

Population sizes and group characteristics of Siberian Crane (*Leucogeranus leucogeranus*) and Hooded Crane (*Grus monacha*) in Poyang Lake Wetland

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Abstract: Both the Siberian Crane (*Leucogeranus leucogeranus*) and Hooded Crane (*Grus monacha*) have limited population sizes and are considered endangered by domestic Chinese and international agencies. To document the current size of their respective populations and characterize their groups, between October 2012 and April 2013 we undertook fieldwork at four nature reserve areas within the Poyang Lake wetlands. We divided Poyanghu National Nature Reserve (PYH) into the Wucheng (PWC) and Hengfeng areas (PHF), because each are each located in different counties. Our fieldwork showed that the Siberian Crane occurred mainly in PYH (364 in the PHF, 158 in the PWC) and the Nanjishan Wetland National Nature Reserve (NJS, with 200 individuals). The Hooded Crane was mainly distributed in PYH (302 in the PHF and 154 in the PWC). Family groups accounted for more than 50% of the total number of groups among both species, with Hooded Cranes forming more family groups than Siberian Cranes. Typically, these groups were formed of two adults with one offspring (Siberian Crane), and two adults with two offspring (Hooded Crane), with the mean family group size of the Siberian Crane and Hooded Crane being respectively 2.65 ± 0.53 ($n=43$) and 3.09 ± 0.86 ($n=47$) individuals per group. The mean collective group size of the Siberian Crane and Hooded Crane included 28.09 ± 24.94 ($n=23$) and 28.94 ± 27.97 ($n=16$) individuals per group, respectively, with the proportion of juveniles among Hooded Cranes being more than double that seen among the Siberian Cranes.

Keywords: Siberian Crane; Hooded Crane; Group characteristics; Poyang Lake wetland

The Siberian Crane (*Leucogeranus leucogeranus*) and Hooded Crane (*Grus monacha*) are frequent winter visitors of the Poyang Lake wetland area, but both species have suffered dramatic losses. Currently, the Siberian Crane is listed in the first category of the nationally protected wildlife species in China and regarded as a critically endangered species by IUCN, with a global population size ranging from 3,800 to 4,000 individuals (BirdLife International, 2008; Li et al, 2012). Though the Siberian Crane breeds in northwest Siberia, it frequently winters around Poyang Lake in Jiangxi Province and Dongting Lake in Hunan Province, with more than 90% of the known global population wintering around Poyang Lake (Zheng & Wang, 1998; Shan et al, 2012). The Hooded Crane has a somewhat larger global population—around 11 600 individuals—only ~1000 winter in China (BirdLife International 2008;

Zhou et al, 2010). The Hooded Crane is also listed in the first category of the nationally protected wildlife species in China, but is regarded as a vulnerable species by IUCN. Typically, the Hooded Crane breeds in eastern Siberia and Heilongjiang Province in China, but winters in an array of areas in eastern Asia, including Korea, Japan and China, predominately along lakes beside the middle and lower reaches of Yangtze River, including Poyang Lake in Jiangxi Province, Dongting Lake in Hunan Province, Shengjin Lake and Longgan Lake in Anhui Province, and Chongming Island in Shanghai (Jing et al, 2002b).

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To date, research on the wintering ecology of Siberian Crane and Hooded Crane has mainly focused on numbers and distribution (Liu, 2001; Li *et al.*, 2012; Shan *et al.*, 2012; Yan & Ding, 1988; Zhou & Ding, 1982;), genetic structure (Zhang *et al.*, 2012), behavior (Jing *et al.*, 2002b; Li *et al.*, 2007; Zhou *et al.*, 2010), diet (Zhao *et al.*, 2002) and habitat selection (Jing *et al.*, 2002a; Sun & Huang, 2010; Zhang *et al.*, 2010). However, despite the popularity and importance of the Poyang Lake are in the north of Jiangxi Province (and the largest freshwater lake in China), no comprehensive and quantitative assessment on population dynamic or age structure of these two species has been conducted. In the present study, we report the findings of several field observations of this area undertaken between October 2012 and April 2013, where we documented population size, group characteristics and age structure. To facilitate more targeted conservation and management of these two crane species, we focused on both documenting population size dynamics of the two crane species at different lakes in the area, and comparing the group characteristics and age structure of the two species.

STUDY AREAS AND METHODS

Poyang Lake (E115°47'–116°45', N28°22'–29°45') is a key wintering or stopover sites for migratory waterbirds in the East Asian-Australasian Flyway. Poyang Lake had a humid subtropical climate with the annual temperature averaging 16.7–17.7 °C, and average annual precipitation at 1400–1900 mm (Huang & Guo, 2007). Between October and April, the Poyang Lake undergoes a drought period, during which many habitats—e.g., grassland and mudflats—form and attract ~500000–600000 waterbirds annually. During the entire year, the wetland vegetation at the Poyang Lake is dominated by *Carex* spp., *Phragmites australis* and *Triarrhena lutarioriparia* (Liu *et al.*, 2006). For the present study, we selected four nature reserves in Poyang Lake to survey the population sizes and group characteristics of the Siberian and Hooded Cranes. To facilitate more accurate measurement, the Poyanghu National Nature Reserve (PYH) was divided into two areas, the Wucheng (PWC) and Hengfeng areas (PHF), since they are located in two counties and were investigated at different times. In the PWC, four lakes (Dahuchi, Baziqiang, Changhuchi, Zhushihu) were selected as observation sites, with additional surveys at two

lakes (Shahu, Banghu) in the PHF. We also surveyed 11 lakes at the Nanjishan Wetland National Nature Reserve (NJS; Zhanbeihu, Sanhu, Changhu, Fengweihu, Sanniwan, Baishahu, Linghu, Shangbeijia, Xiabeijia, Beishenhu, Shentanghu). A further 10 lakes in the Duchang Migratory Bird Nature Reserve (DC; Jishanhu, Zhongba, Xinmiaohu, Mayinghu, Huangjinzui, Binhu, Shuhu, Huamiaohu, Henggang, Xihu) and eight lakes from the Poyang Baishazhou Nature Reserve (BSZ; Zhuhu, Chemen, Rongqi, Sishilijie, Siwanghu, Xiaominghu, Daminghu, Biaoen) were also surveyed (Figure 1).

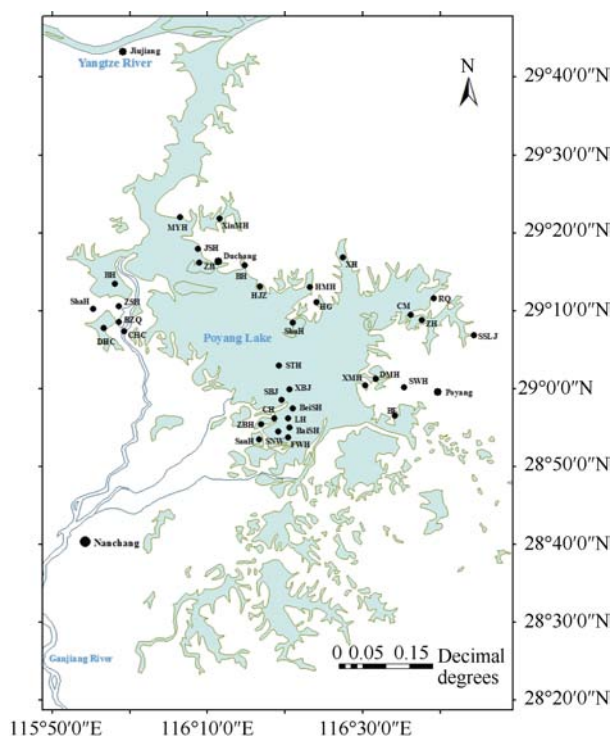


Figure 1 Surveyed areas around Poyang Lake

Abbreviations are as follows: Dahuchi: DHC, Baziqiang: BZQ, Changhuchi: CHC, Zhushihu: ZSH, Shahu: ShaH, Banghu: BH, Zhanbeihu: ZBH, Sanhu: SH, Changhu: CH, Fengweihu: FWH, Sanniwan: SNW, Baishahu: BaiSH, Linghu: LH, Shangbeijia: SBJ, Xiabeijia: XBJ, Beishenhu: BeiSH, Shentanghu: STH, Jishanhu: JSH, Zhongba: ZB, Xinmiaohu: XinMH, Mayinghu: MYH, Huangjinzui: HJZ, Binhu: BH, Shuhu: SH, Huamiaohu: HGH, Henggang: HG, Xihu: XH, Zhuhu: ZH, Chemen: CM, Rongqi: RQ, Sishilijie: SSLJ, Siwanghu: SWH, Xiaominghu: XMH, Daminghu: DMH, Biaoen: BE.

Between October 2012 and April 2013, six surveys, each lasting one or two days, were conducted from at each reserve at intervals of 20–30 days. For comparison, we divided the wintering season into three stages based on the population dynamics: early stage (October to December); middle stage (January to February); and late stage (March to April), in line with a previous study

(Zhou et al, 2010). Totally, between one and five fixed observation points were selected at each lake to count the number of adult or juvenile cranes, group size, group types of two crane species with binoculars (8×) and spotting scope (20–60×). The fixed points varied somewhat according to water level. We noted that the group types comprised of family, collective and special group (Liu et al, 2008), with the family group being subdivided into four types: 1) two adults; 2) two adults with one offspring; 3) two adults with two offspring; and 4) one adult with one offspring. The collective group referred to groups including five or more individuals, while the special group referred to a single adult or juvenile crane. Groups were defined as cranes that were usually within less than 50 m of each other and appeared to coordinate their activities, i.e., they stayed near one another and moved in the same direction (Lcheureux et al, 1995; Liu et al, 2009; Liu et al, 2010).

Our observation data were first checked with the Kolmogorov-Smirnov Test and were found to fit a normal distribution. Next, one-way ANOVA was used to test for differences in the average size of the family or collective groups at different stages, and the size of the family or collective groups between Siberian Crane and Hooded Crane. All data were analyzed with SPSS 19.0 (SPSS inc., Chicago, IL, USA).

RESULTS

Population size and distribution

The Siberian Crane was recorded at 18 of the 35 surveyed lakes located in the four nature reserve areas, but were mainly distributed at PYH and NJS. A large and steady population of Siberian Cranes was observed in Shahu, Banghu, Dahuchi, Baziqiang within the PYH, and

we also observed a large population in Sanhu, Baishahu, Shangbeijia, Beishenghu, Shentanghu at NJS. The Siberian Crane was not observed regularly at any of the other surveyed sites in the other reserves (Table 1).

The Hooded Crane was recorded at 10 lakes located within three of the nature reserve areas, but not in the DC (Table 1). The Hooded Crane was mainly distributed in Shahu, Banghu, Dahuchi, Changhuchi and Zhushihu of PYH, with a large and steady population of the Hooded Crane also observed in Banghu and Zhushihu. Though we also observed the Hooded Crane at the BSZ, the population was comparatively small.

The number of the Siberian Crane peaked in late December and early January when they were mainly distributed in Shahu (333 individuals), Baziqiang (151 individuals) and Beishenghu (182 individuals) but then decreased in mid-March (Table 1). Conversely, the number of Hooded Cranes was high in late January and peaked in later February and early March, when the cranes were mainly distributed in Banghu (226 individuals) and Zhushihu (135 individuals).

Group characteristics

During the course of our field observations, a total of 56 groups of Siberian Crane were observed, with family and collective groups being the most frequently encountered, accounting respectively for 55.54% and 41.07% of the total Siberian Crane groups observed during this investigation. The family groups of the Siberian Crane were the most frequently observed during all three stages. For the Hooded Cranes, 65 groups were observed during this study, with family and collective groups respectively accounting for 72.31% and 24.62% of the total groups. Similarly, the family groups of the Hooded Crane were also the most often observed groups during all three stages (Figure 2).

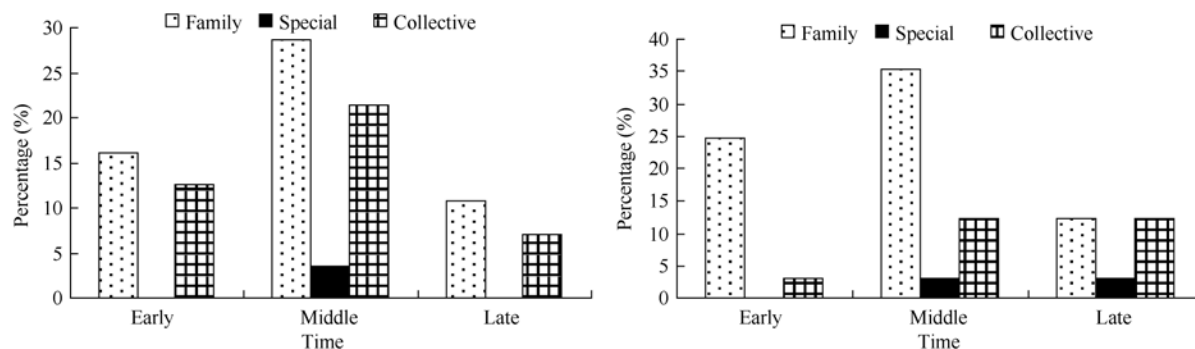


Figure 2 Temporal variation in group type among Siberian Cranes (left) and Hooded Cranes (right) around Poyang Lake

Table 1 Spatial and temporal distribution of Siberian Crane and Hooded Crane around Poyang Lake

Study area	Site	10/15*	11/19	1/2	1/27	3/7	4/13	
PHF	Siberian Crane	Shahu	0	21	333	15	0	0
		Banghu	0	23	31	10	0	51
		total	0	44	364	25	0	51
	Hooded Crane	Shahu	0	0	2	0	76	0
		Banghu	0	25	0	113	226	0
		total	0	25	2	113	302	0
		10/14	11/12	12/24	1/16	2/25	3/18	
PWC	Siberian Crane	Dahuchi	0	3	7	11	22	25
		Baziqiang	0	15	151	0	3	9
		total	0	18	158	11	25	34
	Hooded Crane	Dahuchi	0	2	9	33	15	4
		Baziqiang	0	0	4	0	4	0
		total	0	74	28	60	154	8
			10/19	11/11	12/23	1/20	2/22	3/9
	NJS	Siberian Crane	Sanhu	0	0	3	30	0
Fengweiuhu			0	0	0	0	3	0
Baishahu			0	0	0	35	0	0
Linghu			0	0	0	2	0	0
Shangbeijia			0	0	15	48	39	20
Beishenghu			0	0	182	14	0	4
Shentanghu			–	–	–	39	0	0
total		0	0	200	168	42	24	
Hooded Crane		Changhu	0	0	0	9	4	0
		Shangbeijia	0	0	0	4	0	0
		Xiabeijia	0	0	0	0	0	4
	total	0	0	0	13	4	4	
		11/4	12/2	12/29	1/23	3/14	4/10	
DC	Siberian Crane	Binhu	0	0	8	0	0	0
		Xiaoyang	0	0	5	0	0	0
		Chian	0	0	2	0	0	0
		total	0	0	15	0	0	0
		10/28	11/23	1/9	1/25	3/2	4/2	
BSZ	Siberian Crane	Chemen	0	5	3	0	0	0
		Rongqi	0	0	3	3	6	0
		Xiaominghu	0	0	6	0	0	0
		Daminghu	0	0	3	7	8	0
		total	0	5	15	10	14	0
	Hooded Crane	Biaoen	–	0	0	0	4	0
Total	Siberian Crane	0	67	752	214	81	109	
	Hooded Crane	0	99	30	186	464	12	

* date, e.g., 10/15 = 15 October; – not surveyed; PHF: Poyang National Nature Reserve (Hengfeng); PWC: Poyang National Nature Reserve (Wucheng); NJS: Nanjishan Wetland National Nature Reserve; DC: Duchang Migratory bird Nature Reserve; BSZ: Poyang Baishazhou Nature Reserve

While family groups were the most common grouping for both the Siberian and Hooded Cranes, their composition differed between species. For the Siberian Crane, of four types of family groups, those with two adults and one offspring (51.61%) were most frequently observed, followed by family groups of two adults (38.71%). For the Hooded Cranes, family groups were typically two adults with two offspring (40.43%), though groups with two adults and one offspring (27.66%) and two adults (31.91%) were also regularly observed. No family group with one adult and one offspring was observed for the Hooded Crane at any of our survey sites (Figure 3).

The mean family group size of Siberian Crane and Hooded Crane were respectively 2.65 ± 0.53 ($n=43$) and 3.09 ± 0.86 ($n=47$) individuals per group (Figure 4). The mean collective group size of the Siberian Crane and Hooded Crane were respectively 28.09 ± 24.94 ($n=23$) and 28.94 ± 27.97 ($n=16$) individuals per group. The mean family group size of the Hooded Crane was significantly larger than that of the Siberian Crane ($F=8.191$, $df=88$,

$P<0.05$). The collective group size between the two species of crane showed no significant difference ($F=0.01$, $df=37$, $P>0.05$).

During our survey, we observed no significant difference in the mean family group size for the Siberian Crane ($F=2.023$, $df=40$, $P>0.05$) throughout the three stages, but the mean family group size of the Hooded Crane was significantly lower in the early as compared to the late stage ($P<0.001$). Surveys of both species showed no significant differences in their mean collective group size between the three stages (Siberian Crane: $F=0.396$, $df=20$, $P>0.05$; Hooded Crane: $F=0.834$, $df=13$, $P>0.05$).

Age structure

Totally, 737 Siberian Cranes and 243 Hooded Cranes could be categorized as either being adults or juveniles. The percentage of juveniles among Siberian Cranes was 12.48%, while among Hooded Cranes was 29.22%. The numbers of juveniles displayed the same pattern among both species, being low in early or mid-winter, and high in late winter (Table 2).

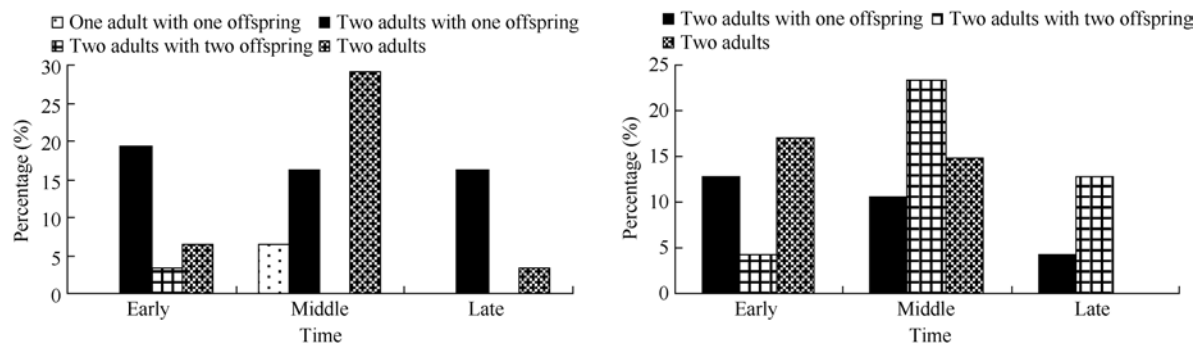


Figure 3 Statistics of four family group types of Siberian Cranes (left) and Hooded Cranes (right) at three different stages

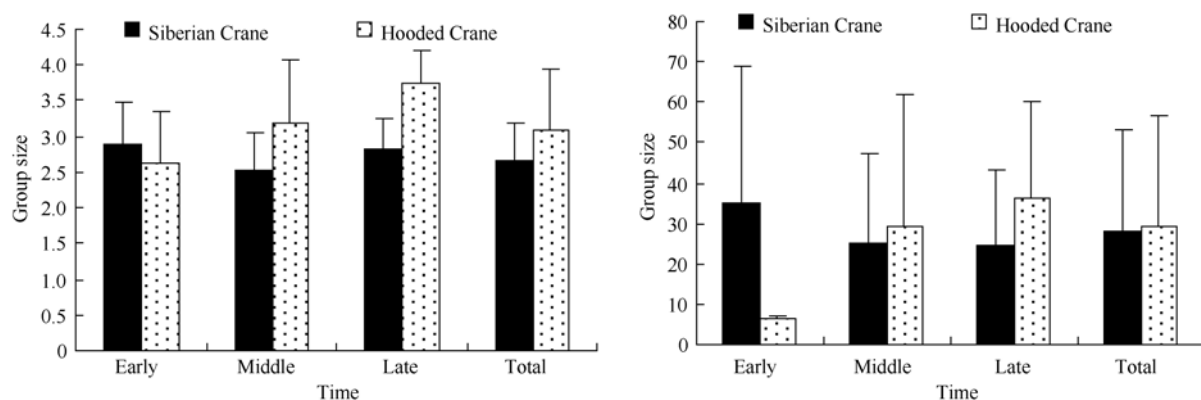


Figure 4 Temporal variation of family group size (left) and collective group size (right) of two Crane species in Poyang Lake

Table 2 Temporal variations in age structure of two species cranes in Poyang Lake

Species		Early stage	Middle stage	Late stage	Total
Siberian Crane	Proportion of juveniles	9.89%	6.92%	42.86%	12.48%
	No. of observed individuals	364	289	84	737
Hooded Crane	Proportion of juveniles	23.73%	27.61%	40.00%	29.22%
	No. of Observed individuals	59	134	50	243

DISCUSSION

Population sizes and distribution

In 1980, Zhou & Ding (1982) recorded the first sighting of more than 100 Siberian Cranes at Poyang Lake. Over the next six years, their numbers have increased gradually, peaking at 1 600+ individuals in 1987 (Yan & Ding, 1988). Between 1998 and 2010, the number of the Siberian Crane at Poyang Lake fluctuated from 1 627 to 3 954 individuals (Shan et al, 2012). Recent research indicates that the global population size somewhere between 3 800–4 000 individuals (Li et al, 2012). This increase suggests that Poyang Lake is an ideal wintering habitat for the Siberian Crane. During our study, we noted that these cranes are primarily distributed across two national nature reserves, with maximum numbers in PHF, PWC and NJS being 364, 158 and 200 individuals, accounting for 9.10%, 3.95% and 5.00% of the global population size, respectively. This shows that these two reserves are important habitats for the Siberian Crane. Compared with previous surveys of the Siberian Cranes, our results showed a smaller and more scattered distribution. For example, previous studies indicated that the Siberian Crane was mainly distributed in Banghu and seldom observed in the NJS (Shan et al, 2012), but we observed a large number of these cranes in the NJS, and detected frequent local movements of the species among different lakes in NJS.

In recent years, continuous low water levels during spring and early summer in Poyang Lake have resulted in long-term drought and a decreased availability of food for many of the water birds that migrate there. The scattered distribution pattern of the Siberian Crane we observed during our surveys may accordingly be due to an insufficient food supply capable of support all the cranes in Banghu. Similarly, the departure time from Poyang Lake recorded for the Siberian Crane during this study was later than the time recorded in previous reports. One potential explanation for this difference may due to a delay in the wintering period due to climate change. Additionally, the juveniles we observed did not need to

breed, and may have delayed their migration after they had acquired enough energy at Poyang Lake, which may subsequently have decreased their mortality.

Our observations also showed that the Hooded Crane was mainly distributed in the PYH, with maximum numbers in PHF and PWC respectively at 302 and 154 individuals, indicating a larger number than previously observed in the entire Poyang Lake (Li et al, 2012). While the Siberian Crane was mainly distributed in Shahu, Banghu, Dahuchi, Beishenghu, the Hooded Crane was only found in Banghu, Dahuchi and Zhushihu. Similarly, the Siberian Crane mainly selected shallow water areas or mudflats for forging habitats, while the Hooded Crane foraged mainly in the grasslands near the lakes. The migration of the Siberian Crane also took place somewhat earlier than that of the Hooded Crane. These ecological differences demonstrate the temporal and spatial separation indicate a positive coexistence of the two species.

Group characteristics

On the whole, both Siberian and Hooded Crane groupings were dominated by family and collective groups. The proportion of family groups for the Hooded Crane recorded in this study was higher than that observed in Chongming Island (Jing et al, 2002b). Family groups for the Siberian Crane were dominated by two adults with one offspring and two adults with two offspring for the Hooded Crane. Compared with the Black-necked Crane, the Siberian Crane had a higher proportion of two adults with one offspring and a lower proportion of two adults with two offspring. The clutch size of the Hooded Crane was two ($n=4$) with a hatching rate of 100% (Guo et al, 2005). A previous study in 1981 noted that family groups of the Hooded Crane were dominated by two adults with one offspring in Poyang Lake, but by two adults with two offspring in Japan in 1967 (Wang, 1988). The higher proportion of two adults with two offspring for the Hooded Crane that we noted during our observations indicates a high survival rate of juveniles. This assessment is also bolstered by the observed higher proportion of two adults with two offspring for the Hooded Crane at Poyang Lake than previously observed in Shengjinhu, or among

the Black-necked Crane (Liu, 2001; Liu et al, 2008).

Age structure

Our characterization of the age structure of both crane species showed some interesting differences between Hooded Cranes and Siberian Cranes. The proportion of juveniles of the Hooded Crane were more than double those seen among Siberian Cranes, suggesting that the proportion of juveniles of the Siberian Crane recorded in this study was similar to the numbers recorded in 1981, and also in line with observations of Black-necked Cranes (Zhou & Ding,

1982, Li, 1997). Typically, the numbers of juveniles of both the Hooded and Siberian Cranes follows an annual pattern, being low in December and January and high in November and February-April, which is again in line with observations of Black-necked Cranes (Liu et al, 2008). On 13 April 2013, we also noted 51 Siberian Cranes, including 30 juveniles, at Banghu, suggesting that the family group began to disintegrate during late wintering stage, with some juveniles leaving the family to cohabit with other juveniles or adults, which is quite similar to the behaviors of both Black-necked Cranes and the Common Crane *Grus grus* (Liu et al, 2008).

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