

Crane

Table of Contents

Cranes	2
Cranes 2016	2
Cranes 2015	4
Cranes 2014	9
Cranes 2013 and earlier	15

Cranes

Cranes 2016

Wan, W., L. Zhou, and Y. Song. 2016. Shifts in foraging behavior of wintering Hooded Cranes (*Grus monacha*) in three different habitats at Shengjin Lake, China. *Avian Research* 7:13.

(Abstract)

Background: Wetland loss and degradation result in a reduction in the availability and quality of food for wintering waterbirds. Birds normally modify their foraging behavior to adapt to variations in food availability. In this study, we compared shifts in foraging behavior of Hooded Cranes (*Grus monacha*) in three different habitats at Shengjin Lake, China to understand the response of these cranes to changes in habitat.

Methods: We investigated the food density and foraging behavior of Hooded Cranes in Shengjin Lake National Nature Reserve from November 2014 to April 2015. We used regression equations to describe the changes in food density. A total of 397 behavioral observations were used in the analyses of their foraging efforts. We fitted a candidate set of generalized mixed linear models to analyze the relationship of foraging efforts and food density. We used a method of information theory to guide the selection of the model and Akaike's Information Criterion to calculate the value of each model. The relationship between food density, disturbances and foraging behavior was illustrated using a generalized linear model.

Results: Along with the temporal variation and exploitation of food biomass, the food density varied widely among foraging sites. During the early winter period, foraging efforts were more pronounced in the paddy fields and meadows but not significantly different among the three habitats. The cranes spent more foraging effort in the paddy fields and meadows during the middle stage and in the meadows and mudflats during the late winter. The results of the generalized linear model showed that food density and disturbances had different effects on the rate of foraging success during the winter, while the effect of foraging effort was not significant. Furthermore, the rate of feeding success was markedly affected by disturbances in the paddy fields. The combined action of food density and disturbances had a significant effect on the rate of foraging success in the meadows, while the effect of foraging effort was also not significant in three habitats.

Conclusions: Changes in foraging behavior were significant in three habitats, which were affected by food density and disturbances. The rate of foraging success increased in the habitat with low food density and low disturbances to increase the foraging efficiency in the lake. With abundant food and a high level of disturbance, the rate of foraging success decreased to ensure more secure access to food.

Dong, H. Y., G. Y. Lu, Z. X. Yao, and X. J. Yang. 2016. Winter diet and food selection of the Black-necked Crane *Grus nigricollis* in Dashanbao, Yunnan, China. *PeerJ* 4:e1968.

(Abstract)

The Black-necked Crane *Grus nigricollis* is a globally vulnerable species whose food is the factor determining its long-term survival. Understanding dietary habits, food preferences, and related factors will facilitate the development of effective conservation plans for the protection of this vulnerable species. For this purpose, we used video recordings and sampling of food availability to examine the dietary composition and temporal variation in food selection of Black-necked Cranes wintering in the Dashanbao National Nature Reserve, China. The Black-necked Crane's diet consists primarily of domestic food crops such as grains (74%) and potatoes (8%), in addition to invertebrates (14%). A much smaller proportion of the diet was comprised of turnips and wild herbaceous plants and tubers. There was monthly variation in food selection, partially related to food availability. Grains were most available in November and decreased through the winter, whereas invertebrates were more available in November and February than in December and January. Grain consumption was lowest in November but higher from December through February. Invertebrate consumption was highest in November and February. The cranes preferred to eat grains throughout winter months, while they mainly selected invertebrates in November and February. We suggested invertebrate populations sharply declined in December and January due to the low temperature. In addition, grain consumption was negatively associated with invertebrate availability. In November, when invertebrates were most abundant, and despite a concomitant peak in grain abundance, we suggested cranes exhibited a preference for invertebrates over grains. We recommend that the protection administration provide appropriate supplemental foods for cranes during freezing weather.

Jiao S, Zeng Q, Sun G, Lei G. 2016. Improving Conservation of Cranes by Modeling Potential Wintering Distributions in China. *Journal of Resources and Ecology* 7 (1):44-50.

(Abstract)

Habitat management is essential for the conservation of wildlife, especially cranes. Here, we collected occurrence data at wintering grounds for four cranes (*Leucogeranus leucogeranus*, *Grus monachal*, *Antigone vipio* and *G. grus*) and analyzed associated environmental variables to model and project overall potential wintering habitat using Maxent. ENMTools was used to calculate the degree of niche overlap among cranes. Results showed that lakes in the middle and lower reaches of the Yangtze River are main habitats for the four focal species. Inland water and coastal wetlands in Jiangsu are also potential wintering areas. *G. grus* spreads over central and eastern China. The four cranes show tight niche overlap in the middle and lower reaches of the Yangtze River. Poyang Lake is one of the most important habitat sites for all four cranes, according to modeling and niche overlap results. Poyang Lake is cut into a dozen nature reserves, but a bigger nature reserve or system would be more effective for cranes. The conservation of these four crane species will be improved

on the basis of this study.

Nilsson, L., N. Bunnefeld, J. Persson, and J. Månsson. 2016. Large grazing birds and agriculture—predicting field use of common cranes and implications for crop damage prevention. *Agriculture, Ecosystems and Environment* **219**:163–170.

(Abstract)

Increasing numbers of previously threatened large grazing birds (cranes, geese and swans) are causing crop damage along their flyways worldwide. For example, the number of reported incidents of crop damage caused by common cranes *Grus grus*, followed by regulated inspections and governmental compensation in Sweden, has increased over the last few decades and was valued at ~200,000 Euros in 2012. Consequently, their impact on agriculture is escalating which raises the need for evidence-informed preventative strategies. We surveyed arable fields for autumn staging common cranes in an area surrounding a wetland reserve in Sweden. We assessed the following factors in relation to the probability of cranes being present on fields: crop stage, crop type, distance to roost site, time of day, field size and time since harvest. Stubble fields had the highest probability of crane presence, progressively decreasing through grassland and grazing grounds, bare soil to growing crop. A stubble field at 5 km from a roost site had a predicted probability (95% CI) of hosting cranes of 0.25 (0.19–0.32). The probability of cranes visiting a field was linearly and negatively related to distance to the roost site. For example, the probability of crane presence increased from 0.05 (0.03–0.07) to 0.09 (0.06–0.15) when distance decreased from 5 to 1 km. At stubble fields, the probability of crane presence decreased with time since harvest and was highest for barley with progressively lower probability on wheat and oat. Illustrative scenario predictions developed from the models demonstrated that probability of crane presence could be high, 0.60 (0.42–0.77), if all favorable factors were combined (e.g. barley stubble, 1 day after harvest, 1 km from roost site). Given the existing framework of international conventions and prohibition of culling, there is a need for preventative strategies to reduce crop damage. Based on our results, such strategies should focus on providing cereal stubbles as diversionary fields, especially close to wetland roosting sites. Stubble field availability can be achieved by careful crop rotation planning. We suggest that crop rotation and time of harvest should be added to flyway management plans recently developed for some large grazing bird species to facilitate stable co-existence between conservation practices and agricultural interests.

Cranes 2015

Zheng M, Zhou L, Zhao N, Xu W. 2015. Effects of variation in food resources on foraging habitat use by wintering Hooded Cranes (*Grus monacha*). *Avian Research* 6:11.

(Abstract)

Background: The ideal habitat use of waterbirds can be considered to be fixed, but current habitat use depends on environmental conditions, especially those of food characteristics, considered crucial to their use of habitats. Understanding how waterbirds respond to variation in food availability at degraded wetland sites and change their habitat use patterns over spatial and temporal scales should direct future conservation planning. The objectives of this study were to identify these spatial-temporal foraging habitats use patterns of Hooded Cranes (*Grus monacha*) and their relationship with food characteristics in the severely degraded wetlands of the Shengjin and Caizi lakes along with the Yangtze River floodplain. **Methods:** We investigated the changes in food characteristics, relative abundance and density of Hooded Cranes in various habitat types across three winter periods from November 2012 to April 2013. We examined the effect of these winter periods and habitat types on the pattern of use by the cranes and explored the relationship between these patterns and food characteristics using linear regression.

Results: The food characteristics and habitat use clearly changed over spatial-temporal scales. In the early and mid-winter periods, the most abundant, accessible and frequented food resources were found in paddy fields, while in the late period the more abundant food were available in meadows, which then replaced the paddy fields. There were fewer effects of winter periods, habitat types and their interactions on habitat use patterns except for the effect of habitat types on the relative abundance, determined as a function of food abundance, but independent of food depth and sediment permeability.

Conclusions: In response to the degradation and loss of lake wetlands, the cranes shifted their habitat use patterns by making tradeoffs between food abundance and accessibility over spatial-temporal scales that facilitated their survival in the mosaic of these lake wetlands.

Zhang, D., L. Zhou, and Y. Song. 2015. Effect of water level fluctuations on temporal-spatial patterns of foraging activities by the wintering Hooded Crane (*Grus monacha*). *Avian Research* 6:16.

Background: The Yangtze River floodplain provides important wintering habitats for Hooded Cranes (*Grus monacha*) in China. Fluctuations in the water level change foraging habitat and food availability, affecting their temporal-spatial patterns of foraging activities. It is of considerable importance to investigate the effect of these fluctuations on food availability for wintering Hooded Cranes and their foraging response to these changes. Understanding their behavior patterns is beneficial in protecting the wintering crane population and restoring their wintering habitats.

Methods: A field survey of the winter behavior of cranes was carried out at Shengjin Lake from November in 2013 to April in 2014. Habitat variables, as well as the spatial distribution

and behavior patterns of wintering cranes at their foraging sites during five stages of water level fluctuation were collected. Based on this data we analyzed the relationship of foraging behavior relative to water level fluctuations and habitat types.

Results: The foraging habitats used by Hooded Cranes varied at the different water level stages. As the water level decreased, the use of meadows and mudflats increased. When the water dropped to its lowest level, the use by the Hooded Crane in the mudflats reached a peak. There were statistically significant differences in time budget in the three types of habitats over the five stages of the water level. In the mudflats, the foraging behavior and maintenance behavior varied significantly with the water level, while the alert behavior showed little variation. Analysis of a generalized linear model showed that the five water level stages and three habitat types had a significant effect on foraging behavior, while the combined effect of these two variables was significant on the foraging time budget and the length of foraging activity of the Hooded Crane.

Conclusions: With the decrease in the water level, the use of mudflats by Hooded Cranes increased correspondingly. Food availability in different habitats was affected by changes in the water level. The Hooded Crane adjusted its foraging patterns and made full use of the three available types of habitat in order to acquire enough food in response to fluctuations in the water level.

Mudrik, E. A., T. A. Kashentseva, and D. V. Politov. 2015. Integration of Molecular Approaches in a Program for the Establishment of a Reserve Gene Pool of the Russian Endemic Siberian Crane (*Grus leucogeranus Pallas*). *Biology Bulletin Reviews* 5:548–554.

(Abstract)

The paper provides an overview of molecular genetic approaches to gene pool conservation, population genetic monitoring of captive breeding, and reintroduction of the Russian endemic and world rare species, the Siberian crane (*Grus leucogeranus Pallas*). The following issues are discussed: the taxonomic position of the Siberian crane in the *Gruidae* family (Aves); estimation of the levels of genetic diversity, differentiation, and relatedness in the captive population; individual genetic passportization and identification by microsatellite loci; DNA analysis of the paternity of birds obtained as a result of artificial insemination; problems of inbreeding and their prevention in captivity; genetic identification of interspecific hybrids; and molecular sex determination by specific DNA markers. Key directions for further research are suggested: broadening the scale of genetic monitoring in the captive population and analysis of genetic diversity of the Siberian crane in the wild.

Sugimoto, T., O. Hasegawa, N. Azuma, H. Masatomi, F. Sato, F. Matsumoto, Y. Masatomi, H. Izumi, and S. Abe. 2015. Genetic structure of the endangered Red-crowned Cranes in

Hokkaido, Japan and conservation implications. *Conservation Genetics* **16**:1395–1401.

(Abstract)

The Red-crowned Crane in Japan was once considered extinct due to hunting and habitat destruction in late nineteenth century; however, in 1926, a small group of cranes was rediscovered in the Kushiro Mire in eastern Hokkaido. Since then, various conservation efforts, including artificial feeding during winter, hunting prohibition, and habitat conservation, have increased the population size to >1400 by 2012. Despite such a successful population recovery, the genetic characteristics of the population have not been fully explored. To ensure the long-term persistence and evolutionary potential of cranes, accurate knowledge of the spatial distribution of genetic variation and its underlying causes are necessary. We assessed their genetic structure using 12 polymorphic microsatellite loci and inferred the mechanisms shaping the observed structure. Among the three regional groups in Hokkaido, we found generally low pairwise F_{ST} values and no significant differences in genetic diversity, probably because of the population expansion in the recent past. In contrast, spatial autocorrelation analysis revealed a significant positive kinship at the short distance (0–15 km) and negative kinship at the long distance (155–205 km), showing a pattern of isolation by distance. The presence of isolation by distance on a small spatial scale despite the species' strong flight ability is probably explained by the recolonization process and restricted dispersal due to natal philopatry in a non-equilibrium condition. Cranes in Hokkaido do not appear to be a panmictic (random mating) population; however they can be considered a single population without genetic discontinuity (i.e. a single management unit). Our findings confirm the importance of considering natal philopatry when developing management strategies such as dispersing cranes into unoccupied areas.

Dinets, V. 2015. Can interrupting parent–offspring cultural transmission be beneficial? The case of Whooping Crane reintroduction. *Condor* **117**:624–628.

(Abstract)

Inheriting behavioral patterns culturally (i.e. by learning from parents) rather than genetically is considered an integral part of individual development for many bird and mammal species. I discuss the possibility that in some cases, particularly when only heavily modified habitat remains available, such transmission might have a negative effect on the individual's adaptability and chances of survival. Instead, animals deprived of normal parental care may be better suited for survival in novel environments. I describe this possible scenario with captive-reared Whooping Cranes (*Grus americana*) released in southwestern Louisiana, primarily in the context of human-modified habitats used by this reintroduced population. Captive-rearing techniques based on this approach may be beneficial for other threatened species, particularly those that have little or no nonmodified habitat left and are amenable to alternative habitats if cultural transmission is interrupted.

Cao, M., H. Xu, Z. Le, M. Zhu, and Y. Cao. 2015. A Multi-Scale Approach to Investigating the Red-Crowned Crane–Habitat Relationship in the Yellow River Delta Nature Reserve, China: Implications for Conservation. *PLoS ONE* **10**:e0129833.

(Abstract)

The red-crowned crane (*Grus japonensis* (Statius Müller, 1776)) is a rare and endangered species that lives in wetlands. In this study, we used variance partitioning and hierarchical partitioning methods to explore the red-crowned crane–habitat relationship at multiple scales in the Yellow River Delta Nature Reserve (YRDNR). In addition, we used habitat modeling to identify the cranes' habitat distribution pattern and protection gaps in the YRDNR. The variance partitioning results showed that habitat variables accounted for a substantially larger total and pure variation in crane occupancy than the variation accounted for by spatial variables at the first level. Landscape factors had the largest total (45.13%) and independent effects (17.42%) at the second level. The hierarchical partitioning results showed that the percentage of seepweed tidal flats were the main limiting factor at the landscape scale. Vegetation coverage contributed the greatest independent explanatory power at the plot scale, and patch area was the predominant factor at the patch scale. Our habitat modeling results showed that crane suitable habitat covered more than 26% of the reserve area and that there remained a large protection gap with an area of 20,455 ha, which accounted for 69.51% of the total suitable habitat of cranes. Our study indicates that landscape and plot factors make a relatively large contribution to crane occupancy and that the focus of conservation effects should be directed toward landscape- and plot-level factors by enhancing the protection of seepweed tidal flats, tamarisk-seepweed tidal flats, reed marshes and other natural wetlands. We propose that efforts should be made to strengthen wetland restoration, adjust functional zoning maps, and improve the management of human disturbance in the YRDNR.

Leito, A., R. G. H. Bunce, M. Kulvik, I. Ojaste, J. Raet, M. Villoslada, M. Leivits, A. Kull, V. Kuusemets, T. Kull, M. J. Metzger, and K. Sepp. 2015. The potential impacts of changes in ecological networks, land use and climate on the Eurasian crane population in Estonia. *Landscape Ecology* **30**:887–904.

(Abstract)

The Eurasian crane (*Grus grus*) is an iconic and sensitive species. It is therefore necessary to understand its landscape ecology in order to determine threats.

Objectives

(1) To map the distribution of cranes and then model their habitat requirements in Estonia, linked to the current level of protection. (2) To determine the environmental characteristics of, and the habitats present in, sites utilized by the birds, and their sensitivity to change.

Methods

(1) The distribution of cranes was recorded by observation and by tracking individuals. A model of potential breeding sites was compared with the occurrence of the bird in Estonia and then linked to protected sites. (2) The seasonal distribution of the bird was overlaid with a European environmental classification and the CORINE land cover map. A model of climate change was also utilized.

Results

(1) A new map of European migration routes, wintering and stopover sites is presented. (2) The bird requires a habitat network, with wetlands being essential for nesting and roosting. The composition of habitats used for feeding varies according to geographical location. (3) In Estonia not all potential breeding sites are occupied and many existing sites are not protected. (4) Climate change could threaten populations in the south but could be beneficial in Estonia.

Conclusions

(1) The existing ecological network in Estonia is adequate to maintain a viable breeding population of the Eurasian crane. (2) Climate change could support the breeding of cranes but complicate their migration and wintering.

Cranes 2014

Jiang F, Qia S, Liao F, Ding M, Wang Y. 2014. Vulnerability of Siberian crane habitat to water level in Poyang Lake wetland, China. *GIScience & Remote Sensing* **51** (6):662-676.

(Abstract)

Assessment of habitat quality for wetland-obligate wildlife and endangered species of waterfowl is essential particularly in the changing environment. In this study, the areas of potential suitable habitat for Siberian cranes in Poyang Lake natural wetland were evaluated using 11 scenes of Landsat TM/ETM+ images. Habitat quality was assessed against six landscape indices. Results indicate that the optimum water level for habitats of Siberian cranes in Poyang Lake wetland would be about 12 m. Potential suitable habitat areas would be reduced from about 2300 km² at 5 m lake level to 530 km² at 15.6 m lake level. Landscape indices revealed that a higher water level would not be suitable for conservation of Siberian cranes. The proposed Poyang Lake Dam should be operated to control water levels for providing a favorable habitat condition for wintering migratory birds. It would create an unfavorable condition to the wintering habitats for Siberian cranes in Poyang Lake wetland if the dam would maintain the lake level higher than 12 m in autumn and winter.

Chandan, P., A. Khan, J. Takpa, S. A. Hussain, K. Mehdi, P. Singh Jamwal, R. Rattan, N.

Khatoon, T. Rigzin, A. Anand, P. K. Dutta, T. Ahmad, P. S. Ghose, P. Shrestha, and L. T. Theengh. 2014. Status and distribution of Black-necked Crane (*Grus nigricollis*) in India. *Zoological Research* **35**:39–50.

(Abstract)

In order to understand and monitor the status and distribution of the Black-necked Crane (*Grus nigricollis*) in India, we carried out systematic long term yearly surveys between 2000 and 2014 at all previously known locations as well as attempted to explore new areas. In this paper, we have summarized the distribution and status of the species in its historic range based on the literature and data collected during surveys in Jammu & Kashmir and at few locations in Northeast India. This paper presents a detailed account of the current status and distribution of the Black-necked Crane in India. The present study is first of its kind which monitored the Black-necked Crane population in India for a period of 15 years. During the entire study period, a maximum of 139 birds were recorded in breeding areas in Ladakh in 2012, and 11 wintering birds were recorded in northeast India in 2006.

Khan, A., P. Chandan, J. Takpa, S. A. Hussain, R. Rattan, P. Singh Jamwal, and T. Ahmad. 2014. Diurnal time budget of breeding Black-necked Crane (*Grus nigricollis*) in Changthang, Ladakh, India. *Zoological Research* **35**:158–166.

(Abstract)

The time budget studies are an appropriate tool in understanding patterns of habitat utilization, exploitation of resources, and factors that limit survival. All this once understood can be integrated in developing of management strategies. Diurnal time budget of the Black-necked Crane (*Grus nigricollis*) was studied in Ladakh during breeding seasons in 2008, 2009 and 2010. In order to understand the activity patterns during various stages of breeding cycle, the entire breeding period of a particular year was divided into three phases: pre-breeding, breeding and post breeding. Between 2008 and 2010, a total 95 days were spent in the field and Black-necked Cranes were observed for 785 hours. All observations were made during the day time only between dawn and dusk (6:00 to 19:00). During the observation period, 16,314 behavioural events were recorded. Feeding behaviour was most prevalent accounting for $48.5 \pm 1.3\%$ (mean \pm SE) of the crane's diurnal time budget. It was followed by resting ($14.2 \pm 1.2\%$), locomotion ($10 \pm 0.7\%$), breeding activities ($10 \pm 2.6\%$), maintenance ($5.7 \pm 0.5\%$), out of sight ($5.4 \pm 1.9\%$), and alert ($4.1 \pm 0.9\%$). Black-necked Cranes spent $1.5 \pm 0.3\%$ of its time in defense while at least $0.7 \pm 0.2\%$ in courtship activities. In the present paper percentage breakdown of overall diurnal activity of the Black-necked Crane have been provided. While studying the activity in various habitats, it was found that Black-necked Cranes spent maximum ($43 \pm 0.9\%$) time in marsh meadows as compared to other habitats.

Kong, D.-J., F.-S. Li, and X.-J. Yang. 2014. Using bird banding and recovery to study the migration of Black-necked Cranes (*Grus nigricollis*) in China. *Zoological Research* **35**:20–38.

(Abstract)

In this present study, by reorganizing and classifying the bird banding and recovery records from 1985 to 2012, we discussed the current research status of the migrations of Black-necked Cranes (*Grus nigricollis*) in China. The results showed that 94 Black-necked Cranes in total were banded and 13 among them were also attached with satellite transmitters. Whereas, only 66 counts were recovered, i.e., 27 or 28 birds (same color ring combinations were used on two individuals repeatedly, but were recovered at different places), indicating a recovery rate of 28.72% or 29.79%, while, most of the recovery (63 counts, 95.45%) happened in wintering sites. Data of banding showed that Black-necked Cranes hit their sexual maturity at the age ≥ 5 years, and the morphological indexes of the sub-adults are all smaller than those of the adults. After being banded, the average life span of banded individuals was 40 ± 40 months ($n=26$, 1-161 months). Moreover, the recovery records indicate three migration routes of Black-necked Cranes: (1) the eastern flyway: from the Greater Ruoergai wetland area (breeding ground) of Sichuan and Gansu Provinces to northeastern Yunnan and northwestern Guizhou Provinces; (2) the central flyway: from the Longbaotan Nature Reserve of Qinghai Province (breeding ground, several other breeding sites along this route are located in northwest Sichuan Province) to the Napahai Natural Reserve, Yunnan Province (wintering ground); (3) from the vast area of northwestern Qinghai, Xinjiang, and northern Tibet (breeding ground) to the Yarlung Zangbo valley, southcentral Tibet and Bhutan. Our findings provide useful information to the relevant conservation and research facilities and institutes upon the banding, recovery and protection of the Black-necked Cranes. We recommend carrying out bird banding at breeding sites, while intensifying banding recovery and observation at wintering sites. Moreover, to establish long-term and stable information platforms and facilitate communication, it is urgent and necessary to standardize the banding and morphology measuring systems.

Li, D., Y. Ding, Y. Yuan, H. Lloyd, and Z.-W. Zhang. 2014. Female tidal mudflat crabs represent a critical food resource for migratory Red-crowned Cranes in the Yellow River Delta, China. *Bird Conservation International* **24**:416-428.

(Abstract)

Staging sites are vital for large-sized migratory cranes, which require high-protein food sources during migration. In this study, we used field surveys and faecal analysis to determine the migration patterns and dietary composition of the globally threatened Red-crowned Crane *Grus japonensis* population that migrates and stages at the Yellow River Delta Nature Reserve (YRDNR), Eastern China. Analysis of 135 faecal samples collected during the migration season in 2008, 2010 and 2011 showed that 78.8% of the faeces comprised > 90%

dry mass of tidal mudflat crab *Helice tientsinensis* remains, suggesting that tidal mudflat crab was an important source of food for these Red-crowned Cranes. Smaller percentages of two other crab species (*Eriocheir sinensis*, *Macrophthalmus dilatatum*), fish remains, ragworms *Hediste diversicolor* and vegetation were also detected in the faecal samples. Consumption of tidal mudflat crabs was found to increase from autumn through to spring. Surveys of tidal mudflat crabs from YRDNR revealed that female crabs have significantly smaller body size (dry mass) but higher energy reserve ratio (ash-free dry mass per body mass) compared to males. Red-crowned Cranes fed predominantly on small and medium-sized female crabs, with a female to male ratio of 5:1 in the diet, compared with the 1:2 ratio of female to male crabs found within the coastal wetland crab population. Our findings suggest that tidal mudflat crabs represent a critical food source for the migratory Red-crowned Crane population in YRDNR, and future crane conservation strategies should encompass the necessary measures to conserve the tidal mudflat crab population at this staging site.

Shao M, Jiang J. 2014. Population sizes and group characteristics of Siberian Crane *Leucogeranus leucogeranus* and Hooded Crane *Grus monacha* in Poyang Lake Wetland. *Zoological Research* **35**, 1–7.

(Abstract)

Both the Siberian Crane *Leucogeranus leucogeranus* and Hooded Crane *Grus monacha* are considered endangered by domestic Chinese and international agencies, with limited populations. To document the 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 they 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 fifty percent of the total number of groups among both species, with Hooded Cranes forming more family groups than the Siberian Crane. 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.

Jiao S, Guo Y, Huettmann F, Lei G. 2014. Nest-Site Selection Analysis of Hooded Crane (*Grus monacha*) in Northeastern China Based on a Multivariate Ensemble Model. *Zoological Science* **31**, 430-437.

(Abstract)

Avian nest-site selection is an important research and management subject. The hooded crane (*Grus monacha*) is a vulnerable (VU) species according to the IUCN Red List. Here, we present the first long-term Chinese legacy nest data for this species (1993–2010) with publicly available metadata. Further, we provide the first study that reports findings on multivariate nest habitat preference using such long-term field data for this species. Our work was carried out in Northeastern China, where we found and measured 24 nests and 81 randomly selected control plots and their environmental parameters in a vast landscape. We used machine learning (stochastic boosted regression trees) to quantify nest selection. Our analysis further included varclust (R Hmisc) and (TreenNet) to address statistical correlations and two-way interactions. We found that from an initial list of 14 measured field variables, water area (+), water depth (+) and shrub coverage (–) were the main explanatory variables that contributed to hooded crane nest-site selection. Agricultural sites played a smaller role in the selection of these nests. Our results are important for the conservation management of cranes all over East Asia and constitute a defensible and quantitative basis for predictive models.

Prakash S, Narain S, Kumar S. 2014. Conservation of the threatened Sarus Crane *Grus antigone* (Linnaeus, 1758) around Alwara Lake in Kaushambi District, Uttar Pradesh, India. *Journal of Threatened Taxa* **6**, 5726–5730.

(Abstract)

The present study deals with the distribution and conservation of the globally threatened Sarus Crane *Grus antigone* in Alwara Lake of district Kaushambi, Uttar Pradesh, India. It proved to be an important site since the lake under investigation was totally unexplored from the conservation point of view. Hence it was aimed at protecting the habitat of this threatened bird species by suggesting conservation measures through rural masses and policy makers. Birds were recorded in all the three transects of the lake surveyed by the authors, however, their relative abundance varied in each transect. A total of 487 cranes was actually observed, although more cranes were claimed to exist in this area by the local people. Cropland habitat harboured the maximum number of cranes. A positive correlation was observed between the crane numbers and the area of agricultural land. The authors recommend continuous population census of this species and declaration of the entire lake zone as a conservation area.

Belaire JA, Kreakie BJ, Keitt T, Minor E. 2014. Predicting and Mapping Potential Whooping Crane Stopover Habitat to Guide Site Selection for Wind Energy Projects. *Conservation Biology* **28**, 541–550.

(Abstract)

Migratory stopover habitats are often not part of planning for conservation or new development projects. We identified potential stopover habitats within an avian migratory flyway and demonstrated how this information can guide the site-selection process for new development. We used the random forests modeling approach to map the distribution of predicted stopover habitat for the Whooping Crane (*Grus americana*), an endangered species whose migratory flyway overlaps with an area where wind energy development is expected to become increasingly important. We then used this information to identify areas for potential wind power development in a U.S. state within the flyway (Nebraska) that minimize conflicts between Whooping Crane stopover habitat and the development of clean, renewable energy sources. Up to 54% of our study area was predicted to be unsuitable as Whooping Crane stopover habitat and could be considered relatively low risk for conflicts between Whooping Cranes and wind energy development.

We suggest that this type of analysis be incorporated into the habitat conservation planning process in areas where incidental take permits are being considered for Whooping Cranes or other species of concern. Field surveys should always be conducted prior to construction to verify model predictions and understand baseline conditions.

Cai T, Huettmann F, Guo Y. 2014. Using Stochastic Gradient Boosting to Infer Stopover Habitat Selection and Distribution of Hooded Cranes *Grus monacha* during Spring Migration in Lindian, Northeast China. *PLoS ONE* **9**, e89913.

(Abstract)

The Hooded Crane (*Grus monacha*) is a globally vulnerable species, and habitat loss is the primary cause of its decline. To date, little is known regarding the specific habitat needs, and stopover habitat selection in particular, of the Hooded Crane. In this study we used stochastic gradient boosting (TreeNet) to develop three specific habitat selection models for roosting, daytime resting, and feeding site selection. In addition, we used a geographic information system (GIS) combined with TreeNet to develop a species distribution model. We also generated a digital map of the relative occurrence index (ROI) of this species at daytime resting sites in the study area. Our study indicated that the water depth, distance to village, coverage of deciduous leaves, open water area, and density of plants were the major predictors of roosting site selection. For daytime resting site selection, the distance to wetland, distance to farmland, and distance to road were the primary predictors. For feeding site selection, the distance to road, quantity of food, plant coverage, distance to village, plant density, distance to wetland, and distance to river were contributing factors, and the distance to road and quantity of food were the most important predictors. The predictive map showed that there were two consistent multi-year daytime resting sites in our study area. Our field work

in 2013 using systematic ground-truthing confirmed that this prediction was accurate. Based on this study, we suggest that Lindian plays an important role for migratory birds and that cultivation practices should be adjusted locally. Furthermore, public education programs to promote the concept of the harmonious coexistence of humans and cranes can help successfully protect this species in the long term and eventually lead to its delisting by the IUCN.

Cranes 2013 and earlier

2013

Germogenov, N. I., N. G. Solomonov, A. E. Pshennikov, A. G. Degtyarev, S. M. Sleptsov, N. N. Egorov, I. P. Byskatova, M. V. Vladimirtseva, and V. V. Okoneshnikov. 2013. The Ecology of the Habitats, Nesting, and Migration of the Eastern Population of the Siberian Crane (*Grus leucogeranus* Pallas, 1773). *Contemporary Problems of Ecology* 6:65–76.

(Abstract)

The structure of the distribution range and population of the Siberian crane in its regular breeding area in the northeastern Yakutian tundra are described, as well as the migration terms, intensity, routes, and stopover sites. The territorial pairs (71.7–97.1% of the summer population), which in 2006 were represented by the birds at ages of 8 to 21 years (mainly 20 years, accounting for 45.4%), constantly stayed on an area of 7.3–16.5 km² independently of their participation in breeding. The breeding success in this population varies from 4.3–8.7 to 65.0–83.3% and depends on the climatic conditions at the beginning of egg laying; these climatic conditions change rather unpredictably from year to year, as well as being seasonally unstable. This explains the fact that some generations in this population are particularly vulnerable to natural elimination factors because of their low numbers. Bird migration in Yakutia follows a narrow tunnel with the highest migratory intensity in the Middle Aldan Valley. In the fall, 30 to 50% of the entire population is visually recorded there.

Jia, Y., S. Jiao, Y. Zhang, Y. Zhou, G. Lei, and G. Liu. 2013. Diet Shift and Its Impact on Foraging Behavior of Siberian Crane (*Grus leucogeranus*) in Poyang Lake. *PLoS ONE* 8:e65843.

(Abstract)

The study of habitat selection and diet has a long history in ecology. This is often used to assess the functional roles of wetland in biodiversity conservation. Shifting habitat and diet

may be one of the survival strategies during extremely adverse conditions. Therefore, sudden changes in habitat selection may indicate the deterioration of the habitat quality, and management interventions are necessary. Siberian crane (*Grus leucogeranus*) became critically endangered due to loss of habitat, and is currently a global conservation focus. Every winter, more than 95% of the species' global population congregates at Poyang Lake, and feeds on tubers of *Vallisneria spiralis* in shallow water and mudflat habitat. In this study, we reported the first sighting of large numbers of Siberian cranes foraging at wet meadows, where they fed on a different plant, *Potentilla limprichtii* due to extreme scarcity of their preferred tuber. To understand how well the cranes adapted to such unusual habitat, field surveys to assess the distribution of cranes across different habitats, and food availability in each habitat were carried out in the winter of 2011. Field observations on crane behaviors at different habitats were also conducted. Results show that cranes displayed significantly different behavior patterns when using the wet meadow, compared to the crane's optimal habitat – shallow water and mudflat. Both juveniles and adults spent significantly less time foraging, and more time alerting in meadows than in shallow waters and mudflats. These results indicated that the meadow might be a suboptimal wintering ground for Siberian crane, which helped the cranes survive from extreme unfavorable conditions. To some degree, this finding alleviates the general concern over the fluctuating of its food resources which was caused by hydrological disturbances. However, more studies are needed to assess the consequences of such diet and habitat shift for crane survival.

Bragina E, Beme IR. 2013. Sexual and individual features in the long-range and short-range calls of the White-naped Crane. *The Condor* **115**, 501-507.

(Abstract)

Sex-related and individually unique vocal features have been demonstrated for many avian and mammalian species. Vocal identity may depend on a call's function and vary within the repertoire of a single species. Vocal features of different call types are very rarely compared in one species. We studied the potential for vocal recognition of sex and individual identity in four types of calls of the White-naped Crane (*Grus vipio*). We analyzed growls and contact calls (short-range communication) and flight-intention and guard calls (long-range communication). Sexual features were strongly expressed in flight-intention and guard calls; furthermore, the guard call allows reliable sexing of a bird. The sexual distinctiveness of short-range calls was less pronounced. We failed to find significant individual features in any call type. The potential for determining sex from vocalizations may be useful for the monitoring of this endangered species.

Liu C-y, Jiang H-X, Zhang S-q, Li C-r, Hou Y-Q, Qian F-W. 2013. Multi-scale analysis to

uncover habitat use of red-crowned cranes: Implications for conservation. *Current Zoology* **59**, 604-617.

(Abstract)

A multi-scale approach is essential to assess the factors that limit avian habitat use. Numerous studies have examined habitat use by the red-crowned crane, but integrated multi-scale habitat use information is lacking. We evaluated the effects of several habitat variables quantified across many spatial scales on crane use and abundance in two periods (2000 and 2009) at Yancheng National Nature Reserve, China. The natural wetlands decreased in area by 30,601 ha (-6.9%) from 2000 to 2009, predominantly as a result of conversion to aquaculture ponds and farmland, and the remaining was under degradation due to expansion of the exotic smooth cordgrass. The cranes are focusing in on either larger patches or those that are in close proximity to each other in both years, but occupied patches had smaller size, less proximity and more regular boundaries in 2009. At landscape scales, the area percentage of common seepweed, reed ponds and paddy fields had a greater positive impact on crane presence than the area percentage of aquaculture ponds. The cranes were more abundant in patches that had a greater percent area of common seepweed and reed ponds, while the percent area of paddy fields was inversely related to crane abundance in 2009 due to changing agricultural practices. In 2009, cranes tended to use less fragmented plots in natural wetlands and more fragmented plots in anthropogenic paddy fields, which were largely associated with the huge loss and degradation of natural habitats between the two years. Management should focus on restoration of large patches of natural wetlands, and formation of a relatively stable area of large paddy field and reed pond to mitigate the loss of natural wetlands.

Dinets V. 2013. Crane dances as play behaviour. *Ibis* **155**, 424–425.

(No abstract available)

2012

Luo, J., Y. Wang, F. Yang, and Z. Liu. 2012. Effects of human disturbance on the Hooded Crane (*Grus monacha*) at stopover sites in northeastern China. *Chinese Birds* **3**:206–216.

(Abstract)

There is a lack of information of whether the behavior pattern and physical condition of the Hooded Crane (*Grus monacha*) have been limited by conditions encountered at stopover sites in Changgou village, which is adjacent to Zhalong Nature Reserve in northeastern China, one of the most important stopover sites of this crane. The objective of our research was to investigate the impact of human-caused disturbances on the Hooded Cranes. We investigated three behavior activities of the Hooded Cranes, i.e., flying time, flushing distance and the

duration of vigilance. The results indicate that the auditory stimuli caused by local people provoked the most pronounced disturbances to the Hooded Crane. Human-caused disturbances not only frequently interrupt the feeding process of the cranes, but also lead to an increase of 200% in the duration of their vigilance and a significant increase in flying time from 0.4 to 0.7 h ($p < 0.05$). In addition, high-intensity noise can cause larger flushing distances; foraging cranes will flush away by about 600 m when disturbed by the honking of vehicles. Whistles or shouts by local farmers in the field generated the largest sound intensity, about 120 dB, which caused a flushing distance of over 700 m. In order to reduce the negative effect of human-caused disturbances on these cranes, it is imperative to define a buffer zone around sensitive areas during the fall stopover period. To solve the conflict between the interest of farmers and the demand for crops on the part of the cranes requires financial compensation to the farmers for the crops consumed by the Hooded Crane in order to enhance the conservation of this vulnerable bird species. [accordion-item][accordion] Su, L., and H. Zou. 2012. Status, threats and conservation needs for the continental population of the Red-crowned Crane. *Chinese Birds* 3:147–164.

Vladimirtseva, M. 2012. Ecological features of Tundra Cranes in North-Eastern Siberia (Aves, Gruidae). *Biodiversity Journal* 3:49-54.

(Abstract)

In sub-arctic tundra of North-Eastern Siberia (Yakutia region) the breeding areas of Siberian Crane, *Grus leucogeranus* (Pallas, 1773) and Lesser Sandhill Crane, *Grus canadensis canadensis* (Linnaeus, 1758), overlap. In the present paper ecological interrelations between these two crane species are reported. Siberian Crane is the dominant species and occupies more productive ecological niche such as damp lowlands. Sandhill Cranes have to content themselves with less productive but more extensive habitats such as drier and higher levels of tundra. Generally speaking, Sandhill Cranes prefer to feed in damp lowlands, as can be observed in areas where Siberian Cranes are absent. Such a displacement toward another ecological niche has not a significant impact on Sandhill Crane thanks to the plasticity and tolerance of this species.

Li, F., J. Wu, D. J. Harris, and J. Burnham. 2012. Number and distribution of cranes wintering at Poyang Lake, China during 2011–2012. *Chinese Birds* 3:180–190.

(Abstract)

Poyang Lake is a very important wintering place for cranes in China and East Asia. Two crane surveys were conducted at Poyang Lake during the 2011/2012 winter, the first on 18–19

December 2011 and the second on 18–19 February 2012. The survey covered the entire Poyang Lake basin, as well as two main lakes in Jiujiang (Saicheng Hu and Chi Hu), i.e., a total of 85 sub-lakes were surveyed. Both surveys recorded four species of cranes. The first survey on 18–19 December 2011 recorded 4577 Siberian Cranes (*Grus leucogeranus*), mostly in Bang Hu, Sha Hu and Dahu Chi, 302 Hooded Cranes (*G. monacha*), 885 White-naped Cranes (*G. vipio*) and 8408 Eurasian Cranes (*G. grus*), for the most part in the center of the lake basin. The second survey on 18–19 February 2012 recorded 3335 Siberian Cranes (mostly in Poyang Lake National Nature Reserve (PLNR) and its surrounding areas), 110 Hooded Cranes (largely in PLNR and its surrounding areas), 283 White-naped Cranes (86% in Bang Hu) and 2205 Eurasian Cranes (particularly in Duchang and Nanjishan NNR). The number of Siberian Cranes enumerated in December was 1000 more than the second count in February 2012. It is not possible to rule out double counting due to the close proximity of the main sites of the Siberian Cranes. During winters from 1998 to 2009, the average of the highest counts each winter was 3091, ranging from 2345 in 1996 to 4004 in 2002. By comparison with counts taken at other times, we therefore estimate a wintering population of Siberian Cranes of ~3800–4000 at Poyang Lake. Additional evidence will be needed to raise the world population estimate. Our more recent surveys indicate a continuing decline in the number of White-naped Cranes and an increase in Eurasian Cranes.

Liu Q, Li F-S, Buzzard P, Qian F-W, Zhang F, Zhao J-L, Yang J-X, Yang X-J. 2012. Migration routes and new breeding areas of black-necked cranes. *The Wilson Journal of Ornithology* **124**, 704–712.

(Abstract)

We equipped five Black-necked Cranes (*Grus nigricollis*) with satellite transmitters between February and November 2009 to investigate their migration routes between breeding areas and wintering area at Napahai Marsh (3,260 m asl), China. We identified the Shaluli Mountain region (southwest Sichuan), including Daocheng, Litang, Baiyu, and Xinlong counties as a new breeding area with a mean elevation of 4,330 m asl. Four of five tracked cranes spent the summer in Daocheng County. The fifth crane was there briefly and then moved north to Baiyu and Xinlong counties. The distance between Napahai Marsh and Daocheng County (,180 km) is one of the shortest migration routes among crane species, but covered an elevation increase of ,1,200 m. The migration route of the fifth crane was ,400 km in length and occurred over 2 or 5 days in spring 2009 and 2010, respectively, and 19 days in fall 2009 with five stopovers.

2010

Harris, J., S. Liying, H. Higuchi, M. Ueta, Z. Zhang, Y. Zhang, and X. Ni. 2000. Migratory stopover and wintering locations in eastern China used by White-naped Cranes *Grus vipio* and Hooded Cranes *G. monacha* as determined by satellite tracking. *Forktail* **16**:93-99.

(Abstract)

Conservation efforts for the threatened White-naped *Grus vipio* and Hooded Cranes *G. monacha* have focused on breeding and wintering areas, in part because of a lack of information on migratory habitats. From 1991–1993, satellite tracking was used to determine stopover locations for these species. This paper reports on migratory sites in eastern China and also on the Russian side of Lake Khanka, near the international border with China. In addition, satellite tracking documented local crane movements in winter at Poyang Lake. Ground surveys provided valuable supplementation of satellite data. We discuss the conservation implications of our study, particularly the need to expand protected areas for both migratory and wintering habitats.

2009

Ma, Z., B. Li, W. Li, N. Han, J. Chen, and A. R. Watkinson. 2009. Conflicts between biodiversity conservation and development in a biosphere reserve. *Journal of Applied Ecology* **46**:527–535.

(Abstract)

1. Integrating biodiversity conservation and the development of local communities is a major challenge for biosphere reserves. Their zonation (core, buffer and transition) is intended to promote biodiversity conservation and sustainable development, although only the core zone is legally constituted to conserve biological diversity. Inevitably, and especially in developing countries, the management of biosphere reserves has to reconcile trade-offs between conservation and development, and address the pressures placed by local communities on the biodiversity resources of the reserve.

2. We studied the effects of development in the three zones of Yancheng Biosphere Reserve (eastern China) on the endangered Red-crowned Crane *Grus japonensis*, the waterbird communities and the economic benefits to local communities. We tested the hypothesis that allowing different developments within each zone can reduce conflict between biodiversity conservation and community development.

3. The number of cranes in the reserve increased from 361 to approximately 1100 between 1982 and 1999, but declined markedly to 612 in 2003. The cranes also became increasingly concentrated in the core zone and switched to feeding predominantly in artificial habitats. The proportion of cranes in the core, buffer and transition zones was largely associated with the proportion of developed land area and the total number of cranes in the reserve as a whole.

4. Developments in the transition zone have reduced and degraded the wetlands, and have disadvantaged cranes and waterbirds. In contrast, the transformation of natural wetlands into artificial ones in the core zone has, to date, continued to support cranes and waterbirds. This has brought economic benefits to the reserve and local communities, but at the cost of the integrity of the wetland ecosystem as a whole.

5. Synthesis and applications. Despite an increase in the number of Red-crowned Cranes in Yancheng Biosphere Reserve, their range has collapsed into the core of the reserve where there is now a substantial artificial wetland complex. Allowing development in all three zones, together with a lack of resources for conservation, appears to have contributed to the reserve becoming overdeveloped. The loss of ecosystem integrity across the reserve as a whole highlights the need for an ecosystem-based approach to future management combined with the restoration of natural wetlands.

2000

Kanai, Y., J. Minton, M. Nagendran, M. Ueta, B. Auysana, O. Goroshko, A. F. Kovshar, N. Mita, R. N. Suwal, K. Uzawa, V. Krever, and H. Higuchi. 2000. Migration of demoiselle cranes in Asia based on satellite tracking and fieldwork. *Global Environment Research* 4:143-153.

(Abstract)

Demoiselle Cranes (*Anthropoides virgo*) winter in the Indian subcontinent after flying over the Himalayas during their fall migration. In the fall of 1995, we satellite-tracked the migration of Demoiselle Cranes from three summering areas: Daursky Nature Reserve (50.15 oN, 115.30 oE), in eastern Siberia, Russia, Har Us Lake (48.11 oN, 91.87 oE), western Mongolia, and Kopa (43.50 oN, 75.77 oE), eastern Kazakhstan. Field observations of crane migration over the Himalayas were also made in Jomson, Nepal, from October 1 to 13, 1995, when the migration appeared to be at its peak. Of the 21 cranes fitted with PTTs (platform transmitter terminals), 4 individuals were completely tracked to their wintering grounds. One of the two cranes from Kopa, Kazakhstan, migrated down to western India via the west side of the Hindu Kush Mountains and Pakistan. Three out of nine cranes migrated from Har Us Lake, Mongolia, to western India via the Tarim Basin, Qing-Zang Heights and the Himalaya Mountains. The crane tracked from Kazakhstan departed Kopa on 25 August and travelled 2000 km to India in seven days without substantial rests. The 3 cranes tracked from Mongolia began migration on 14 to 22 September about one month later than the Kazakhstan crane, and rested at Barkol Lake in Mongolia, before proceeding on migration. From there they completed their migration to India in seven days, from 29 September to 2 October, without substantial rest. The distance between Barkol Lake and India along the routes followed by the cranes was 2200 km to 2800 km. The peak of crane numbers observed flying over the Himalayas was between October 6 and 10. The satellite-tracked individuals also went across the Himalayas during this period. The results of the present study suggest that there are two migration routes for Demoiselle Cranes in central Asia: one flying directly over the Himalayas, and the other detouring around the Hindu Kush Mountains. A characteristic of Demoiselle Crane migration

is that they travel long distances within a short period of time. GED (Global Ecosystem Database) shows that most of the migration routes have little vegetation. It is considered that the margins of deserts and high altitude wetland stopover sites are very important for Demoiselle Cranes and other wetland birds that migrate long distances through rugged terrain.

1998

Higuchi, H., Y. V. Shibaev, J. Minton, K. Ozaki, S. Surmach, G. Fujita, K. Momose, Y. Momose, M. Ueta, V. Andronov, N. Mita, and Y. Kanai. 1998. Satellite tracking of the migration of the Red-crowned Crane *Grus japonensis*. *Ecological Research* **13**:273-282.

(Abstract)

Autumn migration routes of Red-crowned Cranes, *Grus japonensis*, from two continental east Asian sites were documented in detail by satellite tracking. Two routes were identified: a 2200 km western route from Lake Khanka (Russia) to the Korean Peninsula and the Demilitarized Zone. The most important rest-sites were identified as Panjin Marsh (China), coastal mudflats south-east of Tangshan City (China), the Yellow River Mouth (China), Tumen River mouth (North Korea/China/Russia), Kumya (North Korea) and Cholwon (Korean DMZ). Movements within the wintering range were also recorded, including complex commuting between sites by individual cranes and patterns of daily movements within sites. These data should prove useful for conservation of the flyway.