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ABSTRACTS

Following are abstracts of oral and poster presentations given at North American Crane Workshop 11 but which were not published in these Proceedings.

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CAUSES OF EMBRYONIC DEATH IN CAPTIVE WHOOPING CRANES

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Abstract: In 2001, the International Whooping Crane Recovery Team and the Whooping Crane Health Advisory Team re-emphasized the need for analysis of embryonic deaths within captive breeding flocks to identify preventable deaths and promote increased production of chicks for release programs. We conducted a retrospective study of egg necropsy reports to identify causes of death among developing whooping crane (*Grus americana*) embryos from captivity. Records from 44 egg necropsies conducted at the International Crane Foundation (ICF) between 2001 and 2008 were reviewed. The eggs were of captive origin (ICF, $n = 40$; Patuxent Wildlife Research Center, $n = 3$; Calgary Zoo, $n = 1$). All necropsies included gross examinations; few were amenable to histopathological analysis due to advanced autolysis. The primary causes of death included embryo malposition ($n = 7$, 16%), hemorrhage/trauma ($n = 7$, 16%), natural incubation failure ($n = 5$, 11%), artificial incubation failure ($n = 4$, 9%), and miscellaneous ($n = 2$, 5%). Many of the necropsies did not reveal a specific cause of death ($n = 19$; 43%). Most of the embryos ($n = 24$, 54%) died in the last third of incubation. The most common cause of death in late stage embryos was malpositioning (29% of late stage embryonic deaths). Unfortunately, our study did not reveal many preventable conditions that would boost hatchability if corrected. The underlying causes of malpositioning are difficult to discern, as turning rates, position and nest environment may vary between the different species and individual cranes used to incubate whooping crane eggs at ICF. The occurrence of hemorrhage or traumatic membrane rupture is likely caused by mechanical stress to the eggs despite the great care of handlers to avoid injury. On a positive note, infectious disease does not appear to be a risk factor for embryonic mortality in captive whooping cranes at ICF.

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Key words: cranes, embryo, Gruidae, *Grus americana*, malposition, mortality.

A RETROSPECTIVE SEROLOGICAL SURVEY FOR INFECTIOUS BURSAL DISEASE VIRUS IN FREE-RANGING SANDHILL CRANES IN SOUTH-CENTRAL WISCONSIN

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Abstract: A retrospective serosurvey of resident sandhill cranes (*Grus candensis pratensis*) in Florida suggested Infectious Bursal Disease Virus (IBDV, family Birnaviridae) may have been enzootic there as early as 1992, with 13-63% seroprevalence among age classes and wide geographic distribution of seropositive cranes. The purpose of our study was to describe the prevalence of antibodies to IBDV serotype 2 in a local population of greater sandhill cranes (*G. c. tabida*) near Briggsville, Wisconsin, that overlapped with resident Florida birds in winter during the same time period. Blood samples were collected June through October between 1996 and 1999 as part of a long-term ecological research project. Samples were from hatch-year (minimally 6 weeks of age, $n = 47$) and adult cranes ($n = 42$). All birds were captured on breeding territories, were banded with colored leg markers, and were observed periodically post-release. Archived serum samples were tested at the Poultry Diagnostic and Research Center, University of Georgia, Athens, Georgia, in July 2007. Serum neutralization titers ≥32 were considered positive for IBDV exposure. Zero of 47 hatch-year cranes were seropositive for IBDV (geometric mean = 2, titer range 2-2), while 1 of 42 adult cranes was seropositive (geometric mean = 4.9, titer range 2-64). This adult female, sampled in September 1999, had 4 2-3 mm oropharyngeal granulomatous lesions and a normal body weight on examination. Though the oral pathology observed in this crane is similar to previously described lesions associated with an IBDV-associated wasting syndrome in whooping cranes (*Grus americana*), similar presentations are associated with other diseases. Her mate and chick were also captured; both were seronegative. The female was recaptured in September 2000 with a new mate, and both cranes were seronegative. She was last observed alive in late October that year. These results show that greater sandhill cranes in south-central Wisconsin were exposed to IBDV serotype 2 as early as 1999, but exhibited much lower seroprevalence compared to resident Florida sandhill cranes during approximately the same time period. The source of this viral exposure remains unknown.

ACKNOWLEDGMENTS

We thank N. Businga and J. Langenberg for collection of serum samples and ICF field ecology staff for field capture of cranes in the Briggsville area. This study was supported by a grant from the Companion Animal Fund, School of Veterinary Medicine, University of Wisconsin.

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Key words: Birnaviridae, cranes, disease, Gruidae, *Grus canadensis*, infectious bursal disease virus, serological survey.

DEMOISELLE CRANES ON AGRICULTURAL LANDS IN THE UKRAINE

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Abstract: In Eurasia, the western range of the demoiselle crane (*Anthropoides virgo*) includes the southeast of Ukraine. Here the species nests, forms flying and pre-migrating concentrations, and participates in migration. The number of demoiselle cranes in April-June is about 600-700 individuals (200-250 nesting pairs), and toward the end of the year the population can reach 900-1000 individuals.

Of cranes observed during 2000-2008 in the Crimea, 42.3% of pairs (n = 151) nested on agricultural fields: 21.5% on virgin land, 16.1% on cropland, and 3.4% on fallow lands. Principal characteristics of the demoiselle crane nesting locations were wavy relief, scarce herbage, low background herbage, and proximity and accessibility of water (usually 3-5 km distant or farther), absence of danger, or minimal likelihood of disturbance. The height of herbage around the observed nests averaged 1.35 cm (range 0-75 cm, n = 95), and the density of soil cover by herbage averaged 37.2% (range 0-90%, n = 97). The species of grassy vegetation was not important to the cranes for nest placement. In agricultural fields, as in the natural steppe biotopes, the determining factor for them is the presence of herbage, its height and its density; most frequently from complete lack of it to low and rarefied.

The capture of insects by the demoiselle crane during the nesting period showed that the food base in the agricultural fields is no worse than on the steppe. The major threats are the expansion of agricultural areas that are not suitable for nesting (i.e., water saturated earth, perennial grasses, and crops in need of frequent cultivation); disturbance of birds by humans during mass hay harvesting, picnics, disorganized tourism (a disturbance to the daily rhythm of the birds, which disrupts social interaction between them and leads to the loss of abandoned eggs and nestlings); destruction of eggs and death of chicks from the onslaught of agricultural technology during cultivation of the fields; the collection of eggs and chicks for trade and for exchange between bird collectors; and an increase in the number of predators, especially domestic (stray dogs) and synanthropic Corvidae.

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Key words: *Anthropoides virgo*, demoiselle crane, population distribution, threats, Ukraine.

PRELIMINARY WINTERING COUNTS AND NEW LOCATIONS OF SANDHILL CRANES IN MEXICO

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Abstract: Sandhill cranes (*Grus canadensis*) undertake a migration twice a year, when more than 400,000 cranes cross the United States from the Arctic of North America and Eastern Siberia to the southwest U.S. and north central Mexico. Although the sandhill crane has been studied intensely, few studies have been done on their Mexican wintering grounds. Little is known about what proportion of the sandhill crane population migrates to Mexico, and there is even less information regarding its dispersion. During winter 2007-2008 we surveyed 30 wetlands in the Chihuahuan Desert ecoregion in northern Mexico, recording presence/absence and number of sandhill cranes. Cranes were present in 53% of the visited sites. In these wetlands we conducted counts at sunset and sunrise up to a total of 67 counts. Crane counts varied between sites with a maximum of 9,000 individuals in northern wetlands and a minimum of 3 individuals in southern wetlands. The majority of wetlands were visited once (73%) while the rest of sites were visited up to 8 times (27%). Cranes were always present in sites visited more than once during the wintering period (December-January). Noteworthy observations of movement and activity patterns were also recorded during the winter. Our data, although preliminary, provide new information regarding wintering locations and dispersion in 6 Mexican estates. Our data also provides the first counts for sandhill cranes in Mexico confirming that the population that migrates to northern Mexico is a large one, revealing new information regarding the ecological needs of the species

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Key words: distribution, *Grus canadensis*, Mexico, sandhill crane, winter.

THE RESPONSE OF NESTING MISSISSIPPI SANDHILL CRANES TO GROWING SEASON PRESCRIBED FIRES

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Abstract: Prescribed burning is the most natural and cost effective method of restoring and maintaining the coastal longleaf pine (*Pinus palustris*) savannah ecosystem that provides feeding and nesting areas for the critically endangered Mississippi sandhill crane (MSC, *Grus canadensis pulla*). Though growing season burns have shown the greatest results in controlling encroaching shrubs and pines as compared to dormant season burns, burning in the spring and early summer has the potential to disrupt the nesting activities of the MSC population. In order to address both the short and long term needs of this crane population, we make every effort to burn during the growing season on the MSC National Wildlife Refuge while taking precautions to protect our nesting cranes. We evaluate factors such as distance to nest, noise disturbance, smoke, age of nest, and usual disturbance of nesting pair before striking the match. In the past few years we have learned lessons on the tolerance levels of the nesting MSCs and the possibilities for habitat management when biologists and fire managers work together for a common result.

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Key words: *Grus canadensis pulla*, Mississippi sandhill crane, prescribed burning, response.

RURAL INHABITANT PERCEPTIONS OF SANDHILL CRANES IN NORTHERN MEXICO WINTERING AREAS

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Abstract: While a large proportion of the sandhill crane (*Grus canadensis*) population winters in northern Mexico, little information is available regarding conservation status of wetlands and human dimension issues. We conducted preliminary interviews of rural inhabitants living near wetlands used by cranes in 3 Mexican estates. One hundred percent of interviewees affirmed to know cranes, see them regularly (100%), and were capable of describing cranes. Winter is the time most have seen cranes (78%) with fall being second (20%). Most cranes were observed in lakes (56%), agriculture fields (35%), and cattle troughs (2%). Most responded to have seen 0-100 cranes (41%), while larger numbers were reported by smaller percentages. Most interviewees believed cranes eat corn (66%), oats (21%), sorghum (5%), and others items including wheat, insects, and cow droppings (2% each). Foraging was observed in agriculture fields (83%) with less in lakes (15%). Most did not know where cranes came from (71%), while smaller percentages said Canada (24%) and the United States (2%). A majority (58%) said they were not affected by the arrival of cranes, but 43% said they were. The negative effects were described as destroyed crops (31%), eating corn (23%), and diminished production. Those affected said they could implement scare tactics (70%), while others suggested harvesting on time (5%), checking crops regularly (5%), and hunting as possible solutions. Most (90%) said they did not hunt the cranes, 5% mentioned they used to and 3% said they still hunt them. These results offer a glimpse of the attitudes of rural inhabitants in northern Mexico towards cranes.

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Key words: attitudes, *Grus canadensis*, Mexico, rural, sandhill crane.

MAMMALIAN NEST PREDATION IN MISSISSIPPI SANDHILL CRANES

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Abstract: Low recruitment is the largest challenge facing the recovery of the critically endangered Mississippi sandhill crane (MSC, *Grus canadensis pulla*). Lack of information on nest predation and the impacts of specific nest predator species hinder effective management to lower nest predation rates. I have completed my first year of a 2-year research project on mammalian predation at the MSC National Wildlife Refuge in Gautier, Mississippi. I aim to identify common nest predators, determine if nest predation rates are higher in certain nesting habitats than others, and if different mammalian predators are more common in certain nesting habitats than others. I also aim to establish if there is a correlation between the most abundant predators in scent surveys and the most common nest predators. Scent station surveys are used to determine common mammalian predators throughout the refuge. I ran 7 transects of scent stations for a total of 10 days throughout winter and early spring when mammalian movement was likely to be highest, using fatty acid tablets as the attractant. The most abundant predator recorded was the coyote (*Canis latrans*), followed by the red fox (*Vulpes vulpes*) and raccoon (*Procyon lotor*). Nest cameras are used to detect nest predation events and identify specific predators. Infrared heat and motion sensor digital cameras (Reconyx Rapidfire, Holmen, WI) were installed at 22 of the 32 nests so far this season. Increasing the knowledge on the presence and behavior of mammalian predators on the refuge and in relation to the nesting sandhill cranes will help develop more effective management to increase recruitment.

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Key words: *Grus canadensis pulla*, Mississippi sandhill crane, nest predation.

SANDHILL CRANE STAGING AND WHOOPING CRANE MIGRATORY STOPOVER DYNAMICS IN RESPONSE TO RIVER MANAGEMENT ACTIVITIES ON THE CENTRAL PLATTE RIVER, NEBRASKA, USA

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Abstract: The Central Platte River Valley (CPRV) is a critical stopover for migrating whooping cranes (*Grus americana*) and the most important staging area for sandhill cranes (*G. canadensis*) in North America. Due to reduced water flows caused by human activities, the Platte River no longer follows its traditional hydrograph which consisted of high spring flows that produced scouring action that eliminated vegetation. To provide adequate crane roosting habitat during stopover and staging periods, annual and woody vegetation has been mechanically cleared on eastern portions of the CPRV since 1980. Staging sandhill crane riverine roosting area has decreased since 1950 (160 km) to the present (<80 km) with roosts concentrated on the eastern managed area (approximately 60 km). Sandhill crane roosting has dramatically decreased in western reaches of the CPRV between 1945 (90% of population) and 2007 (10% in 2000, <1% in 2007) as a result of woody vegetation encroachment on the river and no management. Whooping crane stopovers in western areas of the CPRV have decreased over time (80% of total observations in 1950-1979, 17% in 1980-2005) while increasing proportionally overall in the eastern portion of the CPRV. Individual sections show higher density and longer permanence of roosting cranes in areas with more intensive channel management. Mechanical clearing is necessary to recreate the appropriate conditions (open and wide river) for roosting cranes during spring and fall migration.

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Key words: *Grus americana, Grus canadensis,* management, Nebraska, Platte River, sandhill crane, whooping crane.

CURRENT STATUS OF LESSER SANDHILL CRANES IN YAKUTIA

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Abstract: In Yakutia, the sandhill crane (*Grus canadensis canadensis*) was considered a common bird in 1957 on the Primorie tundra from the Kolyma River to the Alazeya River. In 1980 the area of the species' supposed breeding grounds within the Kolyma-Indigirka interfluve comprised 34,600 km^2. In 1984-85, the breeding grounds extended west to the Sundrun River, with the total area reaching 49,400 km^2. At present, the westernmost sandhill crane range is on the tundra along the lower reaches of the Berelekh River. This region joins the higher density Siberian crane (*G. leucogeranus*) range, so that the ranges of the sandhill and Siberian cranes are now not only joined, but even overlap each other for great distances. Over the last 50 years, the western frontier of the sandhill crane breeding area has moved to the west, so today the species nests, though in small groups, outside the specified boundary which reaches to the Yana River Delta. The study of the distribution and numbers of sandhill cranes was carried out near the Indigirka tundra in the Kytalyk Resource Reserve during 1993-2007 on a study area that encompassed 1,314 km^2. A landscape analysis of the habitats used by the sandhill crane was completed. Within the study area, nesting sandhill crane pairs were found on the dry elevated tundra parts as well as on low wet sites of polygonal tundra. During the study on a thoroughly surveyed site as large as 1,111 km^2, we found 55 pairs (0.49 birds/10 km^2) of sandhill cranes along with 11 of their nests, and 43 pairs (0.39 birds/10 km^2) of Siberian cranes, along with 40 of their nests. Distances between both species pairs averaged 2,562 m.

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Key words: distribution, *Grus canadensis canadensis*, lesser sandhill crane, Russia, Yakutia.

DEMOGRAPHY OF WHOOPING CRANES IN THE EASTERN MIGRATORY POPULATION

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Abstract: The ultimate success of the whooping crane (*Grus americana*) reintroduction to eastern North America rests on adequate demographic performance of the population. We are undertaking a population viability analysis (PVA) of the eastern migratory population in order to evaluate progress toward the fundamental population objective, to better understand the critical demographic thresholds that must be met to fulfill this objective, and, most importantly, to support management decision-making. The initial phase in the PVA development process involves estimation of demographic parameters to be used in later population modeling phases. Multi-state models provide an appropriate analytic framework for estimation, wherein individuals move amongst breeding states across years, conditional on survival. We describe estimated survival and breeding state transition probabilities in this population as a function of age, sex, and rearing and release method. We also consider demographic parameters as a function of genetic indicators, which should inform future decisions about breeding and release in the captive flock. The ability to conduct critical demographic analyses in this flock is dependent on ongoing collection of monitoring data. Periodic re-evaluation of both monitoring and modeling methods in the context of management decision-making will be necessary to ensure that management decisions made regarding this flock are informed by the most reliable available information.

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Key words: demography, *Grus americana*, population viability analysis, reintroduction, whooping crane.

VIDEO SURVEILLANCE OF NESTING WHOOPING CRANES

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Abstract: The primary objective of the whooping crane (*Grus americana*) recovery plan is to establish and maintain 3 self-sustaining wild populations, 1 being a non-migratory Florida population. From 1993 to 2005, we released 289 captive cranes in central Florida, with 31 surviving as of 1 June 2008. From 1995 to 2008 we monitored 68 nests of the Florida population; from those, only 32 chicks hatched and 9 fledged. It often was not apparent why nests failed, and it was not practical to conduct labor-intensive observations at nests; therefore, we collected behavioral data using 12-volt VHS video surveillance cameras at 13 nests from 2000 to 2008. We positioned cameras and time-lapse video recorders 200-500 m from each nest. We programmed 1-3 days/tape of recording to occur from 1 hour before sunrise to 1 hour after sunset. Seven of 13 nests were successful in hatching chicks, while the remainder failed during the incubation period. Relevant events recorded on the videotapes included: incubation durations, frequency of adults switching off during incubation, frequency of standing and egg turning, duration eggs were not incubated while adults were away, and possible causes of nest failure. Summary statistics relating to these behaviors and also to their possible implications regarding nest survival will be discussed. Video surveillance was a valuable tool for the efficient gathering of behavioral data at whooping crane nests.

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Key words: *Grus americana*, nesting, surveillance, video, whooping crane.

LONGEVITY RECORDS OF ROCKY MOUNTAIN GREATER SANDHILL CRANES BANDED DURING 1969-1987 IN IDAHO, MONTANA, UTAH, AND WYOMING

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Abstract: Cranes species throughout the world are renowned for their longevity; however, most records are based on individuals in captivity. We compiled longevity records for wild Rocky Mountain greater sandhill cranes (*Grus canadensis tabida*) banded in Idaho, Montana, Utah, and Wyoming during 1969-1987. Our analysis was based on over 180 band recoveries and over 1,700 visual observations of known-age individually marked birds from 1969 to 2008. We present only those birds of age >20 years for this summary. Our results yielded 56 birds known to be >20 yrs of age when killed or last observed. Of 7 band recoveries, 7 birds were shot in hunts and 1 died from entanglement in a barbed wire fence. The oldest birds were 35 and 37 years of age when recovered. Of 49 birds >20 years since last observed, the oldest had reached 35 years. Two others marked as adults reached a minimum of 29 years to a maximum of 35 years of age.

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Key words: band recovery, *Grus canadensis*, longevity, sandhill crane, Rocky Mountains.

HABITAT SELECTION OF EASTERN MIGRATORY WHOOPING CRANES ON THEIR WINTERING GROUNDS

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Abstract: As a monitoring technician for the Whooping Crane Eastern Partnership, I (LEAF) noted that birds in years following release selected wintering habitats that differed greatly from those into which they were initially released. An analysis of the habitat preferences of these birds was needed in order to determine any possible implications to the reintroduction efforts. During the winters of 2004-2005 and 2005-2006, I recorded the locations, habitat use, social associations, and behaviors of all migratory whooping cranes (*Grus americana*) at known locations in Florida. I used compositional analysis to determine whether habitat use was random at the following levels: search area versus 95% home range; 95% home range versus core home range, and core home range versus individual locations. If habitat use was non-random, I then ranked the habitat types in order of selection preference by whooping cranes and determined whether the selection for or against a particular habitat was significant. At all levels, open pasture and other rural open lands and freshwater marshes were the highest-ranked habitat types. Whooping cranes' behaviors within the different habitat types suggest that some habitat types complement each other for various activities while they supplement each other for other behaviors. Because of year-to-year variation in habitat availability in Florida, it will be important to continue to monitor habitat selection by this population of birds to determine whether the patterns found in this study are repeated over longer time periods and how management activities may be altering subsequent selection patterns and survival in the wild.

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Key words: compositional analysis, Florida, *Grus americana*, habitat selection, reintroduction, whooping cranes, winter range.

ICF CONSERVATION EDUCATION: BRIDGING CRANE CONSERVATION AND THE INTERNATIONAL EDUCATION COMMUNITY

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Abstract: Education, at multiple levels with audiences in Wisconsin, Florida, Texas, and along the flyways where sandhill (*Grus canadensis*) and whooping cranes (*G. americana*) sometimes find themselves in close quarters with people, is the key to protecting North America's cranes. The migration of these birds highlights the dependence of cranes and other wildlife on wetlands along the migration routes. Most of these wetlands are privately owned, so the decisions and conservation outlook of future generations are critical to the survival of these cranes. The International Crane Foundation's (ICF) conservation education programs and materials focus on the importance of crane and wetland conservation, and encourage students and educators to learn about similar issues internationally. Education programs connect teachers with the conservation community through cross-curricular resources directly linked to academic standards, teaching methods and learning styles, as well as local conservation challenges and needs. ICF has embraced the opportunity to develop and evaluate programs and resources to compliment academic standards as well as the needs and pressures of the K-12 classroom teacher. By creating diverse and cross-curricular learning environments and experiences, the ICF Conservation Education Department is dedicated to bringing people face-to-face with the challenges and successes of crane conservation and strives to give educators and their students the knowledge, inspiration, and the tools to commit to contributing to environmental solutions.

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Key words: academic standards, cranes, curriculum, education, North America, wetland conservation.

AN INDIVIDUAL WHOOPING CRANE'S FAMILY HISTORY

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Abstract: Between 1977 and 1988, 12 cohorts (134 individuals) of whooping cranes (*Grus americana*) were banded in Wood Buffalo National Park (WBNP, Canada-breeding ground) and monitored from Canada to Aransas National Wildlife Refuge (ANWR, Texas-wintering ground). During 2004, historical data on banded individuals was analyzed to estimate population parameters and life table of the wild population. This study used information from one of the few banded cranes known to be alive in 2008 since 1978. A genealogy tree (Family Tree Maker software) was developed from individual RwR-nil to represent its descendents and relatives, as well as a map (GIS) for geographic distribution. We found that his descendents were: 4 in the first generation, at least 13 in the second generation, and 4 in the fourth generation. In total 21 descendents arrived to ANWR, and 3 of them are still alive. We identified that all males in the family selected nesting and winter territories and did not change territories with new mates. Banded females did. All nests were established in the Sass River nesting area of WBNP, and all wintering territories were in Matagorda Island, which are close to their parents' territories. History of mates, nesting fate (success, failures, no nest), number of eggs, chicks, and juveniles were analyzed, as were territory distribution and use of stopovers. Years of nesting success and failure occurred in synchrony among members of the family. Evidence of potential inbreeding, adoption, and extended family migration was collected. Information from this family will contribute to studies of kin selection and inclusive fitness.

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Key words: Aransas-Wood Buffalo population, banding analysis, genealogy, *Grus americana*, whooping cranes.

IMPACTS OF GLOBAL AND REGIONAL CLIMATE ON WHOOPING CRANE DEMOGRAPHY: TRENDS AND EXTREME EVENTS

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Abstract: We analyzed long-term demographic and environmental data to understand the role of large scale climatic factors (the Pacific Decadal Oscillations [PDO]) and environmental factors in 3 regions of North America on natality and mortality of the remnant migratory whooping crane (*Grus americana*) population. This is an endangered species that spends winters at Aransas National Wildlife Refuge (ANWR) in Texas, breeds at Wood Buffalo National Park (WBNP) in Canada and "…uses Nebraska as a primary stopover". Long term data (27 years) of demography and environmental factors (PDO index, temperature and precipitation at WBNP, Nebraska and ANWR, pond water depth at WBNP, freshwater inflow, and net evaporation at wintering ground) were analyzed. Multiple regression analysis (path analysis) and qualitative analysis determined mechanisms (trends and extreme events) affecting whooping crane dynamics. Changes in mortality of eggs, chicks, juveniles during fall migration and at wintering grounds, and adults and subadults at wintering grounds, from April to November and annually, were correlated with environmental factors from the 3 different regions (except net evaporation at ANWR and temperature and precipitation in Nebraska during spring migration). Natality variability (brood failure and clutch size reduction) was explained by PDO, pond water depth in WBNP and environmental factors from the wintering ground that affected pre-breeding conditions and subsequently reproduction. Qualitative analysis showed synchrony of extreme events at ANWR and WBNP and extreme effects on whooping crane demography. Direct and indirect effects of these environmental factors are discussed at the population and individual level.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:202

Key words: Aransas-Wood Buffalo population, climate change, demography, *Grus americana*, Pacific decadal oscillation, whooping cranes.

METHODS TO REDUCE CROP DEPREDATION BY CRANES IN SIBERIA (TRANS-BAIKAL REGION)

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Abstract: Methods of reducing crop depredation by cranes were tested in Daursky State Nature Biosphere Reserve on the steppes of southern Siberia. The Torey Lakes and numerous small lakes support autumn gathering of cranes and waterfowl. Croplands (mainly oats and wheat) attract staging cranes, geese, and ducks. Up to 42,000 demoiselle (*Anthropoides virgo*) and 1,100 hooded cranes (*Grus monacha*) (>10% of world populations for these species) can feed in the fields near the reserve and cause significant damage (up to 70% in some wheat fields). We investigated the problem during 1992-2004 and suggested various methods to reduce damage. The first suggestion was to move grain fields farther from wetlands (especially from crane roost sites). Second, cultivate lure fields at locations most convenient for birds (near roosts). Millet and wheat (millet being better), could be planted in small lure plots (5-10 ha). A third method was to provide alternative food, such as foxtail grass (e.g., *Setaria viridis*), and grow it on fallow lands near wheat fields. A fourth suggestion was to adjust the period and technology of harvest. Experimental trials of our recommendations during 2000-2003 showed good results. At crop fields moved 10-15 km from roosts, cranes fed 15-30 times less than at fields located 1-2 km from the Torey Lakes. Lure millet fields attracted cranes, and the birds stayed out of adjacent wheat until after harvest. Before harvest, cranes ate mainly millet and *Setaria viridis* (about 90% of diet), with wheat comprising 10%. Cooperative farms cultivated lure fields without government subsidies, as the lure crop program cost about 1 tenth of the previous damage.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:203

Key words: *Anthropoides virgo*, crop depredation, demoiselle crane, *Grus monacha*, hooded crane, lure crop, Siberia, Torey Lakes.

THIRTY YEARS OF MORTALITY ASSESSMENT IN WHOOPING CRANE REINTRODUCTIONS: PATTERNS AND IMPLICATIONS

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Abstract: We reviewed postmortem data to identify primary causes of mortality in reintroduced whooping cranes (*Grus americana*) and assess their potential for mitigation in future reintroduction efforts. In total, 240 cases from 3 populations were reviewed for causes of death, including the Rocky Mountain migratory population (n = 24, release dates 1975-1989), the Florida resident population (n = 186, 1993-2005), and the Wisconsin migratory population (n = 30, 2001-ongoing). Traumatic injury was the leading cause of mortality among the reintroduced whooping cranes, most commonly from predation (n = 120 or 50%, range 8-58% per project) or collision with fixed structures such as electrical power lines or fences (n = 22 or 9%, range 3-46%). Disease of infectious etiology (including confirmed cases of bacterial, viral, fungal and parasitic infection) was the second leading cause of mortality (n = 19 or 8%, range 3-17%). The data were limited by the large number of undetermined causes of death due to scavenging and decomposition of carcasses (n = 64 or 27%, 8-40%). Molting and poor roosting behavior or habitat quality may have increased the risk of predation in these populations. Preventive measures for power line collisions (marking devices) are impractical except at significant roost or migration stopover sites. Health evaluations of release candidates should continue in order to minimize losses from endemic or emerging diseases and prevent the introduction of novel pathogens into native ecosystems.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:204

Key words: *Grus americana*, mortality, reintroduction, whooping crane.

HOME RANGE SIZE AND HABITAT USE OF MISSISSIPPI SANDHILL CRANE COLTS

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Abstract: Recruitment in the endangered Mississippi sandhill crane (*Grus canadensis pulla*) is minimal, with the population of 110 sustained by an annual augmentation of captive-reared juveniles. Suitability of available habitat quality is likely involved in nesting success. Thousands of hectares of pine savanna were restored for crane use, but it is not clear how much was being used by crane families. We used 3-g subcutaneous transmitters to radio-tag 27 colts over 6 years from 1998 to 2002 and 2004 to determine home range and habitat use. Using a hand-held receiver, H-antenna and standard triangulation, location data were collected twice daily along with age and habitat type. We used Hawth's GIS Tools to calculate a minimum convex polygons as an indicator of home range. We collected data on the colts from 23 nests and 16 different territories. There were 1,334 total locations with the number of locations per colt ranging from 3 to 130. The average age at tagging was 11.6 days. The home range size doubled about every 30 days until fledging: averaging 30 ha for colts 25 days and younger, 63 ha for colts 26-50 days, and 115 ha for colts older than 50 days. Colts were most often located in savanna habitat accounting for 69% of use, followed by water (11%), hydric drain (7%), pine flatwoods (6%), agricultural (5%), road (2%), and estuarine marsh (<1%). For those colts that survived and were tracked past 50 days old, total home range size varied greatly, from 50 to 400 ha, likely indicating habitat quality. Smaller home ranges included open water, savanna, and agricultural habitat. Larger home range size was observed more frequently in areas including bigger pineywoods tracts. Results support refuge habitat management goals to restore savanna from pine flatwoods and increase scattered shallow ponds. Additional analyses should focus on habitat use vs. availability, density-based home range, and further descriptors of successful territories.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:205

Key words: *Grus canadensis pulla*, habitat use, home range, Mississippi sandhill crane, pine savanna, radio-telemetry, territory.

WHOOPING CRANE MIGRATIONAL HABITAT USE OF THE PLATTE RIVER, NEBRASKA, 2001-2006

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Abstract: The Platte River Endangered Species Partnership monitored whooping crane (*Grus americana*) habitat use along the Platte River between Chapman and Lexington, Nebraska during 11 migration seasons from 2001 to 2006. Daily aerial surveys took place in the morning from 21 March to 29 April in the spring and from 9 October to 10 November in the fall. Decoy detection trials were conducted during each of the 11 survey seasons to calculate actual sample inclusion probabilities for crane groups detected during monitoring flights. The detectability model found significant differences in detectability among strata (upland or channel), contractor, and altitude of the plane. All crane groups observed in the study area were monitored for habitat use and geomorphic profiles were measured at channel use locations. The HECRAS model was used to estimate the water surface differential between the time river profiles were measured and the time of crane group use. The estimated differential was used to adjust flow-dependent characteristics. Resource selection habitat models documented significant selection for areas with large proportions of open water, wetted channel and agriculture, and wetted channels with large unobstructed widths.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:206

Key words: *Grus americana*, habitat use, migration, Platte River, stopover, whooping crane.

WINTER DISTRIBUTION OF GREATER SANDHILL CRANES MARKED AT BREEDING AREAS IN CALIFORNIA, OREGON, AND WASHINGTON

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Abstract: Large numbers of greater sandhill cranes (*Grus canadensis tabida*) have been banded and color-marked at several important breeding sites in the western U.S. since the late 1960s. Crane color-marking began in the late 1960s at Malheur National Wildlife Refuge (NWR) in eastern Oregon. Crane marking programs were initiated at Sycan Marsh, Summer Lake Wildlife Area (both in south-central Oregon), as well as at Modoc NWR in the mid-1980s. In the mid-1990s, a marking program was initiated at Conboy Lake NWR in south-central Washington. This paper reviews winter records and distribution of marked birds from these sites within the Central Valley of California, reviews their movements between wintering areas, assesses their fidelity to wintering sites and discusses conservation implications of this information.

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Key words: banding, California, Central Valley population, *Grus canadensis*, sandhill crane, winter distribution.

EVALUATING CHEMICAL DETERRENCE AT TWO SPATIAL SCALES: THE EFFECTIVENESS OF CHEMICAL DETERRENCE FOR SANDHILL CRANES IN CORNFIELDS

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Abstract: From 2006 through 2008, 9,10 anthraquinone (sold as Avitec™) was used as a deterrent on planted corn seed in Minnesota, Wisconsin, and Michigan. ICF conducted field trials in Wisconsin to determine efficacy of Avitec™ to repel sandhill cranes (*Grus canadensis*) from germinating corn. We assessed crane use at 2 levels: between and within habitats by crane population surveys to determine crane use of fields, and corn density surveys to assess possible damage within fields. In addition, corn seed samples were taken to assess amount of active ingredient on treated corn seeds in the ground. In 2008 the concentrations of Avitec™ on seed obtained from powder treatments (as compared to liquid treated) were generally lower. Where concentration of Avitec™ on the corn seeds was adequate (liquid or powder), it successfully deterred crane herbivory even though crane use of the fields remained high. Non-treated fields had higher damage as crane use increased, whereas treated fields had low or no damage, even with increased crane use. An effective deterrent is a win-win situation for both cranes and farmers. Its use protects a valuable crop while allowing cranes to access critical food items in cultivated fields, which also confers a benefit to the farmer (i.e., consumption of crop pests). Farmers can solve the problem more economically on their own without handling toxic seed treatments. Successful solutions such as this example are critical for advancing wildlife conservation on private lands.

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Key words: anthraquinone, chemical deterrent, corn, *Grus canadensis*, sandhill crane, spatial scale.

INFLUENCE OF LANDSCAPE FEATURES OF WETLANDS ON NESTING PATTERNS OF SANDHILL CRANES IN CENTRAL WISCONSIN

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Abstract: We studied the relationship between landscape features and nesting patterns of greater sandhill cranes (*Grus canadensis tabida*) in central Wisconsin for 3 years. Our study covered 9,840 ha, including about 50% agricultural fields, 20% forest, and 20% wetlands. We analyzed landscape features and nesting patterns at the wetland complex level. Landscape features included size, shape, and type of cover for each wetland complex. Nesting patterns included nesting density and the spatial pattern of the nest locations in a wetland among years. Nest density varied among wetland complexes and years. Mean nest densities in wetlands surveyed were 0.037, 0.033, and 0.047 nests/ha in 2001, 2002, and 2003, respectively. Nest density in individual wetlands varied from year to year, from 0.00 to 11.24 nests/ha. Mid-sized wetlands (80-120 ha) had similar means, around 0.05 nests/ha, and had smaller variations in nest density among years in comparison with small wetlands. Spatial point pattern analysis showed that the spatial pattern of nest locations in the wetlands was not always clustered. Mean distance between the two closest nests within single wetlands within a year was 227 m (11-666 m, SD = 163 m). The distance was usually around 120 m for a mid-sized wetland.

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Key words: *Grus canadensis*, landscape, nesting pattern, sandhill crane, wetlands, Wisconsin.

STUDY OF ENVIRONMENTAL VARIABLES AND CONNECTIVITY OF NORTHERN MEXICO FOR CRANES: CONSERVATION IMPLICATIONS

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Abstract: Wetlands are one of the most important ecosystems for biodiversity and as a resource for humans. Humans depend on wetlands for water and food, but with expansion of urban cores, water overexploitation, and the increase of croplands, wetlands are at risk. The Chihuahuan desert is an ecoregion important for the economy and development of Mexico. Although there are many temporal wetlands that support many migratory birds, water in some desert landscapes is being overexploited due to development. This leads to the desiccation of wetlands important for migratory birds such as cranes. The cranes as a group are associated with grasslands and wetlands and of the 15 species, 7 are under CITES Appendix I risk. In America there are 2 species, the whooping crane (*Grus americana*) and the sandhill crane (*G. canadensis*). The whooping crane is under extinction risk and is extirpated from Mexico. The distribution of the sandhill crane at winter sites in northern Mexico is incomplete. Tacha et al. (1992, 1994) and Meine and Archibald (1996) are the principal studies outlining the distribution of cranes in Mexico. They described the distribution of sandhill crane to the states of Chihuahua, Durango, and Coahuila, but they did not study the possible more southern distribution. Chavez-Ramirez (2005) expanded the distribution of the sandhill crane to the south. He included the states of Zacatecas and San Luis Potosi and other wetlands in Coahuila and Nuevo Leon. In spite of this knowledge, it is important to evaluate the degree of conservation of wetlands that cranes use in winter and to evaluate new wetlands with potential for the reintroduction of whooping cranes. In this study, we try to evaluate the environmental parameter of wetlands in northern Mexico and the connectivity within them for conservation and potential reintroduction of cranes.

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Key words: distribution, *Grus canadensis*, northern Mexico, sandhill cranes, wetlands.

MECHANISMS OF HABITAT SELECTION OF REINTRODUCED WHOOPING CRANES ON THEIR BREEDING RANGE

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Abstract: We examined several mechanisms that influenced the habitat selection of reintroduced whooping cranes (*Grus americana*) on their breeding range in the midwestern United States. Visual observations on 56 whooping cranes from 2001 to 2006 provided accurate locations, habitat descriptions, and bird associations. Location information on each bird was mapped to create home range and to describe the habitat. We found evidence that habitat selection in these cranes resulted from multiple mechanisms, including habitat imprinting, philopatry, site tenacity, intra-specific interactions, and environmental stochasticity. The initial home ranges of all cranes contained habitat similar to that in which they were reared. Strong philopatry was seen in 87% of the first year birds who returned to within 7.2 km of the release site. Site tenacity was significantly stronger after the second year return with the mean distance between consecutive center of home ranges decreasing ($t = 3.136$, df = 38, $P < 0.003$). We found that as population density doubled there was no significant change in the distance between nearest neighbors ($F = 0.038$, df = 51, $P = 0.847$). We also found evidence of environmental stochasticity in a group of cranes that deviated off course during their initial northward migration. Our work revealed the primary mechanisms of habitat selection used by the reintroduced whooping cranes, reassuring project managers that their reintroduction techniques will have predictable outcomes for the locations and habitats used by the new population.

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Key words: breeding range, *Grus americana*, habitat selection, philopatry, reintroduction, site tenacity, whooping cranes, Wisconsin.

FIRST BREEDING RECORDS AND HISTORICAL STATUS OF SANDHILL CRANES IN NEW ENGLAND

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Abstract: Sandhill cranes (*Grus canadensis*) nested at 4 sites in south-central Maine between 2000 and 2008 and at single sites in western Massachusetts and west-central Vermont in 2007 and 2008, continuing their eastward range expansion. Of 13 nests observed, 5 were in a lacustrine marsh, 2 were in a riverine marsh, and 2 were in beaver-impounded palustrine marshes, all dominated by cattail (*Typha* spp.); 2 were in lacustrine fen habitat dominated by sedges (*Carex* spp.), sphagnum, and leatherleaf (*Chamaedaphne calyculata*); 1 was in a lacustrine fen dominated by slender sedge (*Carex lasiocarpa*), sphagnum, and cattail; and 1 was in a lacustrine bog dominated by sphagnum, leatherleaf, sweetgale (*Myrica gale*), and slender sedge. Fourteen of 16 documented nest attempts hatched 1 or 2 eggs. Dimensions of 10 eggs averaged 90.5 mm (83.2-98.0) × 61.2 mm (55.2-62.1). In at least 11 instances, chicks survived to at least 8 weeks of age, including at least 3 2-chick broods. Reports of sandhill cranes in the 6 New England states have increased in frequency over the past 2 decades. A review of historical literature suggests that sandhill cranes were common migrants in the northeastern United States at least north to New England during the 17th and 18th centuries, and may have nested there as well, so recent range extensions may represent re-colonization of former range.

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Key words: breeding distribution, *Grus canadensis*, history, New England, sandhill crane.

THREE WHITE CRANES, TWO FLYWAYS, ONE WORLD

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Abstract: The International Crane Foundation, together with Beijing Brooks Education Center in China and the Institute for Biological Problems of the Cryolithozone in Russia, is implementing a multi-year education project targeting local communities along the eastern crane flyways in the United States and East Asia. The education activities focus on the importance of wetlands, wildlife, and other natural resources from the perspective of local communities and are designed to enhance local leadership for education efforts. In the U.S. project activities are integrated with education programs centering on the eastern migratory whooping crane (*Grus americana*) population, integrating classroom activities and field trips with online education activities focusing on cranes and wetland conservation. In East Asia, school curricula provide needed classroom resources for villages near wetland reserves, while training builds the capacity of local teachers and nature reserve educators. Project activities link educators and students in the U.S., China, and Russia through educator exchanges, student art exchanges, environmental education camps, and a project website. Through these activities, students along both flyways in North America and East Asia learn the importance of their personal actions in effecting change and their connection to global environmental issues.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:210

Key words: cranes, East Asia, education, exchanges, flyways.

BEHAVIOR COMPARISONS OF TWO REARING PROTOCOLS FOR WHOOPING CRANES RAISED BY COSTUMED CAREGIVERS AND TRAINED FOR AN ULTRALIGHT-LED MIGRATION

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Abstract: Whooping crane (*Grus americana*) colts are raised at USGS Patuxent Wildlife Research Center, Laurel, Maryland for the first 40-60 days of a chick's life as part of the Whooping Crane Eastern Partnership (WCEP) ultralight-led reintroduction. Numbers raised for WCEP are increasing each year. Up to 2005, we raised whooping crane chicks in the Propagation Building where there are 10 indoor/outdoor pens, 8 full pens, and 2 half-size pens. In 2005 WCEP proposed increasing the number of colts reared to 20-24, numbers beyond the capacity of the facility. To accommodate this greater number of chicks, we modified several outdoor pens nearby. Pens were made smaller, protective lower fencing was added, and heat lamps were installed in the feed sheds. The addition of 6 such pens allowed rearing and training of 22 chicks. Chicks were placed in these outdoor pens at 25-30 days of age. The purpose of this study is to measure the effects on chick development and training from the new rearing procedure.

Our training program is as follows: for the first week colts need to master the arts of walking, eating, and drinking, and this is the time of the most intense contact with costumed caregivers. Late in week 1 (day 5.8 ± 1.4 days) the colts are taken for foraging trips with a costumed person. Colts are taken to forage near the ultralight trike to become conditioned to the machine and the long crane head puppet at a mean age of 7.5 days ± 2.0 days. The next step in conditioning the colt is to begin circle training with the ultralight. Also in week 2, swimming to increase exercise and prevent leg deformities begins, as well as socialization with other colts, initiated at a mean age of 10.9 days ± 2.8 days. Exposure to water, also referred to as pond training, begins in week 2 at a mean age of 8.9 days ± 2.6 days. During week 3 circle pen training continues up to an average age of 30.8 days ± 3.9 days. Colts receive an average of 3 hours, 13 minutes ± 44 minutes of circle pen training. In week 3 the colts graduate to open field training. In 2005, colts received an average of 112 minutes ± 64 minutes of open pen training. This training started at day 31.9 ± 3.4 days. Average age of shipping to Necedah National Wildlife Refuge has remained relatively consistent.

Focal behavioral observations were collected for 2005 and 2006 with half the colts being raised in 1 facility and half in the other. We have compared the amount of time spent in each type of behavior and have related behavior to subsequent survival and wildness for the 2005 releases.

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Key words: behavior, captive rearing, *Grus americana*, protocols, whooping crane.

MISSISSIPPI SANDHILL CRANE CHICKS PRODUCED FROM CRYOPRESERVED SEMEN

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Abstract: The Mississippi sandhill crane (MSC, *Grus canadensis pulla*), 1 of 6 subspecies of sandhill cranes, is classified as critically endangered and was placed on the United States' List of Endangered Fish and Wildlife in 1973. For 13 years starting in 1996, the Audubon Center for Research of Endangered Species (ACRES) and Freeport-McMoran Species Survival Center (SSC) in New Orleans have been contributing to the MSC Recovery Program. Through successful captive propagation of MSCs by use of natural breeding and artificial insemination, more than 150 chicks raised at SSC have been released into the wild population at the MSC National Wildlife Refuge.

Starting in March of 2006 and continuing through 2008, ACRES established a long-term project to collect and cryopreserve semen from sandhill cranes in the captive flock housed at SSC. A total of 268 semen samples from 11 MSC males were collected and cryopreserved. Using semen from Florida sandhill cranes (*G. c. pratensis*) as a model, we have attempted to determine improved methods to freeze and thaw crane spermatozoa. In 2007 and 2008, we inseminated 2 females with frozen-thawed MSC semen and produced 4 fertile eggs, of which 2 hatched. Two chicks survived to fledge, 1 each from 2007 and 2008. The fledged chick produced from frozen-thawed MSC sperm in 2007 was released into the wild at the MSC National Wildlife Refuge in January 2008 and continues to thrive.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:212

Key words: captive breeding, cryopreservation, *Grus canadensis pulla*, Mississippi sandhill crane, semen.

EFFECTS OF CHANGES IN AGRICULTURE AND ABUNDANCE OF SNOW GEESE ON CARRYING CAPACITY OF SANDHILL CRANES DURING SPRING

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Abstract: The Central Platte River Valley (CPRV) in Nebraska is a key spring staging area for approximately 80% of the mid-continent population of sandhill cranes (*Grus canadensis*). Evidence that cranes currently are acquiring fat less efficiently than in the past along with a large increase in use of the CPRV by snow geese (*Chen caerulescens*) led us to evaluate waste-corn availability and index spatial and temporal variation in abundance of sandhill cranes and waterfowl using the CPRV. We also developed a predictive model to assess impact of changes in availability of corn under past, present, and potential future conditions. Predicted energy demand of cranes and waterfowl increased 69% from the late 1970s compared to 1998-2007. Availability of waste corn before crane arrival was 20%, and 68% less during 1998 and 1999 compared to spring 1979, resulting in cornfield area required to meet energetic demand to increase from 13,838 ha during 1979 to 28,500 ha during 1998 and 80,246 ha during 1999. Future decreases in carrying capacity and resulting increases in distance of daily foraging flights likely would result in reduced crane use of the CPRV and a marked reduction in ability of cranes to store fat reserves. Options to increase carrying capacity in the CPRV for sandhill cranes include restoring degraded roosting habitat for cranes, expanding suitable roosting habitat for snow geese in the neighboring Rainwater Basin, and promoting land use practices in the CPRV that maximize availability of waste corn.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:213

Key words: agriculture, carrying capacity, Central Platte River Valley, *Chen caerulescens*, *Grus canadensis*, sandhill crane, snow goose.

WINTERING SANDHILL CRANE DISTRIBUTION AND HABITAT USE PATTERNS AT BOSQUE DEL APACHE NATIONAL WILDLIFE REFUGE, NEW MEXICO

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Abstract: The single most important factor regulating sandhill crane (*Grus canadensis*) populations is their ability to carry out annual life cycle events while responding to changing habitat availability and distribution across local, regional, and continental landscapes. Wetland and cropland resource availability and distribution across the landscape have become increasingly unpredictable. Recent changes in farming practices, urbanization, and prevailing drought conditions in New Mexico have transformed and reduced dynamic, heterogeneous landscapes into scattered fragments of the original setting. Concerns are increasing for the cumulative influence of these often irreversible actions in providing the type of resources needed by cranes at the right time in their annual cycle, in the right form, and in the right quantities to ensure their continued success. The distributional patterns of wintering sandhill cranes have not been assessed relative to the type, distribution, and availability of foraging habitats important to cranes. Local and regional management plans have placed a high priority on the need for information that identifies and assesses the distribution and patterns of use by sandhill cranes across their range, in light of a changing landscape through land use change and urbanization.

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Key words: distribution, *Grus canadensis*, New Mexico, sandhill crane, winter.

EASTERN EQUINE ENCEPHALITIS IN FLORIDA WHOOPING CRANES

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Abstract: Two whooping cranes (*Grus americana*) that were part of separate projects to reintroduce whooping cranes in eastern North America died suddenly in Florida following a few days of abnormal behavior. The first case was a semi-captive bird on ultralight-led migration from Wisconsin to Florida in December 2004. The second case was a molting 10-year-old male and successful wild breeder that died in May, 2005. Clinical signs were lethargy, abnormal posture, isolation followed by attack by other birds, collapse, heart murmur, and death. Eastern equine encephalitis virus (alphavirus) was isolated from the liver of both birds. The most severe lesions were in the intestinal tract and liver. Evidence of exposure in sandhill cranes (*G. canadensis*) and other released whooping cranes indicate that summertime exposure is relatively frequent, may cause of summertime illness, but only occasionally causes death. These 2 deaths followed months of elevated seroconversion rates in Florida sentinels. Other factors, such as prior exposure, immune status, vaccination, molt or other pre-existing diseases may put individual birds at greater risk.

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Key words: disease, eastern equine encephalitis, Florida, *Grus americana*, reintroduction, whooping crane.

EXAMINATION OF OPPORTUNISTICALLY COLLECTED EGGS LAID BY WHOOPING CRANES IN FLORIDA

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Abstract: We examined 41 whooping crane (*Grus americana*) eggs or egg remains from 27 nests in the field (n = 4), in the laboratory (n = 33), or incubated by another pair (n = 1), or in captivity (n = 3). Eggs were collected because the nest was in danger (2 eggs, 1 nest), abandoned (5 eggs, 4 nests), or failed to hatch after 34 days (27 eggs, 16 nests), or they were removed for management purposes (5 eggs, 3 nests). Evidence of fertility was found in 18 eggs (12 nests, 44%) of 33 opened. The remainder were either infertile or died early in development. In 7 cases for which a sibling egg hatched 3 (43%) had embryos in them. Of the 12 pairs of eggs examined all except 1 were either both with, or without embryos. Five of the embryos were fully developed, 5 were mid-development, and 7 were in early development stages. One near-term embryo was malpositioned with the head on the wrong side such that it could not pip the eggshell. One near-term embryo had bacterial pneumonia and enteritis. Its shell had been cracked. Egg volume was correlated with water levels during the preceding winter, and egg fertility appeared to be associated with winter rainfall. No evidence of a significant bacterial pathogen was found. Eggs in the first clutch laid by a female were significantly smaller than eggs laid in subsequent nests. Mean nest egg volume was greater for fertile nests when compared to those with no embryo (216.2 vs. 199.6 ml).

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Key words: eggs, Florida, *Grus americana*, necropsy, pathology, whooping crane.

PATHOLOGY ASSOCIATED WITH LIGHTNING STRIKE AND DROWNING MORTALITY OF WHOOPING CRANES IN FLORIDA

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Abstract: Severe thunderstorms associated with a strong front passing through the Gulf Coast of Florida on the night of 1-2 February 2007 resulted in the death of 17 whooping cranes (*Grus americana*) penned at Chassahowitzka National Wildlife Refuge. Postmortem examination of 4 of the birds revealed saline fluid in lungs and airsacs consistent with drowning. Coagulation necrosis and other histologic changes in kidney, peripheral nerve, airsac membranes, and heart muscle further indicated electrocution and are comparable to other cases of electrocution associated with power-line strikes in Florida. Aspiration of seawater was the most likely cause of death of birds that were stunned by lightning strike. Tissue changes in some, but probably not all of the birds, would have resulted in death if they had not drowned. Retrospective examination of lightning and tidal records support this presumed cause of death. The pathology associated with lightning strikes has only rarely been illustrated for birds. We provide photos of characteristic lesions and compare them with known power line electrocution cases.

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Key words: drowning, *Grus americana*, lightning strike, pathology, whooping crane.

THE DIRECT AUTUMN RELEASE OF WHOOPING CRANES INTO THE EASTERN MIGRATORY POPULATION: A SUMMARY OF THE FIRST THREE YEARS

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Abstract: This paper describes methods used in an experimental direct autumn release of captive produced whooping cranes (*Grus americana*) into a reintroduced migratory population in eastern North America. Eighteen chicks (4 in 2005, 4 in 2006, and 10 in 2007) were eventually released in the vicinity of adult whooping cranes or wild sandhill cranes (*G. canadensis*). Chicks were reared by costumed aviculturists using strict isolation-rearing techniques at the International Crane Foundation (ICF) and then transferred to Necedah National Wildlife Refuge in central Wisconsin. Initially, 23 chicks were transferred from ICF to Necedah at ages of 17-46 days. Isolation-rearing techniques continued in the field while raising the birds to fledging and until release in October. Although the same rearing and release methods were used each year, the number of cohorts and number of birds in each cohort released varied by year. Cranes were color-banded and tracked with VHS and PTT transmitters throughout their lives. Intervention was required to assist several chicks during their first year's migration. Of released cranes, 83% survived their first fall migration, and 67% survived their first year after release. Results are preliminary, and the effects of unequal sex ratios in annual cohorts are unclear; however, release of juveniles in groups of 2 has so far been most successful in facilitating successful first fall migration.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:215

Key words: direct autumn release, *Grus americana*, migration, reintroduction, whooping crane.

THE ROLE OF RETRIEVAL AND TRANSLOCATION IN A REINTRODUCED POPULATION OF MIGRATORY WHOOPING CRANES

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Abstract: Beginning in 2001, a reintroduction project was initiated using captive-reared whooping cranes (*Grus americana*) to establish a migratory flock in eastern North America. From May 2003 to August 2008, 23 of these birds were retrieved and translocated in 15 separate events. These individuals consisted of 14 cranes that had been led to Florida by ultralight aircraft on their first autumn migration (UL) and 9 cranes that had been directly released in autumn in Wisconsin (DAR). Of 104 (86 UL and 18 DAR) reintroduced individuals that eventually departed from their release location, 22% were later retrieved 1-3 times. Lake Michigan posed an effective barrier to northward migrating yearlings, and 8 retrieval events were of birds in Lower Michigan or in other locations that were a direct result of the bird having been in Michigan during their yearling spring and summer. Three events involved DAR birds ($n = 8$) that were in inappropriate locations during their first autumn migration, and in another event 4 UL birds were translocated within Wisconsin because of inadequate human avoidance behavior. Nine yearlings (6 UL and 3 DAR) in Lower Michigan were not retrieved (retrievals were attempted for only 3 of the birds). The summer location of released birds influenced the location of return in future years. Concentration of this population in the core reintroduction area, where probability of pair formation and association with conspecifics was greatest, became a high project priority. Retrieval and translocation of yearlings to Wisconsin became a critical management tool in the reintroduction. With 1 exception, all translocated birds have successfully returned to the core reintroduction area by 2008, and several have paired and some nested.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 11:216

Key words: *Grus americana*, migration, reintroduction, translocation, whooping crane.

ASSESSING SANDHILL CRANE FLIGHT ALTERATIONS TO POWER LINES IN SOUTH-CENTRAL WISCONSIN

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Abstract: We examined how weather and power line type affected abrupt flight alterations of sandhill cranes (*Grus canadensis tabida*) near electric lines in south-central Wisconsin at 4 U.S. Fish and Wildlife Service fall crane roost count sites near the Wisconsin River in Adams, Columbia, and Iowa counties between September and November 2007. We selected 4 distribution (10-12 m tall, <50 kV) and 2 transmission lines (>20 m tall, >110 kV) in high crane density areas near corn fields within 1.6 km of either the Wisconsin River or local roosting wetland. We recorded frequencies of 3 types of abrupt flight alterations near power lines across 1-2 km of electric line at each site. These included "flare" (dropped legs to vigorously fly over the line within 10 m of wires), "zigzag" (flight parallel, then upwards and over the wire), and "change direction" (flight trajectory change of 90 or 180 degrees of the wire). During 43 2-hour observations, we recorded 6,001 crane flight alterations within 20 m of power lines. We considered any crane flying within 20 m of power lines at high risk of injury from striking a wire. Most cranes (37.18%, n = 2,231) flew 11-15 m above power lines; only 11.25% (n = 675) flew 1-5 m above power lines. We tested flight alterations against weather and power line types using chi-square tests. Although we found that cranes had the same chance of altering and not altering their flight pattern near power lines in both calm/clear and windy/cloudy weather, when cranes did alter their flight paths, they were 2.8 times more likely to react abruptly in windy/cloudy weather ($\chi^2 = 25.3$, $P < 0.001$, n = 97). However, weather did not directly correlate with how often cranes abruptly reacted, but was likely one of several factors (e.g. power line type, flight altitude, or season) contributing to frequency of abrupt reactions. Cranes that altered their flight over more distribution lines ($\chi^2 = 73.6$, $P < 0.001$, n = 3,892) and were 2.04 times more likely to abruptly alter their flight over them ($\chi^2 = 8.1$, $P < 0.004$, n = 109). Of cranes that abruptly reacted over both line types, cranes flared more over transmission lines ($\chi^2 = 22.3$, $P < 0.001$, n = 17). We hypothesize cranes need to increase their flight altitude more and possibly flare to clear transmission lines. In summary, although only 2.1% of cranes (n = 126) abruptly reacted near power lines, they more abruptly alter their flight patterns depending on power line type. This may indicate a higher collision risk with distribution lines. By classifying these 3 abrupt crane flight alterations near power lines, we provide a standardized method for recording crane flight patterns. In response to this pilot study, we are using this observation technique along with recording digital video of crane flight alterations to identify power lines that pose a collision risk to cranes by concentrating our efforts on distribution lines. We are currently studying how local landscape-level topography and weather in Wisconsin affect crane flight alterations.

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Key words: flight reactions, *Grus canadensis*, power line collisions, sandhill cranes, Wisconsin.