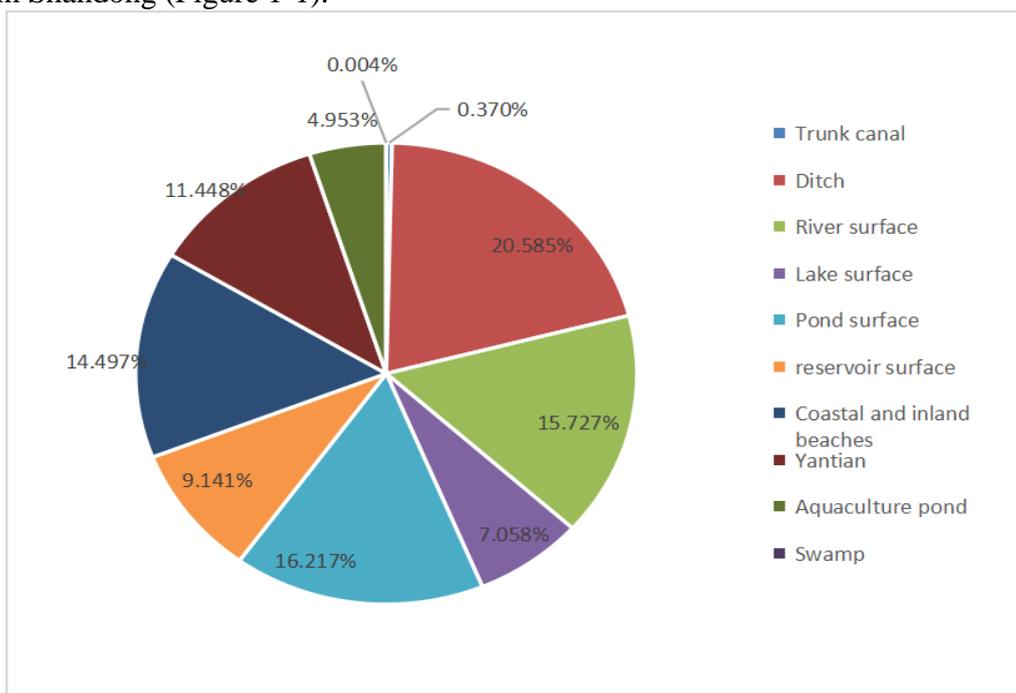


Figure 1: -1Proportion of wetlands in Shandong by type

3. Current Problems of Wetland Resources

In terms of the history of wetland degradation in the whole province and the key regions, the main factors affecting wetland degradation are: the acceleration of wetland reclamation and urbanization, the utilization of biological resources, the shortage of wetland water resources, the environmental pollution of wetlands, coastal erosion and destruction, the utilization of wetland water resources and the construction of water conservancy projects, sediment deposition, urban construction and tourism

development. The reasons for these factors are different, the main areas and the main influencing factors are different, and the development trends are also obviously different []. Except that wetlands are clearly restricted by the government and there are corresponding measures such as returning farmland to lake, other factors are still working and will pose a serious threat to wetland degradation, and it is difficult to reverse the current situation quickly.

3.1 Blind reclamation and accelerated urbanization resulted in the decrease of wetland area

Natural wetlands in our province are reduced in area and degraded in function. It is mainly the decrease of precipitation and the increase of air temperature, the balance of farmland occupation and compensation, the change of natural wetland use and urban development occupying natural wetland. Especially in densely populated coastal areas, wetlands continue to be nibbled. As a result of large-scale salt field development and comprehensive agricultural development, the area of wetlands in the Yellow River Delta has been continuously reduced and the function of wetlands has been degraded; 34% of wetlands in the province have been threatened by desertification and degradation, the area of coastal wetlands has been reduced at a rate of about 3,000 hectares per year, and the area of reclaimed lakes in the whole province has exceeded 20,000 hectares; with the development of cities, garbage landfills and a large number of lakes have been buried as construction land, the natural habitats of lakes and wetlands with serious fragmentation are scattered and independent island patches are scattered [11,12], for example, the eastern coast of Shandong Province is facing great pressure from urban expansion and disorderly development due to favorable landscape resources. Shandong has a large population density, rapid development and great demand for land and natural resources.

3.2 Extreme utilization of biological resources and ecological imbalance of wetlands

Light wetland resources decline seriously, wetland resources are irrationally used and biodiversity is destroyed. Human activities and unreasonable utilization of wetland resources, such as reclamation, transformation, excessive utilization of water resources and blind exploitation, have led to the decline of wetland ecosystem function and the decline of biodiversity, which has greatly destroyed the original ecological structure of wetlands and the living environment of vegetation and animals. Indiscriminate hunting of birds in wetlands is also a serious problem. From the changes in wetlands bird resources, the number of bird species recorded in the two surveys showed a decreasing trend, with more than half of the bird population significantly decreasing [13]. In the Yellow River Estuary, for example, the Yellow Ribbon Fish and the Yellow Croaker Croaker have all but disappeared [14] [15] [16] in recent years. Once some rare species lose their original habitats, they will accelerate to extinction, thus destroying the ecological balance within the wetlands. Shell sand and sandy coasts in some coastal areas of the province have also been damaged due to excessive or unreasonable exploitation. Due to the lack of awareness of wetland protection, the wetland is reclaimed directly, destroying the bottom foundation of the wetland, destroying the biodiversity function of the wetland, and making the natural wetland patchy and fragmented.

3.3 Inadequate water resources and uneven seasonal distribution in wetlands

Wetland is the main source of water for various industries of national economy and residents. Excessive and unreasonable utilization has seriously affected the water supply capacity of many wetlands. Due to excessive withdrawal of water from wetlands or extraction of groundwater, serious shortage of water resources in wetlands often results in large areas of wet land work and degradation. Unreasonable utilization of water resources leads to wetland dry and moist, weathering and water erosion intensified, local desertification or salt evolution. The problem of water shortage has become

a major obstacle to ecological civilization construction and sustainable development in our province. Water from the Yellow River is an important source of water supply in our province. Due to the obvious decreasing trend of water from the Yellow River this year, water diversion in our province will be limited to some extent, and the situation of water shortage will be more severe. In recent years, the dry up trend of the Yellow River has been intensified. For example, in 1997, the 226 days' interruption of the flow of the Yellow River caused a large area of wetlands in the Yellow River Delta to be dry, moist and salinized. In some areas, the lack of water in the wetlands and the over-exploitation of groundwater have led to the rise of sea levels and the backflow of seawater. At present, the water consumption of industrial enterprises in Shandong Province is much higher than that of developed countries, and the utilization ratio of agricultural water is far lower than that of developed countries.

3.4 Pollution of water quality in wetland, resulting in decline of wetland function

Environmental pollution is becoming increasingly serious, and water quality is deteriorating. In recent years, the water quality of the Wetland has been damaged by the aggravation of environmental pollution, the accidents of oil spill and oil leakage caused by the discharge of domestic sewage around the Reserve, the development of oil and gas, the untreated discharge of some solid wastes from industrial production, the residues of fertilizers, pesticides and mulching films formed in farmland cultivation, the tourism in the Nature Reserve and the over-development of tourism in the Nature Reserve.

4. Protection and restoration of wetlands

4.1 Wetland monitoring

3S technology (remote sensing, global positioning system, geographic information system) has been increasingly widely used in wetland resource survey, wetland monitoring, wetland function evaluation and wetland protection research, to conduct efficient, timely and accurate long-term monitoring. The method of combining macro and micro, point and surface, air and ground, continuous observation at fixed monitoring points shall be adopted [17]. Based on the complex nonlinear characteristics of regional wetlands and relying on mass remote sensing data, it is an important direction for wetland remote sensing research to fully excavate the hydrological, ecological and environmental information of wetlands, couple the material quantity, value quantity and energy, and construct the evaluation system and remote sensing calculation model suitable for regional wetlands. [12] [18].

The main models at present include wetland ecosystem models, wetland chemical models and wetland morphological change models [12]. With the development of science and technology, there are many kinds of models adopted at home and abroad, which are not only confined to the study of wetland ecology, but also consider the influence of urban environmental factors. At present, wetland models have been gradually applied to the dynamic monitoring of natural wetlands, which are directly or indirectly used to protect wetlands, predict future changes of urban wetlands, and assess the pressures and development trends of urban ecological environment. Based on the discussion of the commonly used wetland model and the analysis and comparison of the internal process of the wetland, the status of the wetland can be evaluated and forecasted.

4.2 Wetland restoration

Wetland is one of the most productive ecosystems in the world, which is of great value for research

and protection. However, in recent years, due to unreasonable utilization of wetland reclamation, over-utilization of biological resources, environmental pollution of wetlands, over-utilization of wetland water resources, construction of water conservancy projects in large river basins, siltation, coastal erosion and destruction, blind development of urban construction and tourism, etc., the wetland ecosystem has been degraded [19], resulting in sharp decrease of wetland area, deterioration of water quality, lack of water resources, reduction of biodiversity, and even loss of wetland function. So wetland conservation and restoration is becoming more and more urgent [20].

A number of key wetland restoration projects have been implemented in the Yellow River Delta and Nansihu Lake, as well as in the Yellow River, Xiaoqing River, and South-to-North Water Diversion and Dongping Lake basins. The construction contents are as follows: to improve the wetland ecosystem through measures such as water system connectivity, water level control, ecological water replenishment, river dredging, river channel regulation, shore restoration, water quality improvement and eutrophication of water body; to explore the establishment of circular agriculture system by returning farmland to beaches, restoring peatland, restoring drainage degraded wetlands, harnessing alien invasive species and restoring degraded wetlands area; and to explore the establishment of circular agriculture system by harnessing the pollution caused by planting, livestock and poultry breeding and aquaculture and the disposal of rural sewage and garbage. Therefore, comprehensive control of wetland, biodiversity protection, ecological water replenishment, habitat restoration, wetland pollution control, pest control, water purification, and water system connectivity should be taken into account.

4.3 Wetland protection

(1) Accelerating the construction of legal system and standardization of wetland protection

The legal system and standardization system of wetland protection in Shandong Province are not perfect. Only by formulating perfect laws, regulations, policies and standards, can we gradually solve the institutional obstacles restricting development. The province should strengthen the construction of wetland protection laws and regulations, formulate various standards and norms, improve management mechanism and strengthen technical training, improve the level of wetland protection and management. All regions and wetland nature reserves and wetland parks shall also formulate corresponding regulations or norms so as to strictly protect important wetlands. Laws and regulations on wetland protection shall be conscientiously implemented and law enforcement efforts shall be intensified to reverse the situation of wetland reduction and ecological deterioration. The certification system for key wetlands shall be strictly carried out. All the wetlands listed as international, national and provincial important wetlands shall not be reclaimed, occupied or used for other purposes without authorization. The red line of wetland ecological protection shall be determined, the technical standards for defining the red line of wetland ecological protection shall be drawn up and promulgated as soon as possible, and the principles and measures for management and control shall be formulated.

(2) Further improve the monitoring system for wetland scientific research

At the same time, the key to the success of wetland protection and restoration project is to strengthen the research of wetland protection and restoration mechanism and formulate scientific protection and restoration measures. Scientific investigation and special investigation of wetlands shall be carried out on a regular basis in light of specific circumstances to ensure that all monitoring activities such as ecology, resources and environment are carried out in an orderly manner so as to achieve comprehensive and dynamic monitoring of changes in wetland resources, key protection objects, impacts of eco-tourism development, etc. Strengthen the basic research and key technology research of wetland protection. We will strengthen exchanges and cooperation in wetland protection at home and abroad, constantly expand areas of cooperation and innovate ways of cooperation. Learn

from the experience of using integrated ecological exchange methods to protect and restore wetlands abroad, and promote scientific and modern management of wetland protection.

(3) Support by scientific and technological information and attach importance to development planning

Grasp the development information of the frontiers in the management of nature reserves at home and abroad in a timely manner, study the dynamic development and change of wetlands; prepare the medium and long-term planning of wetlands, and adjust the development planning in due time according to the actual needs; formulate the programmatic documents of protection, scientific research, publicity and education, production and tourism, which shall be the basis for guiding the protection, development and construction of wetlands.

(4) Intensifying publicity and raising the awareness of ecological environment

Make use of the rich biological resources in the Wetland Reserve, such as material objects, specimens, videos, photographs, etc., strengthen the popularization of science education to the masses, raise the awareness of the whole society on the protection of the ecological environment of the Wetland, raise the awareness of biodiversity, and raise the consciousness of protecting the natural ecological environment. Make full use of modern publicity tools, intensify publicity, and gradually realize the modernization of publicity, education and management of wetland protection.

References

- [1] Yuan Xingzhong, Liu Hong. *Present situation of wetlands in Shandong Province and protection countermeasures* [J]. *Shandong Environment*, 1999 (06): 14-15.
- [2] Li Yimin, Li Zhuoqing. *Progress and Prospect of Wetland Research at Home and Abroad* [J]. *Yunnan Geographical Environment Research*, 2013, 25 (01): 36-43.
- [3] Yang Yongxing. *Main Features, Progress and Prospect of International Wetland Scientific Research* [J]. *Advances in Geographic Sciences*, 2002 (02): 111-120.
- [4] Baijunhong, Ouyang Hua, Xu Huifeng, Zhou Caiping, Gao Junqin. *Progress in Qinghai- Tibet Plateau Wetland Research* [J]. *Progress in Geographic Sciences*, 2004 (04): 1-9.
- [5] Xu YYAN, Xu YD. *Progress and prospect of wetland research* [J]. *Hebei Fishery*, 2008 (01): 3-7 25.
- [6] Cui Baoshan, Yang Zhifeng. *Progress in Wetland Ecosystem Health Research* [J]. *Journal of Ecology*, 2001 (03): 31-36.
- [7] Yang Lihong. *Wetland Protection and Rational Utilization* [J]. *Xinjiang Forestry*, 2020 (04): 10-12.
- Jiang Wenlai, Yuan Jun. 2004. *Wetland* [M]. Beijing: Meteorological Press.
- [8] Wang Xinfeng. *Fundamentals of Hydrogeology (Sixth Edition)* [J]. *Hydrogeological Engineering Geology*, 2011 (03): 30-30.
- [9] Sun Yugang. *2015 China Wetland Resources · Shandong volume* [M] Beijing: China Forestry Press
- [10] MUSHACKE F, PICARD E. 1999. *Vegetated Wetlands Trends of the NewYork and Lower Hudson River: Final Report* [M]. New York: NewEngland Interstate Water Pollution Control Commission.
- [11] Shao Yuanyuan, Zhou Junwei, Mu Ruimin, Zhu Li, Jiang Tianyi. *Journal of Ecological Environment*, 2018, 27 (02): 381-388.
- [12] *Results of the Second National Survey of Wetland Resources* [J]. *Land Greening*, 2014 (02): 6-7.
- [13] Yan Liqin, Jiang Guangyuan, Han Yunchi, Shi Ruifang. *Biodiversity and Protection of Wetland Types in Shandong* [J]. *Shandong Forestry Science and Technology*, 1998 (01): 28-31.
- [14] Ding Hong An, *Shandong Yellow River Delta National Nature Reserve* [J]. *Wetland Science and Management*, 2013 (3): 2-3.
- [15] Yujia, Zhang Huaiqing, Chen Yongfu. *Discussion on the Development of Wetland Nature Reserves in Shandong Province* [J]. *Anhui Agricultural Science*, 2017, 45 (09): 67-69.
- [16] Lin J, Yan Chenggao, Yuan Jun, Chen Kelin, Meng Xianmin. *Concept of establishing a wetland monitoring system in China*. *Wildlife*, 1997 (04): 12-14.
- [17] Wu Zhifeng, Cao Zheng, Song Song, Jiang Weiguo, Guo Guanhua, Wu Yanyan. *Remote Sensing Monitoring and*
- [18] *Assessment of Wetlands in the Great Bay Area between Guangdong, Hong Kong and Macao: Status, Challenges and Prospects* [J]. *Journal of Ecology*, 2020, 40 (23): 8440-8450.
- [19] Zhang Mingxiang, Yan Chenggao, Wang Jianchun, Chen Fei. *Degradation of Wetland Resources in China and Its Causes* [J]. *Forestry Resources Management*, 2001 (03): 23-26.

[20] Jia Ping, Gong Huili, Zhao Wenji, Li Xiaojuan. *Current Situation and Development Trend of Wetland Research [J]. Journal of Capital Normal University (natural science edition), 2003 (03): 84-88 95.*