Analysis on the Waterbirds Community Survey of Poyang Lake in Winter

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Abstract

Poyang Lake provides wintering sites for several hundred thousands water birds every year. There are historical records of 310 species of birds in Poyang Lake National Nature Reserve (Abbr. in PYNNR), belonging to 17 orders, 63 families, and 158 genus, and including 125 water birds species belonging to 6 orders, 19 families, and 60 genus. The most amount of waterbirds in Poyang Lake are geese and swans, the second most are shorebirds. Dominant species of bird communities are whistling swan, swan goose and white-fronted goose. There are 19 species listed as threatened by IUCN. The Siberian crane is the most well-known wintering species in Poyang Lake. The number of Siberian cranes stablized in recent years. There are 18 species whose numbers are more than 1% of the total number of their global or migrant route's populations according to three separate of surveys. PYNNR is the most concentrated area for rare waterbird and precious species; at the same time, Nanhu and other adjacent areas to PYNNR such as the middle and south branch of the Gan River are also important habitats for rare waterbirds, and need more attention and conservation actions.

Keywords

Poyang Lake, survey, waterbird community in winter, waterbird distribution

I. INTRODUCTION

Poyang Lake in Jiangxi Province is the largest freshwater lake in China, and the largest wintering site for waterbirds in Asia. The lake wetlands provide wintering habitats for the largest populations of siberian crane, oriental stork and swan goose in the world. In 1983, the Jiangxi Provincial Government set up a provincial reserve to protect these migrants birds. In 1988, the reserve was promoted to national nature reserve, status, and was named Poyang Lake National Nature Reserve (PYNNR). Poyang Lake is a very important global biodiversity conservation area. Several organizations with different purposes have carried out pan-Poyang Lake waterbird surveys since the late 1970s, whose focus is on wintering waterbirds. Most surveys were carried out by airplane or ground team work. This paper summarizes the distribution characteristics of the waterbird communities in the entire Poyang Lake region according to the surveys in recent years.

II. NUMBER OF WINTERING WATERBIRD

In Jan. and Feb. of 2004, Feb. of 2005, and Dec. of 2006, PYNNR organized or participated in waterbird surveys for the pan-Poyang Lake area, supported by WWF-China and State Key Lab of Remote Sensing Science and Applications, Chinese Academy of Sciences. All recorded birds were taxonomically classified include Ciconiformes, Gruiformes, Charadriiformes (including Lariformes), Podicipediformes, Anseriformes and Pelecaniformes which are distributed in Poyang Lake.

Because the three surveys data were not exact anniversaries, the survey results could be affected by factors such as: different bird migration dates in different years or between individuals of the same species and different weather patterns. Table1 shows the counts of species of waterbirds of the three surveys. It should be emphasized that the birds include in this survey include breeding and resident birds.

Table 1. Counts and species of pan-Poyang Lake waterbirds surveys in 2004, 2005 and 2006

	Jan. and Feb.2004	Feb. 2005	Dec. 2006
Counts	138643	226105	527557
Species	67	64	75

III. CHARACTERISTICS OF WATERBIRD COMMUNITY

The Poyang Lake area is a complex ecosystem. In winter, there are three vegetation types that occur around the lake on agradient from lake shore to higher elevations. The first is the water-body area, and vegetation is mainly composed of submerged plants, floating-leaved plants, floating plants and emergent plants. These areas could be divided into two types according to the water level. The deeper water area is suitable for natatores including geese, ducks swans, grebes, cormorants, and gulls. The shallower water area is often full of plants, fish, shrimp and shellfish. This shallower area is especially suitable for grallatores including cranes, storks, egrets and shorebirds. The second one is the marsh and grassland area. The marsharea is populated with some shellfish, worms. The grassland is the last area which is populated with hygrophilous plants. Sometimes the grallatores including cranes, storks, egrets and shorebirds look for food in marsharea. The grassland area is often preferred by common cranes, white-fronted geese and snipes. The third type of vegetation is found

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on the farmlands and hills surrounding the lake, and bird communities are mainly composed of Passeriformes, Falconiformes, Strigiformes, Galliformes and Columbiformes (Survey team for migrant in Jiangxi Poyang Lake, 1988).

A. Abundance of water birds species and the proportions of various categories

There are 310 species of birds recorded in PYNNR, belonging to 17 orders, 63 families, and 158 genera. There are 6 orders, 19 families, 60 genera and 125 species belonging to waterbirds (including natatores and grallatores) shown as Table 2. About half of the species belong to wintering migrants, and only few of the species are vagrant individuals. The bird list for Poyang Lake continues to increase according to the surveys or via senior bird watcher's findings in recent years.

Table 2. The amount of groups according to taxonomic classification and resident status for waterbirds in Poyang Lake

Order name	Taxonomic classification			Number of species according to resident status				
	Family	Genera	Species	Resident	Summer visitor	Winter visitor	Passagemigrant	Vagrant visitor
Podicipediformes	1	2	2			2		
Pelecaniformes	2	2	2	2				
Ciconiformes	3	12	19	6	11			
Anseriformes	1	10	33	25	1	3	1	3
Gruiformes	4	12	18	7	7	1	1	2
Charadriiformes	8	22	51	22	9	2	17	1

According to the pan-lake surveys in 2004, 2005 and 2006, Figure 1 illustrates the proportions of all identified water birds belonging to 6 orders listed in Table 2.

It's obvious that Anseriformes is the dominant order according to its counts through Figure 1, though the there were some difference for the proportions of every order among these three years. The proportions of Anseriformes were all more than 70% of the total in the three surveys, followed by Charadriiformes, and the smallest was Pelecaniformes.

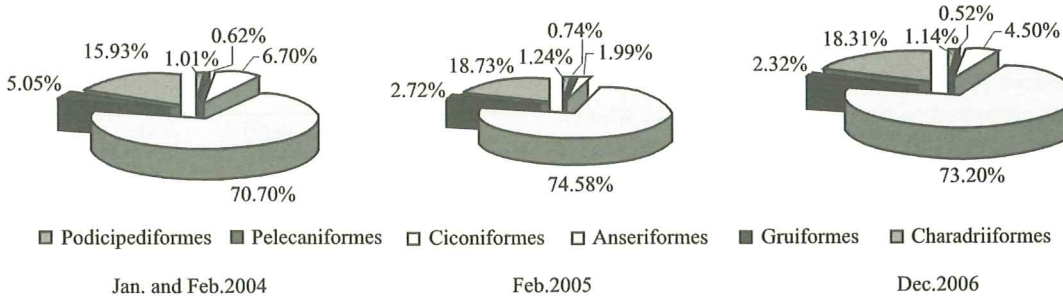

Figure 1. The proportions of every orders Waterbird for pan-lake surveys of 2004, 2005, 2006

B. The wintering birds commonly seen

According to the method adopted to classify the dominance of bird community (Howes and Bakewell, 1989), those species with proportions over 10% of total number are dominant species. The species with proportions between 1% and 10% are common species, and the others with proportions below 1% are rare species.

The PYNNR has conducted periodic monitoring from 2002 to 2005 (conducted on the 8th, 18th and 28th of every October through March), resulting in an annual survey of wintering waterbirds in its administrative area. There are 18 monitoring data sets every wintering season, and the maximum of individuals recorded for each species out of these 18 monitoring surveys is recorded as the counts of this species in the winter. By adding up the maximum of every species, the total number of the waterbird community was calculated (note: some geese and all ducks, shorebirds, gulls are not listed here for identification problems, just the maximum being included in the total number). Table 3 illustrates the dominant and common species for these four years. From this table, it can be concluded that whistling swan, swan goose and white-fronted goose were always the dominant species in wintering waterbird communities in PYNNR, and even some globally rare species, such as Siberian crane, white-naped crane and oriental stork, were commonly seen in the community. Furthermore, some ducks and shorebirds were often the common species even the dominant species for the community, but neglecting these species in the previous time led to no exact the counts being used in analysis.

In the pan-lake surveys of 2004, 2005 and 2006, most waterbirds were identified and counted. According to the proportions of every species number to total waterbirds number, Table 4

Table 3. The dominant and common species of waterbird community in PYNNR from 2002 to 2005

Name	Scientific name	Dominant value of every year(%)			
		2002	2003	2004	2005
Siberian crane	*Grus leucogeranus*	1.76	1.39	0.92	0.65
White-naped crane	*Grus vipio*	0.75	1.52	0.65	0.75
Oriental stork	*Ciconia boyciana*	1.42	1.12	0.42	0.60
Eurasian spoonbill	*Paltalea leucorodia*	4.48	2.37	2.15	1.74
Whistling swan	*Cygnus columbbianus*	12.34	14.84	27.77	3.62
Swan goose	*Anser cygnoides*	20.65	29.08	20.09	13.45
White-fronted goose	*Anser albifrons*	10.56	16.48	13.13	13.47
Bean goose	*Anser fabalis*	no record	no record	2.60	1.35
Spot-billed duck	*Anas poecilorhyncha*	no record	no record	no record	3.50
Pied avocet	*Recurvirostra avosetta*	no record	no record	no record	1.72
Spotted redshank	*Tringa erythropus*	no record	no record	no record	2.62
Black-tailed godwit	*Limosa limosa*	no record	no record	no record	1.18
Dunlin	*Calidris alpina*	no record	no record	no record	14.09
Black-tailed godwit	*Limosa limosa*	no record	no record	no record	4.37
Other species		48.04	33.2	32.27	36.89
Total number		131586	226968	222740	423711

Table 4. Dominant and common species of waterbird in pan-lake surveys during 2004–2006

Name	Scientific name	Dominant value of every year(%)		
		2004	2005	2006
Siberian crane	*Grus leucogeranus*	1.99	1.19	0.51
White-naped crane	*Grus vipio*	1.96	0.66	0.33
Oriental stork	*Ciconia boyciana*	1.08	0.27	0.59
Eurasian spoonbill	*Platalea leucorodia*	2.61	0.91	1.69
Grey heron	*Ardea cinerea*	2.57	0.60	1.72
Whistling swan	*Cygnus columbbianus*	10.42	18.95	15.51
Swan goose	*Anser cygnoides*	21.19	9.87	13.43
White-fronted goose	*Anser albifrons*	9.07	6.90	22.37
Bean goose	*Anser fabalis*	3.75	7.23	5.65
Spot-billed duck	*Anas poecilorhyncha*	9.85	7.75	3.07
Mallard	*Anas platyrhynchos*	2.83	3.64	0.23
Common teal	*Anas crecca*	6.34	8.88	5.72
Northern pintail	*Anas acuta*	0.94	3.56	0.10
Widgeon	*Anas penelope*	1.97	2.07	0.89
Pied avocet	*Recurvirostra avosetta*	4.58	4.18	3.10
Spotted redshank	*Tringa erythropus*	4.18	3.22	5.36
Dunlin	*Calidris alpina*	0.89	6.88	1.69
Black-tailed godwit	*Limosa limosa*	0.27	0.88	1.94
Northern lapwing	*Vanellus vanellus*	1.18	1.36	1.13
Black-headed Gull	*Larus ridibundus*	3.57	0.62	2.56
Other species		8.76	10.41	21.83
Total count		138643	226105	527557

illustrates the dominant and common species of the waterbird community in the whole Poyang Lake area.

Table 4 shows that the three species-whistling swan, swan goose and white-fronted goose-were still the dominant species or approaching dominance. Some ducks like spot-billed duck, mallard, common teal, northern pintail and some shorebirds like spotted redshank and other species basically belonged to common species. Of course, the wintering waterbird community of Poyang Lake is dynamic in the whole wintering season, and the composition and structure of the community are variable. Strictly speaking, the result was mainly confined to the situation when the survey occurred, but it basically illustrates the dominant and common species of waterbird community in winter.

C. Global threatened species

According to the global threatened species list published by IUCN in 2004, there are 16 waterbird species in the list in PYNNR. Siberian crane belongs to critical endangered species (CN); Oriental white stork, black-faced spoonbill, swan goose and scaly-sided merganser belong to endangered species (EN); Dalmatian pelican, red-breasted goose, lesser white-fronted goose, baikal teal, baer's pochard, hooded crane, white-naped crane, swinhoe's yellow rail, great bustard, relict gull and saunder's gull belong to vulnerable species (VU). Table 5 gives the counts of thirteen threatened species recorded by the three surveys. The other species not seen in the surveys, black-faced spoonbill, was observed on photos taken at PYNNR in 2005.

Table 5. Threatened species and their counts surveyed during 2004–2006

Name	Scientific name	Count			Threatened class[1]
		2004	2005	2006	
Siberian crane	*Grus leucogeranus*	2760	2683	2715	CR
Oriental stork	*Ciconia boyciana*	1491	602	3120	EN
Swan goose	*Anser cygnoides*	29378	22313	70830	EN
Scaly-sided merganser	*Mergus squamatus*	31	44	0	EN
Dalmatian pelican	*Pelecanus crispus*	0	1	0	VU
Lesser white-fronted goose	*Anser erythropus*	9	0	98	VU
Baikal teal	*Anas querquedula*	0	0	1	VU
Baer's pochard	*Aythya baeri*	600	0	9	VU
Hooded crane	*Grus monacha*	221	390	359	VU
White-naped crane	*Grus vipio*	2713	1491	1757	VU
Swinhoe's yellow rail	*Coturnicops exquisitus*	1	2	0	VU
Relict gull	*Larus relictus*	0	0	2	VU
Saunders's gull	*Larus saundersi*	0	0	1	VU

D. Important waterbirds with high proportion to global or migration route population

Poyang Lake is important not only because of its of waterbirds, but because large amount of a number of species represent a large proportion of the total individuals known globally. According to the standards of internationally important wetlands, there are 29 species whose wintering population over the standard at least once in the surveys of 2004, 2005 and 2006 in Poyang Lake. Sixteen of them were continuously over the standard in the three surveys. Table 6 shows these species numbers. Because all the surveys were carried out in winter, actually Poyang Lake being the important habitat for breeding species or stopover sites for many shorebirds, if there are some chances to survey for those species, the number of important species reaching the standard would be much more.

[1]CR=Critical Endangered; EN=Endangered; VU=Vulnerable.

IV. ANNUAL POPULATION OF SIBERIAN CRANE WINTERING IN POYANG LAKE

In Jan. 1981, scientists found 91 Siberian cranes at Dahuchi, a sub-lake of western Poyang Lake, which belongs to core zone of PYNNR. From then on, the Siberian crane became a highly protected flagship species, and counts of Siberian Cranes were key objectives for all winter surveys. Figure 2 illustrates the maximum Siberian Crane counts recorded in every wintering season during 1980 to 2005. From the figure, it appears that

Table 6. Waterbird species whose population over the 1% standard of Lamsar Convention during 2004–2006

Name	Scientific name	Counts[2]			1% standare INT.IMP
		2004	2005	2006	
Great crested grebe	*Podiceps cristatus*		957	807	250
Dalmatian pelican	*Pelecanus crispus*		1		1
Great cormorant	*Phalacrocorax carbo*		1574	2545	1000
Black stork	*Ciconia nigra*	29	33	41	1
Oriental stork	*Ciconia boyciana*	1491	602	3120	30
Eurasian spoonbill	*Platalea leucorodia*	3623	2051	8891	65
Whistling swan	*Cygnus columbianus*	14446	42843	81336	860
Swan goose	*Anser cygnoides*	29378	22313	70830	550
Bean goose	*Anser fabalis*	5200	16340	29802	600/550
White-fronted goose	*Anser albifrons*	12568	15602	118035	1300
Greylag goose	*Anser anser*		992		750
Mandarin duck	*Aix galericulata*	718	633		200
Common teal	*Anas crecca*	8791	20076	30172	8000
Spot-billed duck	*Anas poecilorhyncha*	13657	17512	16170	12000
Northern pintail	*Anas acuta*		8042		7500
Baer's pochard	*Aythya baeri*	600			150
Scaly-sided merganser	*Mergellus squamatus*		44		40
Siberian crane	*Grus leucogeranus*	2760	2683	2715	30
White-naped crane	*Grus vipio*	2713	1491	1757	40
Common crane	*Grus grus*	1027	935	1361	110
Hooded crane	*Grus monacha*	221	390	359	10
Pied avocet	*Recurvirostra avosetta*	6344	9448	16342	1000
Northern lapwing	*Vanellus vanellus*	1639	3071	5939	1000
Black-tailed godwit	*Limos limosa*		2000	10221	1600
Eurasian curlew	*Numenius arquata*			362	350
Spotted redshank	*Tringa erythropus*	5791	7280	28272	1000
Common redshank	*Tringa totanus*			3618	1000/1000
Common greenshank	*Tringa nebularia*			572	550
Dunlin	*Calidris alpina*		15556		10000
Number of species		18	25	22	

the population increased rapidly in early 1980s, and increased slightly since 1988. The population curve appears to basically conform to the Logistic Model (Zeng, et al., 2002).

Further study is needed to find if the population increase is restrained by factors such as available habitats at deferent times in their life stage.

V. WATERBIRD DISTRIBUTION IN POYANG LAKE

Although Poyang Lake accommodates hundreds of thousands of waterbirds, the distributions are not uniform. Every lake with continuous water surface during the low water level and with distinct boundaries separating it from other water areas was taken as counting unit. This unit always includes the marsh and grassland around the water bodies. There were about 100 lakes or areas in Poyang Lake region when surveys were carried out in 2004, 2005 and 2006. Some of these lakes accommodated many more waterbirds than others, or some were populated by some special species. At the same time, some of them were observed to have only a few birds.

A. The proportions of sum of waterbirds in all lakes according to administrative region

There are more than 10 counties or districts surrounding the Poyang Lake. Figure 3 illustrates the proportions of every counties or districts according to pan-lake surveys, because PYNNR is independent to these counties, the proportion of bird quantity was calculated separately. Some counties had small amounts of waterbirds, so those areas were classified to "other area".

From Figure 3, it could be concluded that the amount of waterbirds in PYNNR was much more than other county's

[2]The blank cells mean that the count of this species in the survey below the 1% standard of Lamsar Convention.

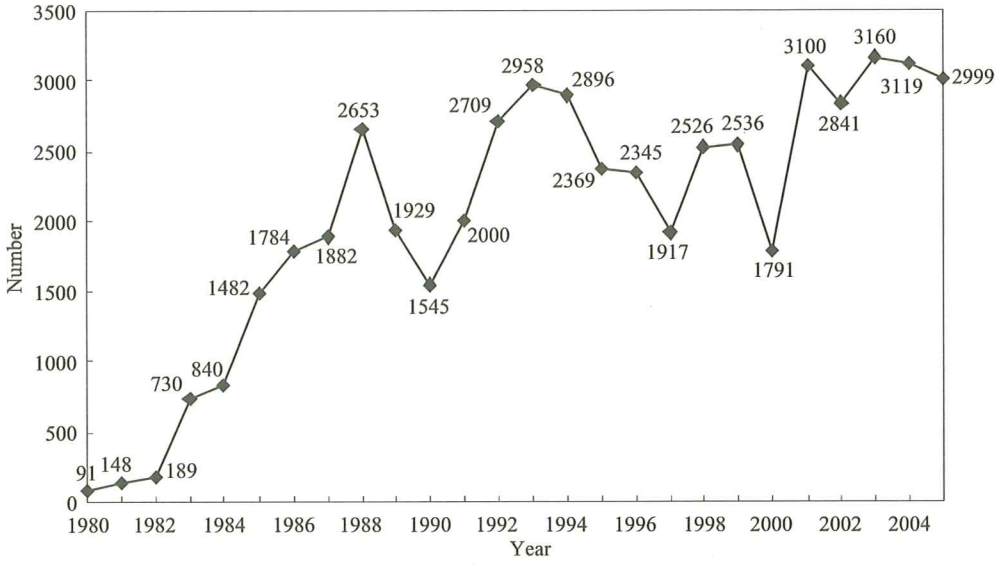

Figure 2. Maximum counts of Siberian crane wintering in Poyang Lake during 1980 to 2005

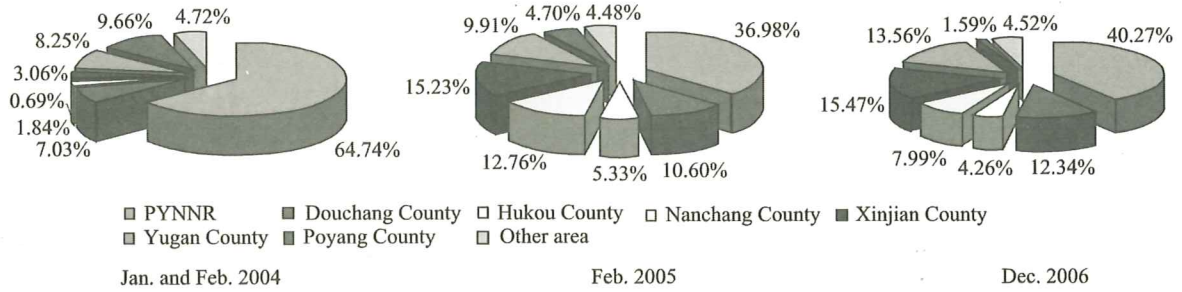

Figure 3. The proportions of sum of waterbirds according to administrative region during 2004 to 2006

individual amounts, which means the reserve is very significant for wintering waterbirds in the whole Poyang Lake.

B. Concentrative sites for Waterbird

In the three surveys, there were totally 17 relatively concentrated sites for waterbirds(Table 7). The concentrated sites mean those sub-lakes or areas whose numbers of waterbirds were not less than 10,000. There were two, three and nine sites whose numbers were more than 20,000 in 2004, 2005 and 2006 respectively, exceeding the requirement for internationally important wetland. Annual differences may be attributed to the survey time and weather.

In order to directly interpret the waterbird concentrated sites, the number of waterbirds at every sub-lake was sorted for every survey. The top fifteen sub-lakes for each year were picked out and identified on a satellite-map(Figure 4–6 respectively in same legend).

PYNNR is located around the north branch of Gan River, northwest of south part of Poyang Lake(Poyang Lake is normally divided into two parts-the south part is wide, and the north is narrow). This area accommodated high quantities of waterbirds, and those sub-lakes around the middle and north branch of Gan River were also highly concentrated areas. Beyond that, the number of waterbirds for certain sub-lakes was dynamic and not as consistent over different years or even in different dates in the same year. For example, at Shahu, the number of waterbirds was more than ninety thousand, giving it a top rank in 2006(Table 7), but in other years it did not reach the top fifteen.

It appears that the water level of lakes deeply affects the waterbirds distribution, especially the natatores. For example, Sanhu of Nanchang county, was almost dry from draining the water too early and too fast in 2006, so only 54 birds were found; but in 2005, the surface of the lake was much wider, and just the number of whistling swans was over 16000.

C. The distributions of several global threatened species

It's known that among the 18 globally threatened species distributed in Poyang Lake, Siberian crane, oriental stork, swan goose, hooded crane and white-naped crane are the most common species and have relatively stable amounts and high proportions related to the global population. Figure 7–11 illustrate the five species distribution sites and the corresponding number classes in the whole Poyang Lake area in three surveys of 2004, 2005 and 2006. The site unit is sub-

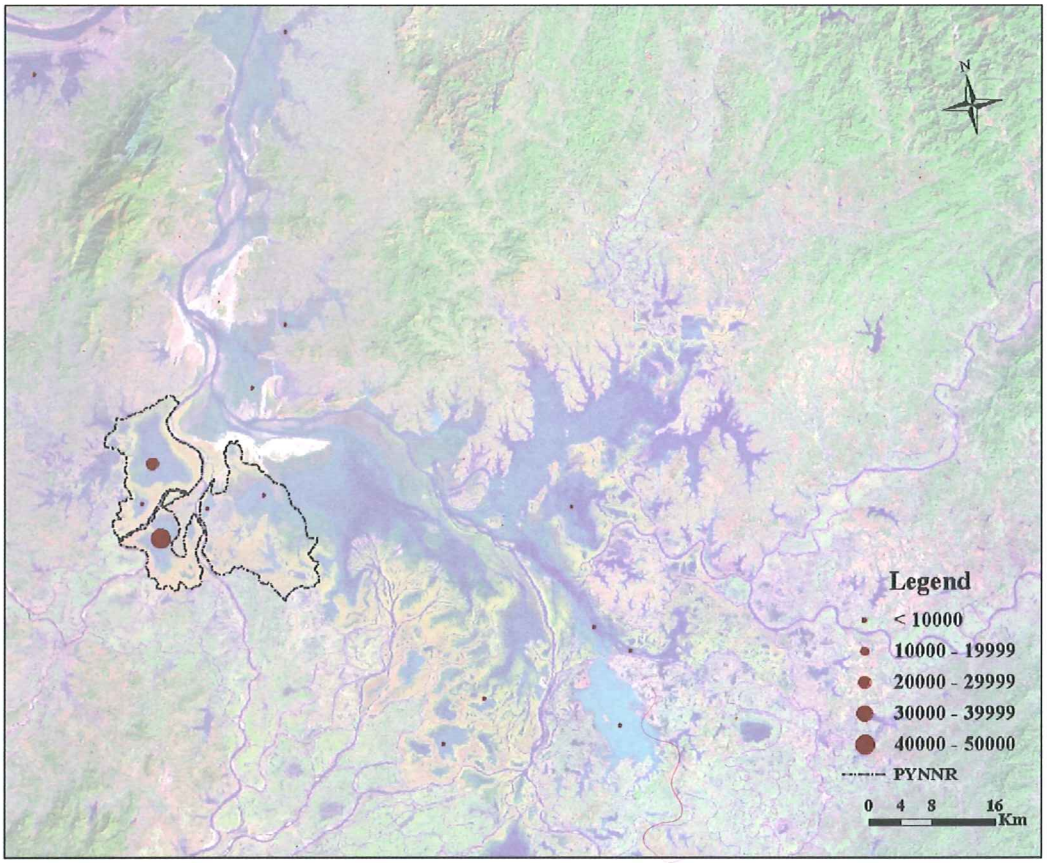

Figure 4. The locations and the numbers of waterbirds for top 15 sites in 2004

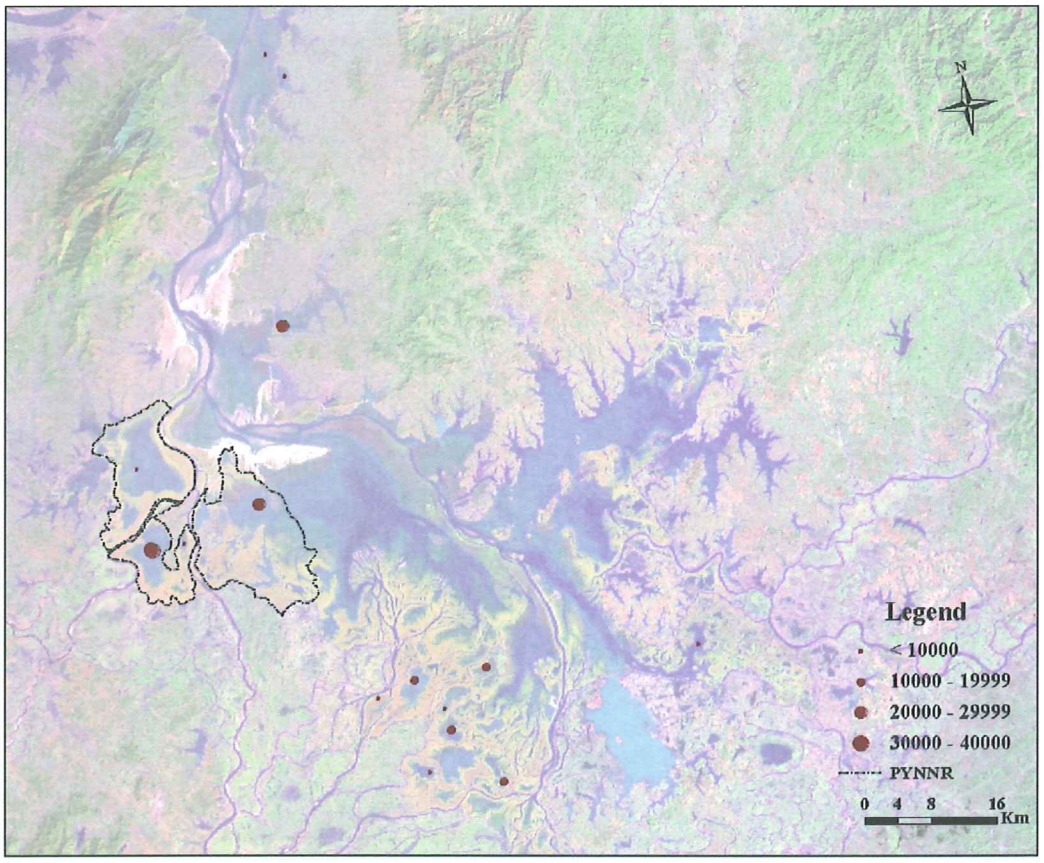

Figure 5. The locations and the numbers of waterbirds for top 15 sites in 2005

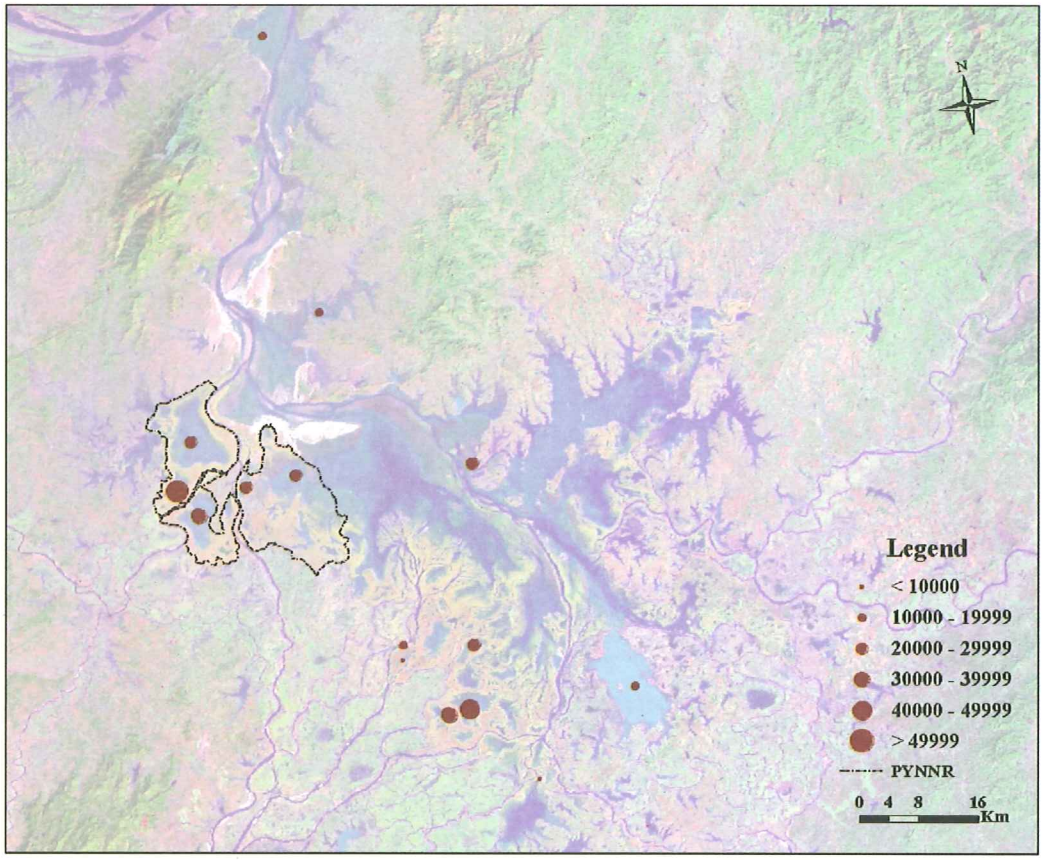

Figure 6. The locations and the numbers of waterbirds for top 15 sites in 2006

Table 7. The sites with amount of waterbirds more than ten thousand in 2004, 2005 and 2006[3]

Sites name	County name	Jan. & Feb. 2004		Feb. 2005		Dec. 2006	
		Amount	Species number	Amount	Species number	Amount	Species number
Shahu	PYNNR					94568	15
Linchonghu	Yugan County					43041	16
Xihu	Nanchang County					35838	9
Dahuchi	PYNNR	49892	30	39708	15	31926	22
Dachahu	PYNNR			22887	25	29768	35
Changhu	Xinjian County					29649	14
Zhonghuchi	PYNNR					28351	16
Banghu	PYNNR	25660	21			22785	17
Zhouxi	Douchang County					20123	20
Xiaoshuhu	Yugan County					17847	15
Xinmiaohu	Douchang County			22754	12	16213	16
Middle Ganjiang	Xinjian County					14097	22
Xieshan	Hukou County					12161	23
Sanhu	Nanchang County			17081	3		
Dashafanghu	Nanchang County			11607	11		
Beishenhu	Xinjian County			15230	14		
Caowanhu	Yugan County			12212	10		

[3]Blank cells mean that the amount of the site was below ten thousand in the year's survey.

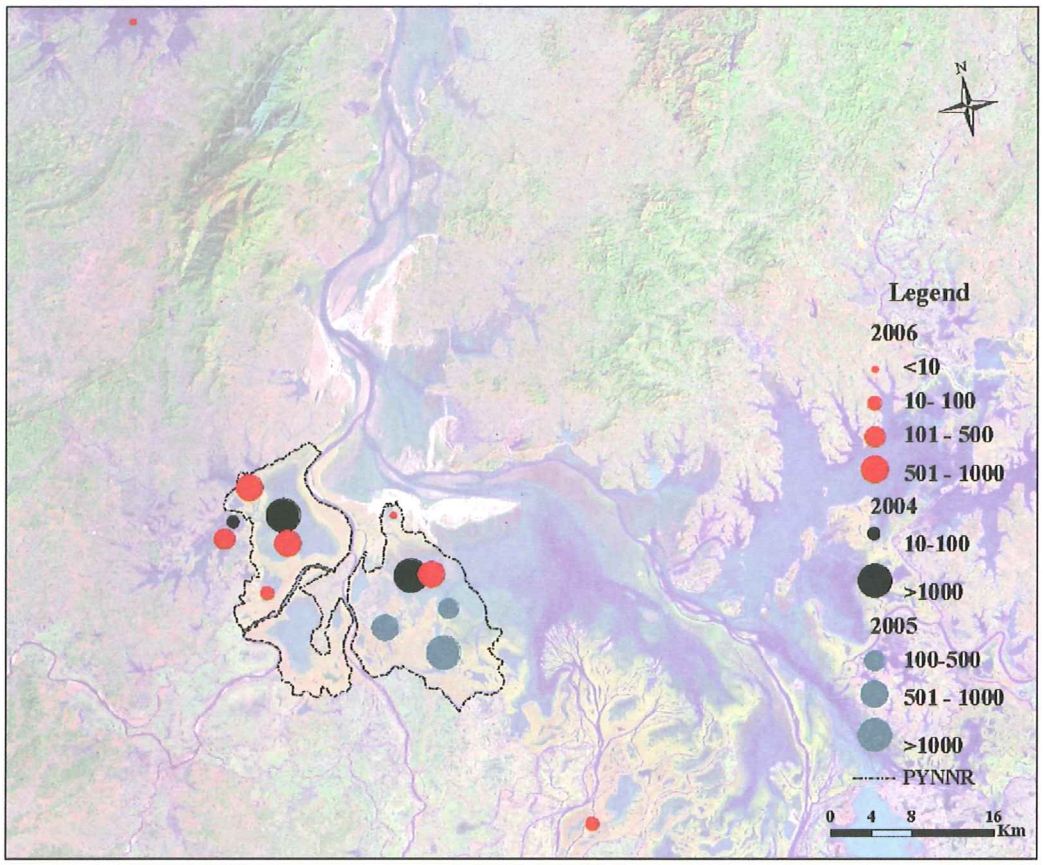

Figure 7. The distribution sites and their corresponding number classes of siberian crane

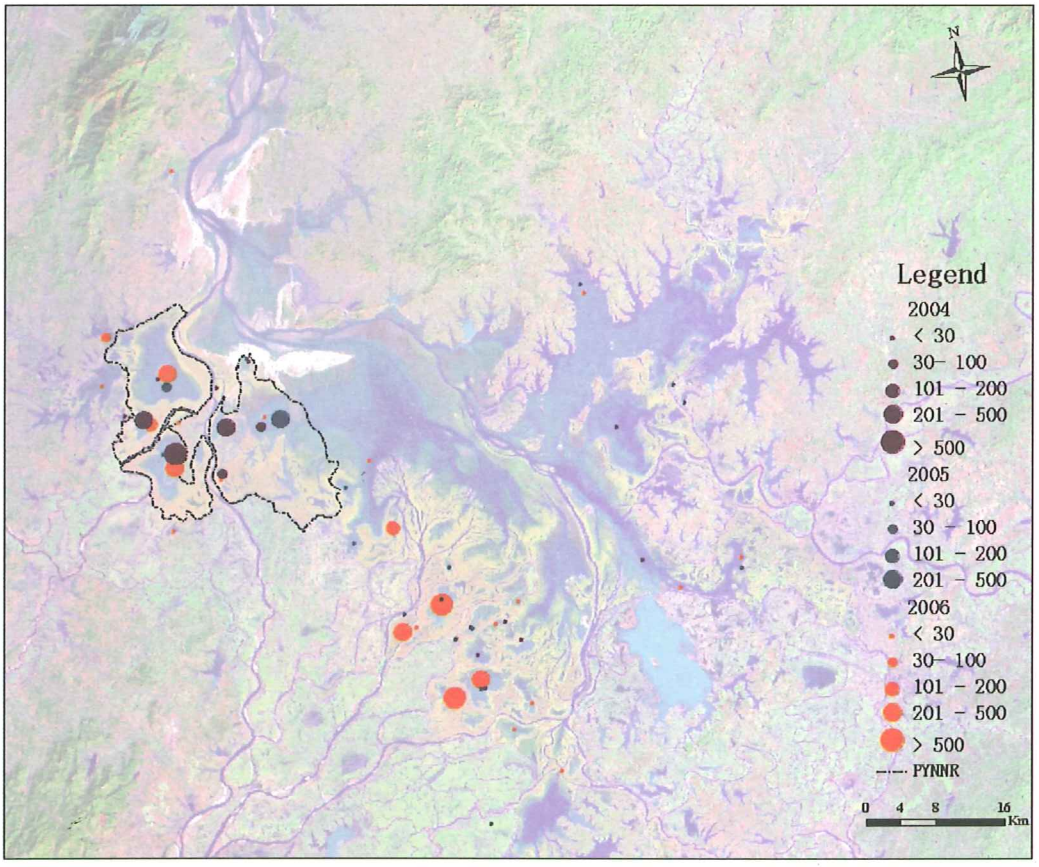

Figure 8. The distribution sites and their corresponding number classes of oriental stork

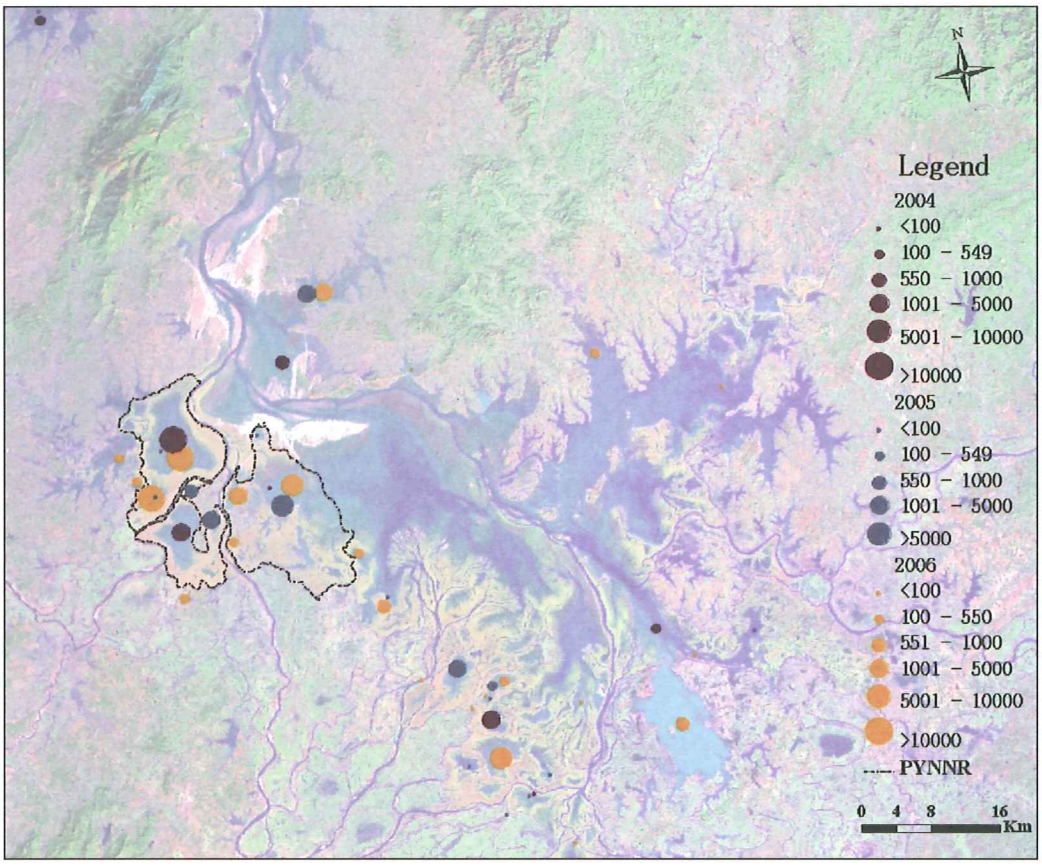

Figure 9. The distribution sites and their corresponding number classes of swan goose

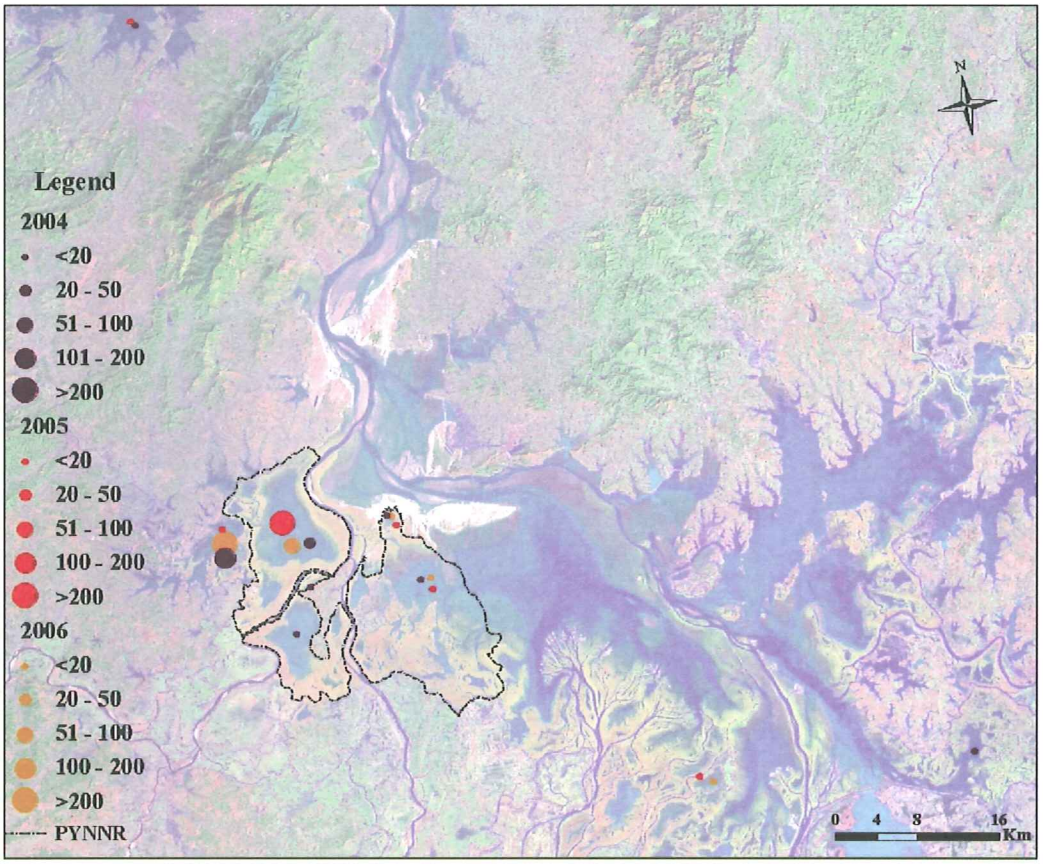

Figure 10. The distribution sites and their corresponding number classes of hooded crane

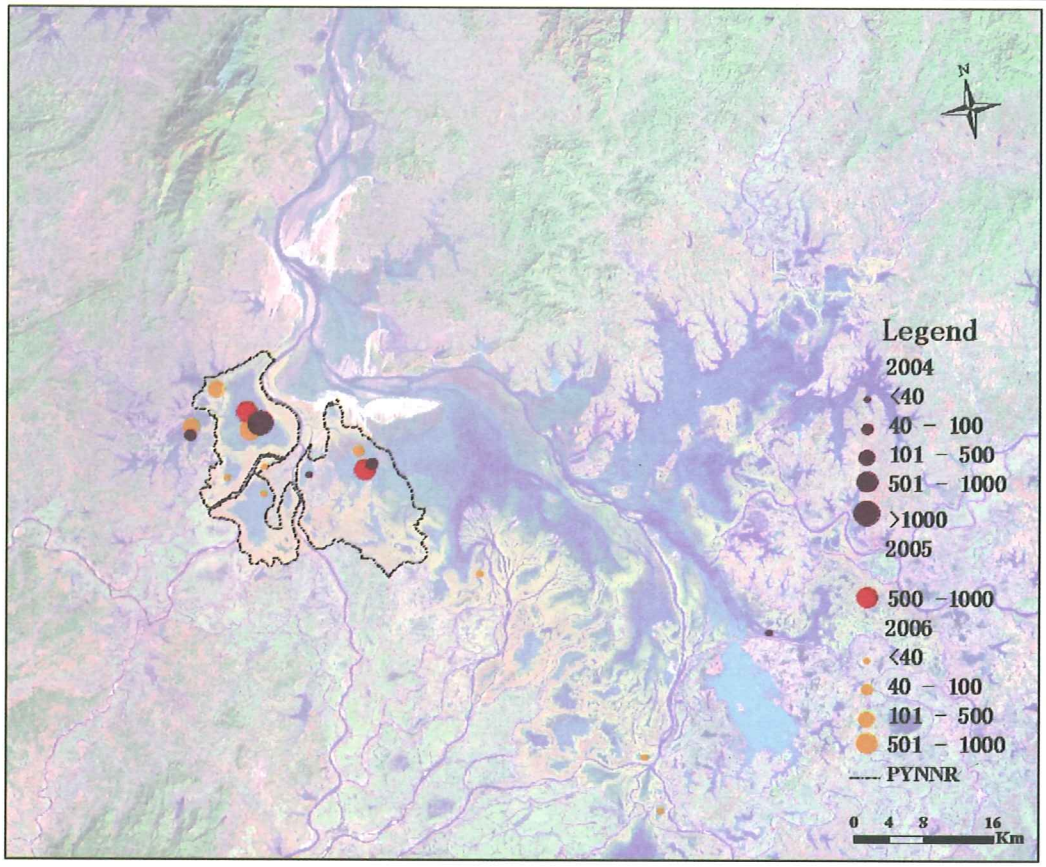

Figure 11. The distribution sites and their corresponding number classes of white-naped crane

lake, some location marks were shifted slightly but are still in the same sub-lake, so that the overlap does not affect the analysis.

From Figure 7, it appears that the distribution of siberian crane is basically in PYNNR and some contiguous sub-lakes, especially Banghu and Dachahu, which are found in the northwestern and eastern part of the reserve. Furthermore, although the siberian crane counts of three surveys were similar, the aggregation levels were different. Especially in 2005, almost all Siberian cranes were distributed in Dachahu, of course, with not only one point but three (in order to illustrate the exact location, the points were marked on the map separately. The distribution of 2004 was quite concentrated too. The difference maybe attributed to the survey time and Siberian crane's biological habitat. According to the long term observation of PYNNR staff, Siberian cranes always aggregate into large flocks and especially prefer to flock in Dachahu in short periods before the spring migration, on the contrary, the distribution in last winter is more scattered. More work is needed on the habitat relationships.

The oriental stork was mainly distributed in PYNNR and south of Poyang Lake, around the middle and south branch of the Gan River, but a few individuals were scattered in other areas. Swan goose was also primarily distributed in PYNNRe and south of Poyang Lake, around the middle and south branch of the Gan River, but quite a few individuals were distributed in Xinmiaohu, northeast of the reserve, they were also distributed in Saichenghu, which is in the northern part of Poyang Lake, and some other areas southeast and east of Poyang Lake. The distribution of hooded cranes and white-naped cranes were both narrow and mainly limited to the reserve and some contiguous sub-lakes. It should be noted that in Nanhu, on the west boundary of PYNNR, quite a few of all three cranes were observed and these lakes may also be a good candidate for more protection.

D. Main distribution area for those important waterbirds

In the 2006 survey, there were 48 sites with at least one species' amount reaching the standard of 1%, and 11 sites with at least three species' amounts reaching the standard. In surveys of 2004 and 2005, there were 18 and 23 sites respectively with at least one species' amount reaching the standard, and both with 5 sites that had at least three species whose quantities reached the standard. Table 8 and 9 show those sites with at least three species' amounts reaching the standard respectively.

Based on Table 8 and 9, it appears that in 2006, Shahu, Dachahu, Banghu Lake and Dahuchi, which all belong to PYNNR, not only was the quantity of species in each individual sub-lake large (more than twenty thousand, referring to Table

Table 8. The sites with at least three species' amounts reaching the standard in 2006[4]

	PYNNR				Gongqing-Cheng	Yugan County			Hukou County	Nanchang County	Douchang County
	Shahu	Dachahu	Dahuchi	Banghu	Nanhu	Linchonghu	Dahu	Xiaoshuhu	Xieshan	Xihu	Waibianhu
Black Stork	7										
Oriental White Stork	107		230	361		478				640	
European Spoonbill	450	1148	3950	375	125	860			130		75
Whistling Swan	8750	4456	2200			2600	2500	1230		23560	950
Swan Goose	37560	5989		10440		5800		710			
Bean Goose	1250					8500		5700	4652		
White-fronted goose	25850		3800	5600			3200		1394	9880	
Siberian Crane	59	901		744	137						
White-naped Crane		57		834	356						
Common Crane		90					361				
Hooded Crane				85	253						
Pied Avocet	1670		3950						3109		2800
Northern Lapwing		1637									
Black-tailed Godwit		6920	2800								
Spotted Redshank					2670	15000				1431	
Eurasian Curlew		351									
Common Teal			13800								
Species' Amount	9	9	8	7	5	6	3	3	4	4	3

Table 9. The sites with at least three species' amounts reaching the standard in 2004 and 2005

Time	Jan. and Feb. 2004					Feb. 2005				
County name	PYNNR			Xinzi County	Poyang County	PYNNR			Duchang County	Xinjian County
Site / Species	Dahuchi	Banghu	Dachahu	Nanhu	Zhuhu	Dachahu	Dahuchi	Banghu	Xinmiaohu	Beishenhu
Dalmatian Pelican							1			
Black Stork		5			11	3	1			
Oriental White Stork	671		32			454		92		
European Spoonbill	2595			358		550	560			
Whistling Swan	1371		1684		5754	2648			14200	5000
Swan Goose	4400	20000				9625			2250	
Bean Goose	3625								630	
White-fronted Goose	4526		2958			3545			5415	
Common Teal							11007			
Spot-billed Duck							13048			
Bear's Pochard	600									
Siberian Crane		1662	1016	65		2674				
White-naped Crane		2546	76	70		660		831		
Common Crane					243	261				150
Hooded Crane		31		142		15		361		
Pied Avocet	4400									
Black-tailed Godwit										2000
Spotted Redshank										1400
Species' Amount	8	5	5	4	3	10	5	3	4	4

[4]The blank cells mean the quantities of the species of the site were below the standard, same as next table.

7), there were also many different species whose population reached the standard of 1% (9, 9, 8, 7 respectively). In particular on Shahu, the number of swan goose and white-fronted goose were very large, and whistling swan's number was very large also. Other sites with both large quantity of waterbirds and several species whose numbers reached the standard of 1%, were Linchonghu and Xiaoshuhu of Yugan County, Xihu of Nanchang County, Xieshan of Hukou County.

VI. CONCLUSION AND REVIEW OF WATERBIRD IN POYANG LAKE

In summary, the complex landscape pattern of Poyang Lake provides appropriate habitats for a great number of birds especially waterbirds. Some features of the bird resource in Poyang Lake can be summarized as follows:

- There are 310 bird species in PYNNR, which comprise most species of whole pan-Poyang Lake area, and 125 of them are waterbird species. Among the 36 threatened waterbird species in China (identified in IUCN), fourteen of them are distributed in the Poyang Lake area.
- In the wintering waterbird community, the quantity of Anseriformes is the greatest, followed by Charadriiformes. Whistling swan, swan goose and white-fronted goose are the dominant species in the community, other common species include ducks and shorebirds. The widely recognized, globally threatened species include Siberian crane, white-naped crane and oriental white stork, are often relatively in high abundance as well.
- According to the three pan-lake surveys, there were a total of 29 species whose numbers were more than 1% of global or the migration route's population, and sixteen of them were consistently observed over the standard in all these years.
- The population of the Siberian crane, the flagship species of Poyang Lake, was stable in recent years, but future forecasts for the population maybe need more study.
- The distribution of waterbirds in many sub-lakes are not uniform; the PYNNR is always a concentrated area, especially Dahuchi, Shahu, and Dachahu. Outside the reserve, those sub-lakes around the middle and south branch of Gan River, are also concentrated areas and important habitats for important species. Xinmiaohu of Douchang County and Nanhu of Gongqingcheng are also concentrated areas or important habitats for several vital species. All of the above areas need more attention and potentially protection.
- The water level is highly relevant to factors of habitat availability and food supply for waterbirds, so changes in management may greatly exert influence the number of waterbirds. This aspect needs sufficient consideration in the program of resource exploitation and biodiversity conservation for Poyang Lake area in the future.

The abundant bird resources in the Poyang Lake area make it a globally important area for bird studies especially for wintering waterbirds. Poyang Lake has received much attention from domestic and international bird researchers especially since the largest Siberian crane population was found wintering there. Because of various reasons, the study of waterbirds was quite limited. In the past 20 years, the most common investigations were the surveys of species resources, distributions, dynamic wintering populations, and observations of ecological and habit behaviors of some important species (Liu, et al., 1987A; Chen, et al., 1987; Liu, et al., 1987B; Chen and Zhou, 1987; Liu and He, 1987), other investigations included the survey of shorebirds (Ji et, al., 2001); the population, distribution, dynamic description and some behaviors of Siberian crane (Zeng, et al., 2002; Wu, 2005); the habitat selection and behavior of oriental stork in winter (Wu, et al., 2002); breeding habits of little ringed plover in Poyang Lake(Wu, et al., 2000); the work of bird banding in Poyang Lake from 1988 to 1998 (Zhao, et al., 2002). Japanese scientists have carried out studies on bird migration routes of some rare species, such as cranes and oriental white stork, by satellite tracking in 1990s. They found many of these species wintering or staying for longs period in Poyang Lake(Kanai, et al., 2002; Higuchi, 2004). Since 1999, PYNNR has been co-operating in a study with the International Crane Foundation (ICF) on the relationship between the factors of water level, turbidity, tubers of *Vallisneria spiralis*, and large waterbird species such as the Siberian crane and other species.

Besides the variety of rare birds in Poyang Lake need continuous quantitative survey and ecological study, Due to the dominancy of some Anseriformes species in community, it is also imperative to further develop other studies on these species like migration route analysis, status in the ecosystem of Poyang Lake, and niche analysis. Furthermore, besides 125 waterbird species, there are 185 other bird species in Poyang Lake, and monitoring and study of these birds should be improved too.

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