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Introduction

Oriental White Stork (*Ciconia boyciana*) is a kind of large waders only distributed in Asia, living in rivers, lakeside and wetlands. They build nests on trees or other artificial tall objects. Oriental White Stork feed on fish, rats, frogs and insects. They are so rare that has been in listed in the appendix I of the "*Convention on International Trade in Endangered Species of Wild Fauna and Flora*". International Council for Bird Preservation has identified Oriental White Stork as an endangered species in the “*Bird Red Book*”. The Chinese government has listed it as a national key protected wild animal. And the research on Oriental White Stork was developed just in the last ten years in China.

In the taxonomy, the Oriental White Stork is *Ciconiformes, Ciconidae, Ciconia*. It was originally classified as an oriental subspecies of the White Stork (*Ciconia ciconia*) and later classified as an independent species and has been recognized since 1983 as the *Ciconia boyciana*. In the first report (1983) of the ICBP Stork, Ibis, Heron Group, Oriental White Stork had become the official English name. In 1980s, most scholars had accepted and used the name of the Oriental White Stork in China.

In the last 20 years, researchers studied deeply on the distribution, quantity, migration, habitat and utilization of Oriental White Storks in China. Nature reserves, taking Oriental White Stork as the main protection object, were built up and made remarkable achievements on protection and management of Ciconia. With the rapid development of economy construction in recent years, the habitat environment of White Stork has been influenced greatly. It’s a serious threat to White Stork that habitat depletion and gradual deterioration of environmental conditions. To strengthen protection of White Stork resources, it’s so necessary to carry out more comprehensive investigation of present status based on the ongoing work. Through the investigation of the resources and habitat status of the white stork, we can understand and grasp the present status of the White Stork, and provide scientific and accurate decision basis for the protection work.
1 The historical distribution area and population quantity of Oriental White Stork

The breeding ground of Oriental White Stork is mainly in the Amur River Basin, from the west of Russia's Daursky Nature Reserve, to the east coast of Khabarovsk. In addition to geographical factors, the breeding ground distribution of Oriental White Stork basically depends on conditions and size of nest trees and wetland. And the effect of human’s behavior on wetland and environment also have an impact on breeding ground distribution of Oriental White Stork. The breeding populations of Oriental White Stork mainly distributed on the eastern border of the Heilongjiang and Wusuli River, overwintering in the Yangtze River in China.

1.1 Breeding ground distribution

Oriental White Stork’s breeding ground distributed mainly in the Sanjiang Plain and the middle and lower reaches of the Nenjiang River region in China, moreover there are a small number of breeding individuals distributed in Daxinganling region. In recent years, the following breeding grounds were found: Fuyuan delta; Hong river; lower reaches of the Gulu river in Luobei; Qixing river basin in Baoqing; Raoli river estuary; Yichun Youhao area; Dalian river in Yilan county ; Mengjiagang in Huanan county; Yingchun marshland; Hutou town and Dumu river in Hulin city; the lower reaches of Abuqin river; Neijiang, Fuyu and Zhalong in Heihe region; Haernao river in Momoge in Momoge nature reserve; Ximinzhu and Zhoujiadian towns in Xianghai nature reserve; Inner Mongolia Horqin.

Before 1984, there were no statistics reports on the quantity of Oriental White Stork in national breeding grounds. In the May 5th to 19th, 1984, 71 pieces of Oriental White Storks were found in Heilongjiang province by Feng kemin(1984), among them 3 pieces were in the Wuyuer river region, 66 pieces were in the Dulu river region and 2 pieces were in the Qixing river region. From 1983 to 1985, Ma Yiqing et al. (1991) did a survey and got the result that 66 pieces were in 7 places of
Sanjiang Plain and 57 pieces were in 2 places of the middle and lower reaches of the Nenjiang river region. This showed that Oriental White Stork mainly distributed in the Sanjiang Plain and the middle and lower reaches of Nenjiang region, and Sanjiang Plain is the most important nesting area. At the international conference in Russia in 1992, Piao Renzhu proposed there were 19 nests and 124 pieces of Oriental White Storks in Heilongjiang province based on the data from 1984 to 1986. There would be 25 nests and 211 pieces, if the middle and lower reaches of the Nenjiang region in Jilin province were included. Moreover, Oriental White Stork nested and breed in the Horqin Nature Reserve in Inner Mongolia (Yu Zhongzhong et al.1991). The similar thing was found in the Qinglin forestry farm of Songlin Forestry Bureau in the middle reaches of the Nenjiang region (Ma Yiqing et al.1989). According to the survey for many years, its distribution in Heilongjiang Province were Fuyuan delta (40 pieces of Oriental White Stork and 2 nests were found in 1984-1986), Honghe Nature Reserve (3 nests in 1984-1986; 30 breeding individuals and 282 summer clusters were found in 1998), Yichun (one sample was collected in July 1987, one piece of Oriental White Stork was captured in Tangwang River in August 1993, and one chick was caught in Cuiruan in October 1993), Zhalong Nature Reserve (2-3 pairs were found in the lower reaches of the Wuyu River in an aerial survey in May 1981), Naoli River region (12 individuals and 4 nests were found during 1984-1986), the lower reaches of Dulu River region (4 individuals and 1 nests were found during 1984-1986), Qixing River region (12 individuals and 1 nests were found during 1984-1986, including Changlin island and Yanwo island), Hulin yingchun marsh area, Xingkai Lake Nature Reserve(13 pieces were found in April 1997).

In Jilin province, in Momoge National Nature Reserve, 1 pair nest and about 20 pieces spent summer in 1987; in Xianghai National Nature Reserve, 1-2 pairs nests were reported in the end of 1980s.

In Inner Mongolia province, in Zhalaite of the Dalai Lake National Nature Reserve, 1 pair nest was found at a telegraph pole in southern Tumuji in 1990; in Horqin Nature Reserve, 17 pieces were found during March to October in 1987.
1.2 Migration route

Oriental White Stork migrate by the following way of Xing’anling, eastern mountain, Songnen plain and Sanjiang plain in Heilongjiang province; Haernao river in Momoge nature reserve, Xianghai nature reserve, Antu, Dunhua, Jingyu county in Jilin province; Shuangtaizi estuary, Chaoyang, Faku, Shenyang, Liaozhong, Taian, Taian, Dawa, Gai county, Xiongyue, Zhuanghe, Dalian in Liaoning province; Beidaihe in Hebei province; Weishan lake, the Yellow River, Jiaodong, Changdao and other places in Shandong province; the middle and lower reaches of the Yangtze river area.

1.2.1 Heilongjiang province

During the migration period, in Heilongjiang province, Oriental White Stork were found in the Fuyuan delta (40 pieces were found during 1984-1986, 24 pieces were found in a small island in Ussuri River region in September 1999), Honhe Nature Reserve (34 individuals were found during 1984 to 1986, and 252 pieces of summer clusters were recorded in 1998), Zhalong Nature Reserve (2-3 pairs were found in the lower reaches of the Wuyu River in an aerial survey in May 1981), Naoli River region (12 individuals were found during 1984-1986), the lower reaches of Dulu River region (4 individuals were found during 1984-1986), Qixing River region (12 individuals and 1 nests were found during 1984-1986, including Changlin island and Yanwo island, then 12 individuals were found in this area in September 1999), Hulin yingchun marsh area, Xingkai Lake Nature Reserve. In 1999, 41 pieces of Oriental White Storks were found in Changlin island and Yanwo island. The largest group was recorded 7 pieces in the beginning of September 1999 in the Yanwo island, after that, 24 pieces autumn clusters were found in same place in September 2001.

1.2.2 Jilin province

In terms of known data in Momoge National Nature Reserve in the city of Baicheng on Northwestern Jilin province, the number of annual statistics of autumn clusters was 372 pieces in 1985, 573 pieces in 1987, 600 pieces in 1988 and 750 pieces in 1989. The number of clusters increased year by year, which was close to the
total number of Oriental white storks in the middle and lower reaches of the Yangtze River in China (Wu Zhigang et al. 1991). Moreover, in Xianghai National Nature Reserve 30-40 pieces of Oriental White Storks were found when they were migrating and stopping in spring in 1987, 15 pieces in May 1994. Also there were recorded in the Dehui county (male individuals were found in April 1978), Dunhua county, Jingyu County and other places.

1.2.3 Inner Mongolia province

In Inner Mongolia province, Oriental White Storks were found in the Zhalaite of the Dalai Lake National Nature Reserve (14 pieces were found in September 1990); In Horqin National Nature Reserve (17 pieces were found during March to October in 1987), and other places.

2 The comparison of the number of breeding population of Oriental White Storks in nature reserves of Sanjiang Plain

2.1 Honghe National Nature Reserve

2.1.1 Introduction of Honghe National Nature Reserve

Honghe National Nature Reserve is located in the hinterland of Sanjiang Plain in Heilongjiang Province, at the junction of Tongjiang City and Fuyuan County. From 1993, the Honghe National Nature Reserve built artificial tripod nest and carried out the project of nesting and men-made attraction for the Oriental White Storks. So far, nearly 100 artificial nest has been built, attracting more than 200 pairs of Oriental White Storks in Nature Reserves. The cumulative number of Oriental White Storks is nearly one thousand.
Today, the Honghe National Nature Reserve is “the Chinese village of Oriental White Stork” in the world which has become the largest population of the Oriental White Stork’s breeding base. At the same time, according to the different reproductive characteristics of each child, the birds were put on particular rings, in order to further study the Oriental White Stork migration route and provides a more scientific basis. Therefore, it is representative to take the Honghe National Nature Reserve as a object of comparison of breeding population over the years of Oriental White Storks in Sanjiang Plain area.

2.1.2 The comparison of breeding Population of Oriental White Stork in Honghe National Nature Reserve over the Past Years

Through comparing the number of breeding population of Oriental white stork in the Honghe National Nature Reserve, we found that the number of Oriental White Storks in the reserve was stable from 1970s to 1980s, decreased from 1980s to 1990s, then went up apparently from 1990s to 2010s.
This situation is closely related to the local Oriental White Stork strategy. Before the 1990s, the reserve adopted a relatively passive protection strategy. Since 1993, the reserve had set up a manual tripod nest for the oriental white stork and carried out the project of nesting and men-made attraction. So far, nearly 100 artificial nest has been built, attracting more than 200 pairs of Oriental White Storks in Nature Reserves. It can be seen that the development and implementation of conservation strategies have a significant effect on the conservation of Oriental White Storks.

2.2 Xingkai Lake National Nature Reserve

2.2.1 Introduction of Xingkai Lake National Nature Reserve

Xingkai Lake National Nature Reserve (131°58′30″—133°07′30″E, 45°01′00″—45°34′30″N), is located in the southeast of Heilongjiang province. Xingkai Lake National Nature Reserve west to the Bailing River, north adjacent to the Muling River, northeast border with Hulin City, east to Songacha River, south to big Xingkai Lake and Russian Xingkai Lake National Nature Reserve. In early spring, migratory birds come from the southeast coast, the Yangtze River Bohai Bay, Taiwan, the islands of Japan and the Korean Peninsula, after the long migration, consume great physical strength. Because the opening of Xingkai Lake can provide amounts of
aquatic plants, plankton and fish for waterbirds, there has become the largest station in migration of migratory birds in the Sanjiang Plain. Thousands of migratory birds gather here, so Xingkai Lake also become the best place for observation of migratory birds.

Fig. 3—Wearing tracker for Oriental White Storks in Xingkai Lake National Nature Reserve

2.2.2 The comparison of breeding Population of Oriental White Stork in Xingkai Lake National Nature Reserve over the Past Years

Through comparing the number of breeding population of Oriental White Storks in Xingkai Lake National Nature Reserve from 1970 to 2005, we found the number of breeding population of Oriental White Storks showed a clear downward from 1970 to 1995, however, there had a clear upward after 1995.
3 The quantity statue of Oriental White Storks in Sanjiang Plain

Sanjiang Plain is the most important breeding area of Oriental White Storks. According to data statistics results of Honghe, Sanjiang, Naoli River, Qixing River and Xingkai Lake Nature Reserve in Sangjiang plain from 1984 to 1986, 112 pieces of Oriental White Storks were found there, and this result is similar to survey data of the rare waterfowls in the spring of 1985. However, due to the influence of wetland development and human activities, the breeding areas of Oriental White Storks decreased, while the number of Oriental White Storks also decreased obviously. By the early 1990s, the number of Oriental White Storks was less than 10 pairs. With the increase of people’s environment protection awareness, coupled with the success of artificial celery, the number of Oriental White Storks increased year by year. In 2008, the number of breeding Oriental White Storks in Sanjiang Plain reached 56 pieces. In the spring of 2016, we investigated the quantity of Oriental White Storks in Sanjiang Plain of Heilongjiang province. 566 pieces of Oriental White Storks were recorded in the investigated areas, including Xingkai Lake, Sanjiang, Honghe, Dajia River, Sanhuanpao, Heixiazi Island, Naoli River, Bacha Island Nature Reserves and so on.
Through comparing the number and proportion of Oriental White Storks in each month of spring, we found most of Oriental White Storks was observed in April, accounted for about 75%.
Since most of Oriental White Storks were observed in April, 2016, the number of Oriental White Storks in different protected areas in April were compared. The results showed the largest observed number of Oriental White Storks was in Naoli River National Nature Reserve, 262pcs; At present, amounts of Oriental White Storks were observed in Honghe National Nature Reserve.
Through comparing the distribution number of Oriental White Storks between Naoli River National Nature Reserve and Honghe National Nature Reserve in April, we found there was no regularity for distribution.

4 Threatening factors

In recent years, the wild population of Oriental White Storks in Russia and China are being reduced, while the main reason for decrease of the number of Oriental White Storks is habitat reduction and degradation and human disturbance.

In China, as one of the important threatening factors ever, large-scale hunting activities were found in 1980s. However, in recent years, Chinese government has gradually realized the importance of the protection of Oriental White Storks, and some nature reserves has been established in the breeding, migration and wintering areas. At the same time, law enforcement in nature reserves has also been increased, and poaching behavior has been basically controlled.

In today’s China, the most important factor affecting the population of Oriental White Storks is habitat destruction. Oriental White Storks nest in the tall trees, so the tree felling in breeding areas become a huge threat to the survival of Oriental White Storks. In the northeast, water shortage situation in wetland has become a common phenomenon, therefore Oriental White Storks lost the survival foundation. In addition,
the reduction of wetland areas, fire, drought and other human factors has made the wild population of Oriental White Storks fragile extremely, in an unstable state.

Although the number of breeding individuals of Oriental White Storks in Heilongjiang River Basin increased in recent years, it is still not optimistic for protection area and surrounding environment. The decrease of population of Oriental White Storks was caused by agricultural development, population increase, fishing, animal husbandry, wetland pollution and so on, and these factors affect directly the habitat of Oriental White Storks. According to the present situation of a reduced number of Oriental White Storks, several threat factors were concluded, as follows:

(1) **Habitat loss**

Wetland is the necessary environment for the survival and breeding of Oriental White Storks, however in Heilongjiang province, it is difficult to find a wetland that is not affected by human development activities. In the Sanjiang Plain, a large-scale land reclamation has not ever been stopped since 1958. Due to the loss of nestling trees, Oriental White Storks has ever extincted in the Nenjiang downstream in 1970s.

Sanjiang Plain is the most suitable area for the breeding of Oriental White Storks, however, the habitat quality has been degraded obviously since 1960. At the same time, natural wetland has been transformed into farmland, and the wetland has become fragile. In the past 40 years, the wetland area of the Naoli River Basin decreased by 87%, trees were cut down and breeding habitat was destroyed, which lead to the dramatic decline in the number of Oriental White Storks.

(2) **Illegal hunting**

For Oriental White Storks, due to their nests are tall and striking and young birds stay in the nest for 100 days or so, so it became the object of hunters. Although the phenomenon of picking eggs in protected areas has been halted, there occurs still outside the reserves.

(3) **Excessive fishing**

Oriental White Storks feed mainly on fish, amphibians, reptiles, insects and small mammals, but fish is the main food of Oriental White Storks. In the Sanjiang Plain, fishermen often use fishing nets or other tools to catch excessively fish, which
lead to the reduction of fish resources. One more step, there is the phenomenon of people and birds fight for food.

(4) Human interference

Destructing nests, taking eggs, digging chicks and hunting is another direct cause of breeding failure of Oriental White Storks. It was observed that those nest tree would not be selected again, once Oriental White Storks breed failure in their nests caused by human interference. However, because of the private acquisition of urban construction, foreign tradition and other departments, taking eggs, digging chicks and other behavior still exists. In addition, human hunting of Oriental White Storks event still occur, which brought a fatal threat to the survival of Oriental White Storks. The wetlands in the Sanjiang Plain are affected by human interference in different degrees, especially in the breeding season, which affects directly the reproduction of Oriental White Storks.

(5) Environment pollution

Taking human as the center of the earth, because of the social economic activities are subjecting and blindness, the structure and function of ecological system was destroyed greatly. Human is faced with the serious imbalance of the ecological natural environment. People realized that it will bound to allover the natural environment once individual biological resources is destructed. The pollution of the environment mainly comes from pesticides and fertilizers. At present, in most of agricultural production areas in the Sanjiang Plain, there still uses in a large number of toxic, harmful and pesticide residues of fertilizers and pesticides.

5 Protection proposals

For the protection of Oriental White Storks, the combined way of in-site and ex-site conservation is still used in the Sanjiang Plain. In-site conservation is to establish protected areas in the breeding and wintering region of Oriental White Storks. Ex-site conservation is to create a suitable survival and reproduction conditions through the artificial breeding, and develop gradually a healthy artificial population with a considerable amount of scale. It is a way to preserve the genetic
pool of endangered species. For the protection of Oriental White Storks, the following suggestion are put forward.

(1) **Encourage the captive breeding of Oriental White Storks**

Although the breeding technology of Oriental White Storks is mature basically, because the time for researching Oriental White Storks is very short in China, there have not formed the scale for the artificial population of Oriental White Storks. Only the artificial population reaches a certain scale, Oriental White Storks would not recess or extinct caused by inbreeding.

(2) **Enhance the cooperation and exchanges between domestic and international**

Oriental White Storks are transnational large migratory waders, and subject to widespread concern whether in domestic or abroad. So the study on Oriental White Storks need to strengthen scientific communication in domestic units, and get technical assistance, project cooperation and financial support through communicating with international institutions.

(3) **Carry out the research on protecting and restoration of Oriental White Storks in protected areas**

The suitable living environment is a basic for breeding of Oriental White Storks. Only to improve breeding and wintering habitat, allocate scientifically water resources, return farmland to wetlands and expand wetland areas, Oriental White Storks would be protected really.

(4) **Strengthen the research on reproduction and wildness of Oriental White Storks in reserves**

The cage-breeding work of Oriental White Storks is mainly concentrated in zoos. Because the zoos are far from the original habitat, so it is hard to carry out the wildness research of Oriental White Storks. But if there is a breeding population of Oriental White Storks, and they are familiar with the local habitat, we can carry out wildness work of Oriental White Storks gradually. That is more conductive for Oriental White Storks to return to the wild.

(5) **Strengthen publicity and education work**

Oriental White Storks are large rare waders, however, its popularity is not high in
China, which is extremely unfavorable to carry out protection works. Whether in the field of protection of wild population or cage-breeding of Oriental White Storks, it is very important to attract the attention of the people.

(6) Carry out the pedigree registration work of Oriental White Storks

Pedigree registration is an important basis work in ex-site conservation. Genetic problems can be avoided in the process of breeding and wildness only in the case of pedigree of artificial population in breeding units is clear.