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SHORT COMMUNICATION

Survey of breeding populations of the Red-Crowned Crane (*Grus japonensis*) in the Songnen Plain, northeastern China

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Abstract With the support of the UNEP/GEF Siberian Crane Wetland Project, a five-year field survey of breeding waterbirds was conducted in four nature reserves — Zhalong, Keerqin, Xianghai and Momoge National Nature Reserves in the Songnen Plain for the period from May 2004 to August 2008. The purpose of the survey was to improve our understanding of the distribution and populations of breeding waterbirds in this area. The Red-crowned Crane (*Grus japonensis*) was the most important target species. Our survey results confirm that the Zhalong wetland is the largest breeding ground for the Red-crowned cranes in the Songnen Plain. Over 90% of the breeding birds were found in Zhalong, with numbers fluctuating from 112 to 275 over the years. Reed (*Phragmites australis*) is the most important plant species associated with breeding locations of this bird species. Water supply to the wetland can relieve pressure from deterioration of wetland habitats for the breeding of Red-crowned cranes. However, a sound scientific basis for the water supply mechanism is the key to better management of their habitat and a prerequisite for ensuring the breeding success of the Red-crowned Crane.

Keywords breeding location, Songnen Plain, Zhalong, *Phragmites australis*, water supply

Introduction

The Red-crowned Crane (*Grus japonensis*), listed as an endangered species by the IUCN Red List of threatened species (IUCN, 2012), is only found in east Asian countries (Ellis et al., 1996), i.e., China, Japan, Mongolia, Russia, North Korea and South Korea. Breeding Red-crowned cranes can be divided into two populations; the first one is referred to as the island breeding population in Hokkaido, Japan and the other one is the mainland breeding population, which includes breeding birds in northeast China, eastern Mongolia and eastern Siberia, Russia (Meine and Archibald, 1996).

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The Red-crowned Crane has been listed as a first-grade protected wildlife species in China since the early 1980s. Research has been carried out on its population, distribution, breeding and wintering ecology, migration, habitat selection, conservation and habitat management (Ma, 1982; Feng and Li, 1985, 1986; Ma and Jin, 1987; Ma et al., 1987, Higuchi et al., 1998; Zhang and Li, 2001; Zhou et al., 2002; He et al., 2004; Wang and Li, 2008; Liu et al., 2009; Ma et al., 2009; Wu and Zou, 2011). However, given the speedy development of the economy in China, conservation issues for the Red-crowned Crane are becoming more challenging (Ma et al., 2009).

Historically, the Songnen Plain has been one of the important breeding grounds for the Red-crowned Crane. Given the recent dry climate cycle and human disturbances, the wetlands have deteriorated in the plain over the last decades and the breeding population of the Red-crowned Crane is decreasing dramatically (He et al., 2004; Tong et al., 2008).

From 2004 to 2008, with the implementation of the United Nations Environment Programme (UNEP)/ Global Environment Facility (GEF) Siberian Crane Wetland Project, the National Coordination Unit (National Bird Banding Center of China) for this project conducted a five-year breeding population monitoring project in the following four reserves: Zhalong, Xianghai, Keerqin and Momoge National Nature Reserves (NNRs). These four nature reserves comprise the main areas of natural habitat remaining in the Songnen Plain. The GEF project monitoring activities included annual ground surveys and two aerial surveys that were conducted during the project period, The first aerial survey was conducted from 13 to 15 May 2005, covering all ground survey areas, while the second aerial survey covered only Zhalong and its important neighboring wetlands and was carried out from 23 to 25 April 2008.

Survey area

The surveys were conducted mainly in the four reserves, with some important neighboring wetlands included. The total survey area covered about 670000 ha, of which 210000 ha were in Zhalong, 144000 ha in Momoge, 106000 ha in Xianghai, 140000 ha in Keerqin and 70000 ha in adjacent wetlands (Fig. 1).

Methods

Ground surveys

The ground surveys were carried out from late May 2004 to May 2008. The exact dates for starting surveys varied at different locations according to the weather conditions of a specific year (Table 1). The survey dates would also depend on the growth of the reeds in the wetlands. The aerial surveys were conducted right before or after the ground surveys. We considered it easier for ground surveys to be conducted before the reeds grew too tall; therefore, we performed the aerial survey after the ground surveys in Zhalong in 2008 (Table 2).

Survey routes and observation points for the ground surveys remained the same during all five years from 2004 to 2008 (Table 3). Based on previous information about the birds, a total of 55 routes with a combined distance of 423 km and 180 observation points were selected and surveyed. We tried to cover all the potential breeding sites for the Red-crowned Crane in the area. Each route and observation point was surveyed once a year.

Aerial surveys

A light aircraft, a Yun-V, was used for the surveys, i.e., the same type of plane used for previous studies in 1990 and 1996 in Zhalong NNR (Wu et al., 1997, Pang 2000). The flying height was about 100–150 m in order to secure a good view from the air and ensure safety of the aircraft. We maintained flying speeds of around 100 $km \cdot h^{-1}$ during the surveys.

Flight transects for each nature reserve were carefully designed before the surveys. Based on previous experience (Feng and Li, 1985), we set up intervals of 1000 m between transects. This distance made it possible to identify all large waterbirds, including the Red-crowned Crane. Table 4 shows the flight routes and time used for the surveys in each location in the plain. The areas covered by the aerial surveys were the same as for our

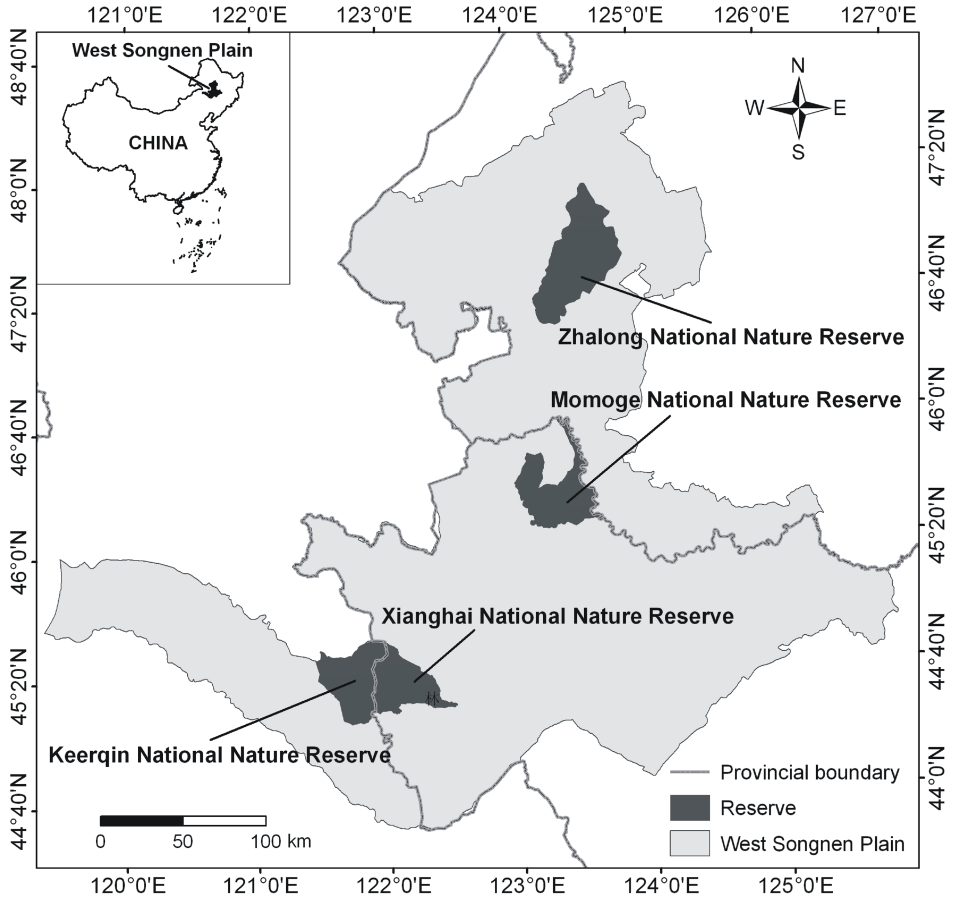

Fig. 1 Locations of the four national nature reserves in western Songnen Plain, northeastern China

Table 1 Dates of ground surveys conducted in Songnen Plain, 2004 to 2008

Location	2004	2005	2006	2007	2008	Days of survey in each year (d)
Zhalong	22 May – 5 Jun	15–30 May	18 May – 1 Jun	15–24 May	8–17 May	10–15
Momoge	22–31 May	15–24 May	17–27 May	15–24 May	8–17 May	10
Xianghai	22–31 May	15–24 May	17–26 May	15–24 May	8–17 May	10
Keerqin	22–31 May	15–24 May	16–25 May	15–24 May	8–17 May	10

Table 2 Aerial survey dates at different locations in Songnen Plain, 2005 and 2008

Location	2005	Days of 2005 survey (d)	2008	Days of 2008 survey (d)
Zhalong	13–14 May	2	23–25 April	3
Momoge	15 May	1		
Xianghai	14 May	1		
Keerqin	13 May	1		

Table 3 Number of survey routes and observation points for ground surveys at different locations in Songnen Plain, 2004 to 2008

Location	Number of survey routes	Number of observation points	Distance of survey routes (km)
Zhalong	45	130	287.7
Momoge	3	17	23
Xianghai	4	17	104
Keerqin	3	16	8.2
Total	55	180	422.9

ground surveys.

The aircraft followed the coordinates of designated transects automatically. In addition, we had one of the team members helping the pilot with navigation when necessary.

Data collection

Direct counting was used to record all birds during the surveys. We recorded the coordinates of every discovered individual crane, pair of cranes and nest by GPS. Ground survey teams were made up of 40 trained people. The field work usually started on the same day in each year at all four reserves (Table 1). Vegetation quadrates with an area of 1 m² were sampled where nests were found during ground surveys.

During aerial surveys, a survey team of seven people was on board, consisting of a navigator, a cameraman, a photographer and four investigators, two on each side of the aircraft; in addition there were two pilots. The investigators recorded the times, directions and distances along the transects whenever they found birds or nests. The coordinates of the birds or nests could be reconfirmed later in the office.

Results

Birds surveyed

In addition to the Red-crowned Crane, all other large waterbirds were recorded during the surveys. Below, we present only the results for the Red-crowned cranes.

Number of Red-crowned Cranes in Songnen

From the results of our field survey, we conclude that the population of the Red-crowned Crane in the Songnen Plain ranges between 114 and 275 birds. The number of cranes was low during the 2004–2006 period and highest in 2008 (Table 5). Zhalong hosted most of the breeding population of Red-crowned Cranes in the plain during the 2004–2008 period (Table 5). We can conclude that the population in Zhalong NNR roughly represents the current status of the Red-crowned Crane in the Songnen Plain.

Nest habitat

We took samples from areas immediately surrounding 20 nests of the Red-crowned Crane that were discovered during the five-year surveys at Zhalong. All the nests were in reed marshes with an average depth of its shallow water of 8.84 cm. Table 6 shows the relative importance values (IV) of eight of the most frequently occurring plant species found around the nests. The reed (*Phragmites australis*) is the dominant species and characterizes the habitat for nests of the Red-crowned Crane.

Discussion

Population fluctuation of the Red-crowned Crane

Currently, the Zhalong wetland is the main breeding ground for the Red-crowned Crane in the Songnen Plain. The breeding population of the crane has been changing (Feng and Li, 1985; Ma et al., 1987; Pang, 2000; Wang et al., 2011). According to earlier historical data, the crane population has increased from the 1980s to the 1990s at Zhalong, where the peak number reached 346 with 66 nests in 1996 (Wu et al., 1997). In March 2003, the ground survey, conducted by staff of the Zhalong Nature Reserve, found 405 individual birds and 84 nests, the highest numbers ever recorded. However, during the period of the GEF Siberian Crane Wetland Project, our results show that the breeding population of the cranes has experienced large fluctuations (Table 5, Fig. 2). Such changes were caused by large-scale disturbances, such as fires and lack of water in the wetlands. In the fall of 2001 about 40000 ha and the spring of 2005 almost the entire core area of the Zhalong Nature Reserve was burned. The Red-crowned Crane lost most of its previously occupied breeding ground (Zou et al., 2003; Kong et al., 2007). After the fires, the Heilongjiang Provincial Government decided to deliver extra water from the Nenjiang River to compensate for the shortage of water in Zhalong, so the wetland environment could recover quickly after the fire. We think fire is the main

Table 4 Flying routes and times used for aerial surveys at different locations in Songnen Plain, 2005 and 2008

Location	Dates for survey	Aerial survey routes					Time for survey (h, m)		
		Area covered (ha)	Number of transects	Distance by flying (km)	Distance for survey (km)	Distance for travel to survey sites (km)	Total time	Time for survey	Time for travel to survey sites
Zhalong	13–14 May 2005	280000	28	1433	903	530	14 h and 30 min	10 h	4 h and 30 min
	23–25 April 2008	210000	24	2800	1050	1750	21 h	12 h	9 h
Momoge	15 May 2005	144000	11	1058	554	504	8 h and 10 min	4 h and 10 min	4 h
Xianghai	14 May 2005	106000	11	950	418	532	8 h	4 h and 30 min	3 h and 30 min
Keerqin	13 May 2005	140000	12	1182	442	740	8 h	3 h and 50 min	4 h and 10 min

Table 5 Number of Red-crowned Cranes found at the Zhalong, Xianghai, Momoge and Keerqin wetlands, 2004 to 2008

Location	2004 ground survey			2005 ground survey			2005 air survey			2006 ground survey			2007 ground survey			2008 ground survey			2008 air survey		
	A	J	N	A	J	N	A	J	N	A	J	N	A	J	N	A	J	N	A	J	N
Zhalong	129	19	10	106	2	28	151	2	33	118	0	3	208	3	16	273	1	27	266	1	27
Momoge	0	0	0	0	0	0	0	0	0	8	0	1	4	0	1	0	0	0	-	-	-
Xianghai	5	0	0	6	0	2	5	0	2	4	0	2	4	3	2	2	0	1	-	-	-
Keerqin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-
Total	134	19	10	112	2	30	156	2	35	130	0	6	216	6	19	275	1	28	266	1	27

Notes: A, adult; J, juvenile; N, nest; "-", no data.

Table 6 Importance values (IV) of the most frequently occurring plant species surrounding the nests of Red-crowned Cranes in Zhalong NNR, 2004 to 2008

Number	Plant species	Coverage (%)	Coverage (RCO)	Density (ind. per m^2)	Density (RDE)	Frequency (%)	Frequency (RFE)	Average height (cm)	IV = RDE + RCO + RFE
1	*Phragmite australis*	2.8	47.2	68.5	38.3	100.0	30.5	55.3	116.0
2	*Carex* sp.	0.8	14.0	79.0	44.2	66.7	20.4	54.6	78.5
3	*Carex scabrifolia*	0.88	14.6	14.6	8.2	25.0	7.6	52.5	30.4
4	*Carex eremopyroides*	0.2	2.8	6.2	3.5	19.2	5.9	19.2	12.1
5	*Equisetum arvense*	0.5	9.0	4.92	2.8	54.2	16.5	25.1	28.3
6	*Cardamine lyrata*	0.3	4.8	2.0	1.1	16.8	5.1	16.9	11.0
7	*Sium suave*	0.2	2.8	0.3	0.2	16.7	5.1	15.0	8.1
8	*Utricularia minor*	0.3	4.8	3.5	1.9	29.2	8.9	7.8	15.7

Note: RCO, relative coverage; RDE, relative density; RFE, relative frequency.

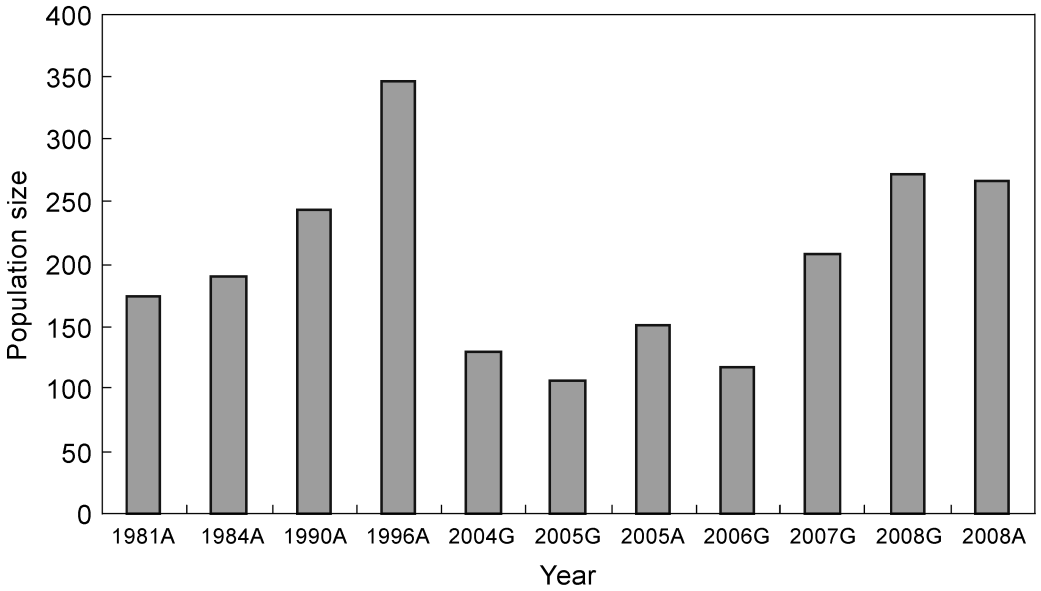

Fig. 2 Fluctuation in number of Red-crowned Cranes in Zhalong NNR during 1981–2008. "A" after a year means the data are obtained from aerial surveys, and "G" after a year indicates the data come from ground surveys. Sources of other records: data for 1981 and 1984 are from Feng and Li (1985), data for 1990 are from Wu et al. (1997) and data for 1996 are from Pang (2000).

cause for the fluctuation in the breeding population of the Red-crowned Crane in Zhalong.

Although the number of adult birds slightly increased after 2004, the number of chicks decreased sharply. The big fires in April–May of 2005 destroyed most nests. In the spring of 2006, we found only six nests but without any juveniles. Although we found more nests in the spring of 2007 and 2008, i.e., 16 and 27 respectively, the number of chicks was still low. Kong et al. (2007) studied the impact of fires in the fall of 2001 and in March 2005 and concluded that fires might destroy the most suitable breeding habitat of the Red-crowned Crane.

Xianghai had been an important breeding ground for the Red-crowned Crane in the past, with about 20 pairs and 3–4 nests during the 1980s (Yang, 1983; Feng and Li, 1985; Yu and Li, 1989). From 1997–2003, the number of cranes ranged from about 14–92 with 2–16 breeding pairs (Sheng et al., 2001; He et al., 2004). During our surveys, only one or two nests were discovered in the field. The decrease of the breeding population largely resulted from increasing human disturbances, wetland deterioration and fragmentation due to water shortages during the last decade (He et al., 2004; Zhang et al., 2006).

Management of the breeding habitat of the Red-crowned Crane

The reed marshes provide breeding habitats for the Red-crowned Crane (Table 6). Previous research shows that uncut reeds with a height of 1.5 m or more is the key factor that affects the nest-site selection of this species at Zhalong (Zou et al., 2003). Kong et al. (2007) studied the impact of fires on crane habitats at Zhalong with the use of satellite images. Comparison of images before and after the fires in the fall of 2001 showed that fire wiped out reeds and the food resources most suitable for the Red-crowned Crane. As a consequence, the birds were forced to select secondary habitats where the height of reeds and food resources could not meet the requirements of nest-making, brood-hatching and juvenile-feeding. Our results suggest that the low number of cranes is probably the result from these human disturbances.

Water shortage is the main threat to the reed marshes. Even if the Heilongjiang Provincial Government promises to deliver water to the wetland when needed, many important questions, such as how much water should be delivered, the best time for delivering water

and the best route for delivery of water are waiting for future, long-term research. The Zhalong wetlands received artificial water supplies in April and May of 2005, 2006, 2007 and 2008. These water releases did improve the wetland situation (Liu, 2006; Yuan et al., 2009; Zou and Wu, 2009). But these quick water releases in the spring could drown the nests of Red-crowned cranes as well as nests built by other birds in March. Spring water releases could be one of the reasons why only a few chicks were found during the field surveys in May of 2006, 2007 and 2008.

A reasonable water supply mechanism needs to be established for better management of the habitat for the Red-crowned Crane. The GEF Siberian Crane Wetland Project initiated such research in Zhalong in 2007. We hope this research can be continued and applied to maintain the breeding habitat for the Red-crowned Crane in the future.

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中国东北松嫩平原丹顶鹤繁殖种群调查

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摘要：自 2004 年至 2008 年，在白鹤 GEF 项目的支持下，全国鸟类环志中心于每年 5 月在东北松嫩平原的 4 个国家级自然保护区，即黑龙江的扎龙国家级自然保护区、内蒙古的科尔沁国家级自然保护区、吉林的向海和莫莫格国家级自然保护区，开展了繁殖水鸟的地面调查。调查的目的在于了解各个保护区繁殖水鸟的分布和种群动态。丹顶鹤（*Grus japonensis*）是本调查活动的重要目标物种。通过 5 年的调查，了解到松嫩平原的扎龙保护区是目前丹顶鹤最为重要的繁殖地，逾 90% 的繁殖丹顶鹤种群分布在扎龙保护区，但种群数量变动较大，变动幅度介于 112–275 只之间。良好的芦苇（*Phragmites australis*）生境是丹顶鹤的繁殖种群保持稳定和增长的首要条件。通过给湿地供水可以缓解丹顶鹤繁殖栖息地的快速退化，但科学合理的供水机制是保证丹顶鹤繁殖成功的前提。

关键词：繁殖地，松嫩平原，扎龙，*Phragmites australis*，供水