PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP

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ABSTRACTS

Following are abstracts of oral and poster presentations given at North American Crane Workshop 15 but which were not published in these Proceedings.

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UPDATE ON THE CAPTIVE WHOOPING CRANE POPULATION

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Abstract: Following the closure of Patuxent Wildlife Research Center's Whooping Crane (*Grus americana*) breeding program, 70 whooping cranes traveled to new homes at facilities across North America. Through this move, the captive breeding effort has on-boarded 3 new breeding facilities (denoted by asterisks), bringing the total up to 7 including: Calgary Zoo, Dallas Zoo*, Freeport-McMoRan Audubon Species Survival Center, International Crane Foundation, San Antonio Zoo, Smithsonian Conservation Biology Institute*, and White Oak Conservation Center*. Additionally, 16 institutions, including 5 of the breeding centers, exhibit whooping cranes to the public. These animals serve as ambassadors and provide an opportunity to share the history, ecology, and biology of the whooping crane as well as the monumental conservation efforts that have endeavored to save this species.

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Key words: captive breeding, *Grus americana*, new facilities, whooping crane.

DESIGNING MORE CRANE-FRIENDLY TRANSMITTERS: THE IMPORTANCE OF WORKING WITH MANUFACTURERS AND LESSONS LEARNED

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Abstract: Previous telemetry work on cranes has centered around technologies utilizing transmitters with external whip antennas measuring approximately 20 cm (VHF and PTT) due to the frequency range they operate within. External antennas have been documented icing up in wet and freezing conditions, cause behavioral issues, and are known to break prematurely for cranes and many other species. Improvements and miniaturization in GSM (Global System for Mobile communications) technologies have made transmitters utilizing this system applicable for use on crane-sized birds. Most GSM transmitters on the market today utilize patch antennas incorporated internally rather than an external whip style. Intuitively, eliminating this potential for issues from a transmitter's design should be an improvement, but depending on the mounting method used, it can be an avenue for new and unforeseen issues. Working with manufacturers of these new technologies to develop suitable designs is critical for successful implementation of new or existing studies. I examine this changing of technologies and transmitter design in detail for telemetry studies on Wood Buffalo/Aransas whooping cranes (*Grus americana*) in 2009-2019 and detail the process involved with developing and testing new designs for deployment in the field on wild birds.

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Key words: *Grus americana*, GSM, transmitter design, whooping crane.

WINTER ECOLOGY OF SANDHILL CRANES ON THE SOUTHERN HIGH PLAINS OF TEXAS

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Abstract: Survey and satellite telemetry data suggest >80% of the Mid-Continent Population (MCP) of Sandhill Cranes (*Grus canadensis*) overwinter on the Southern High Plains (SHP) of Texas. The SHP is a mosaic of rowcrops and rangelands, dotted with playa wetlands and saline lakes. Crops, especially sorghum, comprise >95% of the population's winter diet. Our objective is to give an updated description on the winter ecology of the MCP in the SHP, including spatial ecology (movements and home range), habitat selection, and energy requirements. We captured 35 cranes and attached satellite transmitters ($n = 4$) and GPS receivers ($n = 31$) on Platform Transmitter Terminals (PTT). We modeled spatial ecology using dynamic Brownian Bridge movement models within core areas (50%) to locate areas of importance (AOI, $n = 10$) and home ranges (95%) to estimate habitat selection. Each AOI had ≥1 wet wetland surrounded by a mosaic of crops, grasslands, and shrublands. Wetland wetness and sorghum stage (i.e., standing, cut, disked) were estimated using satellite imagery, which we compared to crane movements and locations. Home range size was positively correlated with surface water across the region, and data showed cranes visited more roost sites when more were holding water. We calculated regional carrying capacity using only sorghum acreage and found that sorghum can feed the MCP for >90% of each winter. Wetlands remain the key habitat requirement of the MCP in the region, given they only cover <1% of the SHP.

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Key words: GIS, *Grus canadensis*, home range, PTT, sandhill crane, Southern High Plains, winter.

USING ULTRASONOGRAPHY AND ENDOCRINOLOGY TO UNDERSTAND FOLLICULOGENESIS AND REPRODUCTIVE FAILURE IN WHOOPING CRANES

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Abstract: For endangered species managed *ex situ*, production of offspring is a key factor to ensure healthy and self-sustaining populations. However, current breeding goals for the whooping crane (*Grus americana*) are impeded by poor reproduction. Our study seeks to better understand mechanisms regulating ovarian function in captive whooping cranes and the regulatory function of the hypothalamic-pituitary-gonadal (HPG) axis in relation to follicle formation and egg laying. We know from other avian species that small follicles on the ovary produce estradiol which in turn stimulates release of luteinizing hormone from the pituitary and yolk precursors (vitellogenin and very low-density lipoproteins) from the liver. As dominant follicles continue to grow, they enter a preovulatory phase and transition to progesterone production, while the remaining small follicles continue to produce estradiol. We hypothesize that a perturbed HPG axis depresses steroid hormone production and prevents follicles from switching to the preovulatory phase. For this study we paired weekly blood collections with transcutaneous ultrasonography of the ovary. Ultrasonic images were scored based on ovarian condition, number of follicles visible, and size of largest follicle. Preovulatory follicles (>12 mm) were observed in laying females (n = 5) but absent in non-laying females (n = 7). Estradiol concentrations were significantly higher with advanced ovarian condition, while both estradiol and progesterone concentrations were elevated when the largest follicle reached 8 mm in size ($P < 0.001$) and when 3 or more supportive follicles were present on the ovary ($P < 0.001$). Ongoing data analysis is investigating patterns and roles of pituitary hormones and yolk precursors in follicle formation and egg production.

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Key words: endocrine, folliculogenesis, *Grus americana*, ovarian function, ultrasonography whooping crane.

UNDERSTANDING THE INFLUENCE OF THE MAJOR HISTOCOMPATIBILITY COMPLEX ON MATE CHOICE AND SUCCESSFUL REPRODUCTION IN THE WHOOPING CRANE

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Abstract: Although we know that pair bond formation is required for successful reproduction in cranes, there is little information on underlying mechanisms that influence how successful mates actually select each other. Recent evidence suggests that the major histocompatibility complex (MHC) may play a role in mate choice, likely through olfactory cues in pheromone secretions. We examined the MHC class II exon II gene region to determine if whooping cranes (*Grus americana*) exhibit a mate choice strategy based on MHC alleles. We sequenced a total of 145 birds, 88 captive and 57 from the Eastern Migratory Population, using samples sourced from the PWRC frozen biorepository. Captive pairing histories were established from individual and breeding records maintained at PWRC, while wild pairings were determined by breeding records maintained by researchers at International Crane Foundation. Samples were sequenced using the Illumina MiSeq platform and alleles were confirmed through AmpliSAT analysis tools. A total of 14 alleles were found within the exon II region. The mean number of alleles present was 4 and ranged from 1 to 8. As 8 alleles was the maximum number observed it is possible that 4 loci are in the whooping crane. The 2 most common alleles were found in 97.9 and 91.7% of the population, respectively. Further analyses will include calculating genetic distance between individuals and determining if allele frequency within this gene region can predict pairing success if a cause of reduced egg production in captive birds is related to MHC incompatibility between current mates.

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Key words: genomics, major histocompatibility complex, mate choice, whooping crane.

CLIMATE CHANGE THREATENS WHOOPING CRANE RECRUITMENT AND POPULATION GROWTH

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Abstract: We identified climatic drivers of whooping crane (*Grus americana*) recruitment throughout breeding, migration, and wintering periods. We used a repeated cross-validated absolute shrinkage and selection operator approach to modeling recruitment. We simulated the effects of climate change on those drivers and predict whooping crane population growth given scenarios of climate change and solar activity (i.e., sunspots). Sunspots were a primary driver of recruitment in the model, with fewer sunspots enhancing recruitment. During autumn migration, increased precipitation resulted in less recruitment. On the breeding grounds, fewer days below freezing during winter resulted in less recruitment. This likely affects recruitment through changes in hydrological processes. Also, more precipitation during breeding reduces recruitment probably by increasing risks of nest flooding and exposure. Atmospheric CO_2 concentration is expected to increase to 500 ppm by 2050. Our models predict this scenario will result in population growth falling below long-term averages. Given a scenario with a typical solar cycle and 500 ppm CO_2, species recovery will require 8-times longer with the chance of population decline increases to 31%. Although the whooping crane population is growing and may currently appear secure, long-term threats imposed by climate change jeopardize its persistence. Weather on the breeding grounds likely affects recruitment through hydrological processes (i.e., nesting pond depth) and predation risk, whereas precipitation during autumn migration may influence juvenile mortality. Management actions that mitigate threats or abate climate change must occur soon or this wild population of whooping cranes will begin declining to extinction.

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Key words: boreal pond, decadal cycle, groundwater, LASSO, precipitation, reproduction, solar activity, sunspots.

SANDHILL CRANES IN MEXICO: STATUS OF HISTORICAL HABITATS AND CONSERVATION CHALLENGES

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Abstract: Sandhill cranes (*Grus canadensis*) have historically been a winter visitor to Mexico's wetlands. It has traditionally been a game species as well, for recreational purposes or as a subsistence alternative food in many rural communities. However, a paucity of information exists on population assessments of sandhill cranes in Mexico, the habitats they use, and the conditions of these habitats. With the exception of northeast Mexico, the U.S. Fish and Wildlife Service conducted mid-winter aerial counts in Mexico from the 1950s to 2006. These surveys, although focused on waterfowl, provided important information on population numbers of sandhill cranes wintering in Mexico and the wetlands they used. However, since 2006 there have been no efforts to monitor these populations. Here we present an overview of the historic wetland habitats used by cranes in Mexico, their current conservation status, their conservation challenges, and the identified gaps of knowledge to support their long-term conservation in their southernmost wintering areas. We found that most of the wetland habitats used by cranes have significantly changed in the last 2 decades and are currently facing issues related to anthropogenic activity. Additionally, local counts and observations suggest a recent shift in the distribution and abundance of cranes, likely a result of agricultural expansion and deterioration of wetland habitats. Mid-winter surveys, particularly those including northeast Mexico, would facilitate an understanding of the current distribution and abundance of sandhill cranes in Mexico. Additional research is needed to identify habitat management, restoration, and conservation goals.

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Key words: conservation challenges, Mexico, sandhill cranes, wetlands.

IMPORTANCE OF FOOD SUBSIDIES FOR MIGRATORY BIRDS WINTERING IN CENTRAL NEW MEXICO

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Abstract: The Middle Rio Grande Valley (MRGV) of New Mexico overwinters migratory birds, including the Rocky Mountain Population (RMP) of greater sandhill cranes (*Grus canadensis tabida*). Because of changes in agricultural practices and loss of habitat, migratory birds have become largely dependent on public lands where natural resource agencies subsidize food. To evaluate if food subsidies supply a sufficient resource base, we estimated the energy available in cultivated corn varieties and seasonal energy requirements of the RMP. We additionally considered the energetic requirements of cranes belonging to the Mid-Continent Population, light geese, and dabbling ducks that winter in the MRGV. Daily depletion rates of post-mowed corn increased throughout the winter, ranging from 3,673 ± 843 kg/ha in December to 7,014 ± 1,884 kg/ha in February. Daily energetic expenditures of RMP cranes also generally increased monthly and averaged 623 kcal/day throughout the winter. The RMP required 210,259 kg of corn through the course of the winter. Combined, seasonal energetic demands of the RMP, MCP, light geese, and dabbling ducks at current population levels required 832,718 kg of corn. During 2014-2017, corn production on state and federal properties in the MRGV was 1,052,006 ± 58,965 kg, which covers the energetic requirements of the identified migratory bird populations reliant on this food resource for the duration of the winter. Interagency collaboration, effective planning during the growing season, and strategic schedules for manipulating corn crops that integrate population abundances and their respective energy demands should further promote the success of the corn subsidy program in the MRGV.

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Key words: bioenergetics, corn subsidies, greater sandhill cranes, *Grus canadensis tabida*, migratory birds, winter.

WHOOPING CRANE OUTREACH IN THE EASTERN FLYWAY

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Abstract: The International Crane Foundation began to expand outreach efforts in the Eastern Flyway in 2015. We are now able to reach over 13,000 individual interactions at over 200 events annually. We have active outreach campaigns in Alabama, Indiana, and Wisconsin, and some smaller scale activities in Illinois, Kentucky, and Tennessee. The impetus for this program was to try to reduce the number of whooping crane (*Grus americana*) shootings in the Eastern Migratory Population but has since expanded to other behavioral changes, such as support of wetland conservation, increased membership in ICF, and general enthusiasm for cranes. We have worked with Dr. Wayde Morse at Auburn University, and Dr. Linda Prokopy at Purdue University, to conduct social science surveys that can help inform our campaigns. Both researchers have conducted baseline surveys, primarily through the mail. Initial results show slightly higher levels of whooping crane awareness and knowledge in Indiana than in Alabama, although there has not been a formal analysis made of the difference between the states. Both sets of surveys have helped inform our campaigns, which are uniquely tailored to each state. Since we have begun work in Indiana and Alabama, there have not been any documented whooping crane shootings in those states, but with the anticipated increase in population numbers, it is essential that we maintain our presence in the Eastern Flyway to ensure recovery of the whooping crane in North America.

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Key words: *Grus americana*, human dimensions, human wildlife conflict, outreach, social science, whooping crane.

SALINAS OF THE SOUTHERN GREAT PLAINS OF TEXAS: ORIGINS, THREATS, AND IMPORTANCE TO SANDHILL CRANES AND MIGRATORY BIRDS

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Abstract: Saline lakes and playa wetlands are the predominant landscape features and major wetland ecosystems of the Southern Great Plains (SGP), where approximately 1 saline lake exists for every 500 playa basins. Combined, they support much of the regional biodiversity, where saline lakes contain less numerical biological diversity but provide highly specialized habitats and ecosystems for biota obligate to these rare and complex systems, which are particularly susceptible to both natural and/or anthropogenic perturbations. Conservation concerns surrounding saline lakes and playas are multifaceted, but cessation of spring flow and reductions in hydroperiods, respectively, are arguably the most pressing conservation concerns for regional saline lake integrity and persistence. Surface water presence (and residence time) operates as an ecological driver of floral and faunal community composition, structure, and abundance in saline lakes and is clearly linked to regional hydrologic cycling on the SGP. Although regional saline lakes have been foci of geological, paleoenvironmental reconstruction, and geomorphological research in the mid-20th Century, they have largely been overlooked as relevant ecological features or hydrological drivers of the SGP in more recent research efforts. Regional saline lakes are geologically older than playas (25,000-300,000 years old) and are considered Pleistocene pluvial lakes to differentiate them from the regionally more common playas that provide the primary surficial features on the SGP. As such, sandhill crane (*Grus canadensis*) use of these saline lakes extends for millennia, and their relevance for hemispheric conservation planning for sandhill cranes remains germane. This presentation highlights the geologic origins of these saline lake systems and linkages to migratory bird conservation and management in the SGP with a particular focus upon overwintering and migrating sandhill cranes.

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Key words: *Grus canadensis*, playa, saline lakes, sandhill crane, Southern Great Plains.

FACTORS ASSOCIATED WITH LOCAL AND STATEWIDE POPULATION TRENDS OF THE FLORIDA SANDHILL CRANE

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Abstract: Breeding Bird Survey (BBS) data indicate that the Florida sandhill crane (*Grus canadensis pratensis*) population has been increasing for 50 years despite substantial habitat loss and a period of extended drought. We generated BBS route-specific population trends for 1966-2016 to better understand the statewide population growth. We also assessed whether changes in land use over time were correlated with local increases or decreases in the sandhill crane population. Finally, we explored how drought during the breeding season affected the number of cranes detected during the BBS and the number of young cranes detected in a fall post-reproductive survey we conducted during 1991-2016. Of the 42 BBS routes on which cranes were observed, populations increased on 17 (40%), declined on 3 (7%), and no change was detected on 22 (52%). Most of the population growth occurred in the north and northwest portions of the core breeding range, in central Florida. During the period for which land cover change data were available (1985-2016), populations increased on routes with increased urban land cover. Contrary to our predictions, drought during the breeding season was positively associated with a greater number of birds, probably because adults forgo nesting during dry periods and occur more frequently in upland habitats, where they are easier to see during roadside surveys. Drought did affect productivity; substantially fewer juvenile cranes were detected in fall surveys following a drier breeding season. Productivity rates were similar to those associated with stable or growing crane populations in all but the driest years.

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Key words: Breeding Bird Survey, *Grus canadensis pratensis*, Florida, sandhill crane.

FLORIDA SANDHILL CRANE MARSH USE AND NEST SUCCESS IN IMPROVED PASTURE AND FIRE- AND MECHANICALLY-MANAGED DRY PRAIRIE

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Abstract: Habitat loss is the primary threat to Florida sandhill cranes (*Grus canadensis pratensis*). Many publicly managed lands have suitable wetlands for cranes but lack usable uplands due to dense vegetation. We monitored nesting of cranes in 51 depression marshes on publicly managed dry prairie, before and after roller-chopping, and on 55 marshes of privately owned pastureland in central Florida, 2014-2017. Nest density was marginally greater in pastures (11.0 nests/km^2 ± 3.40 SE) than in in dry prairie (5.0 nests/km^2 ± 0.91 SE). Too few nests occurred in dry prairie to compare nest density in roller-chopped versus control plots. We measured vegetation at a subsample of marshes and found overall shorter vegetation, more grass, and fewer palmettos and shrubs in pastureland compared to treated and untreated dry prairie. We found roller-chopping altered vegetation structure in the expected direction for nearly all measured variables, but the effects were highly variable. Overall, roller-chopping and burning reduced palmetto (*Serenoa repens*) and shrub density in the nearly impenetrable vegetation immediately surrounding marshes and surrounding prairies and resulted in an observable increase in prairie grass density. We did not, however, see an increase in crane nest density on dry prairie after roller-chopping and burning during the project time frame.

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Key words: Florida, *Grus canadensis pratensis*, habitat, mechanically managed, sandhill crane.

NEST SUCCESS AND CHICK SURVIVAL OF SANDHILL CRANES IN SOUTHCENTRAL WISCONSIN

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Abstract: Greater sandhill cranes (*Grus canadensis tabida*) and whooping cranes (*G. americana*) are biologically similar species; thus, understanding productivity of sandhill cranes in the varied habitats they occupy in Wisconsin could be an indicator of future whooping crane breeding success and inform subsequent release locations and techniques. The Eastern Migratory Population (EMP) of whooping cranes is dispersing across central Wisconsin through current captive rearing and release techniques, but it is not entirely known how this landscape will affect breeding success in the wild. We may gain insight into the ability of whooping cranes to successfully breed in these novel habitats based on how sandhill cranes perform. To understand the success of sandhill cranes breeding in habitats of varied agricultural intensity, nest success of color-marked pairs and weekly survival of their chicks were analyzed during 2017-2019. To assess nest success, trail cameras were placed at active nests of color-marked pairs to determine the outcome in Necedah National Wildlife Refuge (NWR); Briggsville, Wisconsin; and Horicon NWR. After hatch, family groups were monitored weekly to determine their status until the chick(s) fledged or the pair was no longer observed with a chick. Overall, sandhill crane nest success was comparable across these different landscapes but chick survival was not. This information will be critical when assessing future release areas for EMP whooping cranes.

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Key words: breeding, chick survival, greater sandhill crane, *Grus canadensis tabida*, nest success, Wisconsin.

A METAPOPULATION VIABILITY ANALYSIS FOR WHOOPING CRANES, WHAT IT MEANS FOR SPECIES RECOVERY PLANNING—NEXT STEPS

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Abstract: The International Whooping Crane Recovery Team initiated a process with the IUCN-SSC Conservation Planning Specialist Group and partners to develop a metapopulation viability analysis (PVA) for whooping cranes (*Grus americana*), updating a 1991 PVA for the species. A PVA examines current and predicted future population demographic trends using the best available information to evaluate how populations might perform under various threat and opportunity scenarios. We gathered best available information through 2 expert workshops held in 2015 and 2016 at the Calgary Zoo and a number of conference calls through 2018. Demographic dynamics were explored using the software package *Vortex* for the 4 extant populations: the natural, migratory Aransas-Wood Buffalo population (AWBP); the reintroduced, eastern migratory population (EMP); the reintroduced, non-migratory Louisiana population (LNMP); and the captive population managed by a Species Survival Plan (SSP). We also modeled potential interactions between these populations. The PVA indicates that the AWBP is likely to continue to grow and appears to be resilient to a wide variety of threats across its range. The extinction risk for AWBP is predicted to be <1% over the next 100 years. The AWBP was most sensitive to changes in adult survival and juvenile recruitment; therefore, management scenarios that maintain relatively high adult survival and enhance juvenile recruitment provided the greatest demographic benefit. Insights from the PVA will be incorporated into a Species Status Assessment (SSA) currently being prepared by U.S. Fish and Wildlife Service. The SSA will inform a 5-year status review and updated International Recovery Plan for the species.

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Key words: *Grus americana*, metapopulation , population viability analysis, recruitment, survival, threats, whooping crane.

IMPACTS TO INTEGUMENT FROM LEG BAND-MOUNTED TELEMETRY DEVICES IN WHOOPING CRANES

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Abstract: We used standardized postmortems of suitable carcasses to assess pathological effects of leg band-mounted telemetry tags on whooping cranes (*Grus americana*). Our dataset included gross and histopathological assessment of leg skin from 20 Eastern Migratory Population cranes from 2014 to 2017. All cranes carried a leg band-mounted radio tag; 7 carried an additional PTT or GSM tag on the opposite limb. Gross lesions, typically flattened or depigmented areas with or without cutaneous ulceration or scabs, varied in surface dimension from 2 mm to >1 cm in diameter, and were described in 14 of 20 (70%) cranes. Of cases with histopathological assessments, 13 of 14 (93%) cranes were described with hyperkeratosis, epidermal hyperplasia, epidermal ulceration with intralesional bacteria, and dermatitis. We scored the severity of both gross and histopathological lesions in each leg in order to yield a maximum severity score from each crane. The distribution of severity scores ranged from none/normal ($n = 3$, 15%), mild ($n = 4$, 20%), moderate ($n = 9$, 45%), to severe ($n = 4$, 20%). The maximum severity score for the cranes was associated with a radio tag in 15 of 20 cases (75%), a PTT or GSM tag in 2 of 7 cases (28%), and a color band set in 3 of 13 cases (23%). The risk ratio of a maximum severity score associated with a radio tag versus bands alone was 3.25 (Fisher exact 1-tail $P < 0.01$) and versus a PTT/GSM tag was 2.62 ($P < 0.05$). The health and welfare risk from leg band-mounted telemetry devices may be greater than previously believed.

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Key words: Eastern Migratory Population, *Grus americana*, integument, leg bands, pathology, telemetry, whooping crane.

EFFECTS OF SALINE LAKES AND PLAYA WETLAND ECOLOGICAL STATE CHANGES ON SANDHILL CRANE SPACE USE OF THE SOUTHERN HIGH PLAINS

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Abstract: Saline lakes and playa wetlands on the Southern High Plains represent unique ecological systems in a semi-arid landscape. The <50 saline lakes, historically winter roost sites for sandhill cranes (*Grus canadensis*), are discharge wetlands directly connected to the Ogallala Aquifer. Exploitation of the Ogallala Aquifer since the 1950s has resulted in the reduction and frequent cessation of spring discharge into saline lakes. Only 4 saline lakes have maintained inundated conditions since 1973. Saline lakes experienced complete drying starting in the 1970s. The ecological state of saline lakes has changed from continuous inundation to one dependent upon unpredictable, intensive precipitation events for inundation. The combination of hydrological changes and landscape changes has resulted in nearly cessation of use of saline lakes by sandhill cranes. The approximate 20,000 playa wetlands are freshwater wetlands solely dependent on precipitation runoff collectively form principal recharge sites for the Ogallala Aquifer. Historically, playas supported sandhill cranes as a source of freshwater. Anthropogenic alternation to accommodate row-flood irrigation during the 1950s-1990s, changing cropping practices, establishment of exotic grasses in surrounding Conservation Reserve Program (CRP) land, roads, and many other impacts have greatly altered the presence and function of playas. Approximately 20% of playas have been lost from the landscape, <1% are free of any anthropogenic impacts, and nearly 60% are nonfunctional. Wintering sandhill cranes have abandoned roosting on saline lakes since the early 2000s and currently depend on the freshwater playas to serve as roost sites. Continued physical and functional loss of playas will further constrain space use by sandhill cranes.

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Key words: ecological state, *Grus canadensis*, playa wetland, saline lake, sandhill crane.

TESTING USE OF SMALL UAS TO DETECT NESTING SANDHILL CRANES

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Abstract: The Mississippi sandhill crane *(Grus canadensis pulla*) is a non-migratory endangered subspecies found in the wild on and near the 8,000-ha Mississippi Sandhill Crane National Wildlife Refuge. Locating nesting cranes is necessary to monitor nest success and progress toward recovery as well as informing decisions on timing and areas for prescribed burning during the growing season. With more nesting pairs, yet reduced monitoring resources, we needed cost-effective survey methods to cover the necessary area. During the 2016-2019 nesting seasons, we began testing small Unmanned Aircraft Systems (UAS) to detect nests, eggs, chicks, and adults. We tested multirotor and fixed-wing UAS, different still and video cameras, visible color and infrared sensors, different speeds and altitudes, and viewed in real time or recorded imagery. From 18 days and 34 missions, we were able to detect 14 nests and 1 large chick with its parents. Flying 30-40 m above ground level at 4-5 m/sec allowed the best opportunity for detection while still minimizing disturbance to the cranes. In most cases, we had higher detection using a direct georeferenced FLIR (infrared) sensor, especially with any overstory. Color visible camera video was useful in detecting crane movement as a cue for nest location, but was not directly georeferenced although locatable through later reference to mission flight plan on map. Due to low altitude detection requirements, most nest areas required multiple flights with multirotor UAS to complete area coverage.

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Key words: drone, endangered species, *Grus canadensis pulla*, Mississippi sandhill crane, monitoring, nesting.

RETHINKING WETLAND CONSERVATION IN A WATER-SCARCE FUTURE

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Abstract: Water availability is of increasing concern globally. In the United States, conflicts over water resources are common and are no longer limited to arid western lands. Agriculture, energy development, and urban use are increasingly impacting water availability and hence, wetland availability for cranes. Numerous public lands, even those with strong water rights, are embroiled in contentious water issues. Increasing human populations and changing human food habits are expected to increase pressure on global food resources and water availability. We argue that a new, or improved, approach to wetland conservation is needed that is grounded in long-term water security. Because agriculture is the greatest user of water, understanding the economic incentives of farmers and market pressures that affect their land and water use decisions is a critical first step in addressing conservation needs. Conservation programs such as the Wetlands Reserve Program and the Conservation Reserve Program have provided numerous benefits to wildlife, but we argue that status quo conservation efforts without changing broader water use behaviors will achieve little long-term success in many regions. Agricultural production in these regions is also threatened by the same water issues, thus opportunities exist to work with agricultural interests, but solutions will require innovative approaches possibly outside current agricultural approaches.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 15:164

Key words: conservation, farm bill, policy, water, wetlands.

THE ARANSAS-WOOD BUFFALO WHOOPING CRANE POPULATION: MULTI-LEVEL, MULTI-SCALE HABITAT SELECTION OF WHOOPING CRANES ON THE TEXAS COAST

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Abstract: We used a multi-level, multi-scale resource selection function to examine habitat selection of the Wood Buffalo/Aransas Population of whooping cranes (*Grus americana*) along the Texas coast. We used variables based on land classification, vegetation height derived from LiDAR data, plant phenology as derived from eMODIS, and monthly indices of drought summarized at the 4-km^2 scale to predict habitat selection by these whooping cranes at population, landscape, and local scales. We also included Topographic Position Index as a predictor variable, a metric that summarized the elevation of an area relative to the surrounding habitat. We summarized each predictor variable using focal means calculated at 0.05, 0.125, 0.25, 0.5, 1, 2, 4, and 8-km radii, with the exception of coarser resolution variables. These variables were summarized at all focal means larger than their initial resolutions. Whooping crane data were collected from 63 GPS-equipped birds between 2009 and 2015. For our response variable, we used a used-available design by drawing a set of random points that was equal to the total number of GPS locations in the data set (n = 55,400). Preliminary results suggest that marsh habitats were important at all spatial scales. Crop distribution, including percent cover of corn and sorghum, and vegetation phenology metrics were important at intermediate spatial scales.

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Key words: *Grus americana*, LiDAR, remote sensing, resource selection function.

PROGRESS MADE WITH LAND MANAGERS TO IDENTIFY AND IMPROVE POTENTIAL STOPOVER HABITATS FOR MIGRATING WHOOPING CRANES

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Abstract: Whooping cranes (*Grus americana*) of the Aransas-Wood Buffalo Population migrate 4,000 km twice each year between their nesting grounds in northern Canada and their wintering grounds on the Texas Gulf Coast. During migration they must land approximately 12 to 24 times at suitable ponds, lakes, or other wetlands to feed or rest. The Whooping Crane Recovery Plan calls for the protection and management of whooping crane stopover locations within the migration corridor. While some major stopover areas have been protected, many other smaller sites remain to be identified. Moreover, the Recovery Plan offers no specific entity to protect and manage the latter. To address these gaps in information and activity, Friends of the Wild Whoopers engaged with large land-holding entities (Corps of Engineer lakes, military bases, and Indian Reservations) within the migration corridor to share information about whooping cranes and their habitat needs and to identify suitable stopover sites that could be protected and managed for cranes. This cooperative effort identified up to 177 wetlands/ponds as potential stopover sites on 14 military bases in Kansas, Oklahoma, and Texas, and as many as 1,275 on 6 Indian Reservations in North and South Dakota, with commitments to manage the habitats as resources allow. To date, 34 Corps of Engineer lakes in Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, and Wyoming have been evaluated and 123 stopover sites have been identified and slated for management.

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Key words: Aransas-Wood Buffalo Population, stopover habitat, Whooping Crane Recovery Plan.

FRAGMENTATION OF THE NETWORK OF ISOLATED WETLANDS ON THE SOUTHERN HIGH PLAINS OF TEXAS

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Abstract: There are >80,000 ephemeral freshwater wetlands in the Great Plains (playas) that form a transcontinental habitat network of migratory stopover and overwintering resources for sandhill cranes (*Grus canadensis*). Because they are filled from precipitation runoff, playas are sensitive to surrounding land use and climate and are highly dynamic seasonally and interannually in inundation and hydroperiod. Weather patterns and human activities work singly and in tandem to affect whether a playa contains water, which in turn has implications on whether a crane can successfully traverse the network during migration or seek resources efficiently in winter. In my lab, we use remote sensing, GIS, and connectivity modeling to examine the dynamic structural connectivity of the playa wetland network in the Southern High Plains of Texas. We have documented functional losses of playas in terms of their ability to hold water, and we have estimated how much animals must now compensate for those losses. Originally, organisms had to be able to disperse 4-8 km to traverse the playa network. But because >80% of the playas in Texas no longer hold water even during wet times due to land conversion, the network's topology has thinned. From the tandem effects of drought and land conversion, organisms must now be capable of travelling 2-8 times farther to traverse the landscape via the remaining playa wetlands, even if all were wet simultaneously. Wildlife management is challenging in such a dynamic, large-scale system, where identification of key playas that play outsized roles in facilitating connectivity is an unfeasible objective.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 15:166

Key words: graph theory, network theory, playa, structural connectivity.

IDENTIFYING SUSTAINABLE HABITAT FOR WINTERING WHOOPING CRANES

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Abstract: The only wild population of endangered whooping cranes (*Grus americana*) requires a sustained network of conservation lands for wintering along the Texas Gulf Coast. We identify the locations providing the highest quality and most sustainable wintering habitat for cranes (through 2100) by predicting habitats under 3 projections of sea level rise (0.6, 1.0 and 2.0 m by 2100), while incorporating a scenario of urban development. We combine predictions of habitat with whooping crane density estimates, using a hierarchical distance sampling framework, to calculate the potential carrying capacity of whooping cranes within this 17,725-km^2 area. We found whooping cranes using locations with salt marsh at twice the rate of places lacking marsh. Areas >15 km from development or <3 km from estuarine water had increased crane use. We predicted 3% of this area converting to development by 2100. We estimated the study area supporting 1,544 (95% CI: 1,366-1,772) whooping cranes currently, 1,100 (95% CI: 993-1,228) with 0.6-m sea level rise and 849 (95% CI: 788-919) with 2-m sea level rise by 2100, when including development projections. With 1-m and 2-m sea level rise scenarios, development reduced carrying capacity outside of protected areas, whereas sea level rise posed greater threats within protected areas. By anticipating climate-induced habitat loss with species population expansion, we provide the requisite spatial information for conservation planners to build a sustainable conservation estate for downlisting whooping cranes.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 15:166

Key words: carrying capacity, *Grus americana*. landscape design, sea level rise, Texas Gulf Coast, whooping crane, wintering grounds.

TRENDS IN SANDHILL CRANE NUMBERS IN EASTERN NEW MEXICO–AN UPDATE

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***Abstract*:** Sandhill cranes, predominantly the lesser subspecies (*Grus canadensis canadensis*), migrate through and winter in agricultural areas in the Pecos River Valley of eastern New Mexico. As part of routine wildlife monitoring activities, weekly roost counts were conducted at Bitter Lake NWR and off-refuge sites in Chaves County, New Mexico, from fall 1989 through spring 2019. From a low fall migration peak (October through November) of 5,640 in 1989, fall peak numbers gradually increased to 15,790 in 2003 and 13,560 in 2004. This increase was significantly correlated ($r = 0.761$, $P < 0.01$, $n = 16$) with an increase from 1,781 ha in 1989 to 7,325 ha in 2004 ($\bar{x}$ = 4,038 ha) of corn grown and cut for silage in Chaves County. Likewise, crane-use (defined as the sum of weekly counts from September to April) was also correlated with hectares of corn ($r = 0.600$, $P < 0.05$, $n = 16$). In 2005, the fall peak count abruptly increased to 22,000 and continued to increase to a high of 32,010 in 2012. Fall migration peak numbers then averaged over 23,000 through 2018. From 2005 to 2016, hectares of corn varied annually from 7,608 ha to 4,249 ha ($\bar{x}$ = 6,204 ha). In contrast to 1989-2004, the large fall peak numbers and annual crane-use were not correlated with hectares of corn ($r = -0.198$ and 0.302 respectively, $P > 0.05$, $n = 12$). Between 2005 and 2018, weekly numbers following the fall migration peak did not remain high but steadily declined to approximately 5,000 by late January and 3,000 by late February. This decline indicates available resources in Chaves County are not sufficient to support large numbers of cranes through the winter. We do not have a local explanation for the abrupt fall increase in 2005 and the continued high fall peak numbers through fall 2018; however, these suggest a shift in the migration pattern of cranes entering eastern New Mexico.

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Key words: Bitter Lake NWR, eastern New Mexico, fall migration, *Grus canadensis*, increase in numbers, sandhill crane.

HUMAN DIMENSIONS OF WHOOPING CRANE CONSERVATION IN ALABAMA

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Abstract: As part of a group symposium on human dimensions research with the International Crane Foundation, this abstract presents the results of 2 efforts to provide a foundation for outreach communication strategies regarding whooping crane (*Grus americana*) conservation. The whooping crane population has grown through enhanced protection and management, but still faces many challenges to its existence. Human dimensions research can help us to understand how the public views conservation–and poaching–of whooping cranes. Effective outreach of endangered species often requires an understanding of human dimensions information to guide pro-conservation behavior. In Alabama, we administered surveys to local residents, waterfowl hunters, and birders to identify the best predictors of attitudes and behavioral intentions toward whooping cranes across the audiences. Using constructs from the cognitive hierarchy and the value-belief-norm theory, we tested a theoretical framework to identify the best predictors of attitudes and behavioral intentions toward whooping cranes. The second research effort is designed to understand the conversations on social media regarding conservation and poaching. We used the Social Media Listening Center (SMLC) at Clemson University to listen, discover, and measure in conversations across the Web. The first phase of this research will use text analysis tools to analyze all of the social media communications of the ICF and affiliates. SMLC searches will be used to analyze which conservation messages are being distributed, on which platforms, and to which audiences. Results of this project will provide information and help ICF understand how their conservation messages are being interpreted and spread through social media.

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Key words: communication, *Grus americana*, human dimensions, social media, whooping crane.

SUMMER HOME RANGES AND NESTING ECOLOGY OF GREATER SANDHILL CRANES IN NORTHEAST OREGON

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Abstract: Oregon Department of Fish and Wildlife (ODFW) began color banding pre-fledging greater sandhill cranes (*Grus canadensis tabida)* at Ladd Marsh Wildlife Area (LMWA) in northeastern Oregon in 2007. In 2015, we began placing Platform Transmitter Terminals (PTTs) on adults and pre-fledging colts. To date, we have banded 43 cranes and placed PTTs on 14 individuals. Using telemetry and resight data on these and unmarked cranes, we mapped summer home ranges, nesting territories, and nest sites of cranes at LMWA. We used Brownian Bridge Movement Models (95%) to assess placement and size of home ranges on LMWA. When we located a nest, we recorded nest characteristics such as size, water depth, and materials used for our fine-scale assessment. Results for summer home ranges indicated nesting territories on LMWA have changed little since monitoring began, although with unmarked cranes, we were uncertain the same pairs held them every year. However, PTT data have shown repeated use of the same territories. At nest locations, cranes at LMWA built nests in water up to 82 cm deep, using common cattail (*Typha latifolia*), hardstem bulrush (*Schoenoplectus acutus*), reed canarygrass (*Phalaris arundinacea*), or some combination of these materials. Several pairs also built more than 1 nest-like structure near the nest on which they incubated eggs. Based on results at the home range scale, cranes placed nests in managed wetlands away from highways and open pastures. These initial results stress the importance of maintaining managed wetlands on LWMA while minimizing anthropogenic development around historical nesting territories.

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Key words: greater sandhill crane, *Grus canadensis tabida*, managed wetlands, nesting ecology, northeast Oregon, satellite telemetry, summer home range.

FIVE YEARS OF RELEASING PARENT-REARED WHOOPING CRANES IN WISCONSIN

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Abstract: Starting in 2013, we began a multi-year study using adult whooping crane (*Grus americana*) pairs to rear chicks that were then released in central Wisconsin after fledging in captivity. The first 3 years were a pilot study with 3-4 colts released each year. Parent birds were chosen based on experience rearing sandhill or whooping crane chicks in previous years. During the pilot years 2013-2015, the 1-year survival rate of released whooping crane colts was similar to that of costume-reared whooping cranes and whooping cranes that hatched at Wood Buffalo National Park in the wild. Parent-reared colts were transported by private aircraft in late September to Wisconsin where they were banded and received a conventional VHF transmitter on 1 leg band and a satellite transmitter on the other leg band. Then the colts were placed in a temporary enclosure within the home range of a breeding pair of whooping cranes that had previously nested and either lost their nest or chick. After several days, the colt was released and monitored daily until migration. In 2016, 10 colts were released in a similar fashion but with several releases of 2 colts at the same site. In 2017 the enclosures were not used, with all releases made directly into known roosting areas of adult birds. One female from 2013 paired with a male, nested, and successfully hatched a chick as a 3-year-old. The program has generally been successful and is now the method preferred by the U.S. Fish and Wildlife Service for releasing whooping cranes in Wisconsin.

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Key words: allo-parent, *Grus americana*, parent rearing, rearing method, whooping crane.

PRESENCE OF WIND TOWERS DISPLACE MIGRATING WHOOPING CRANES

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Abstract: Wind energy production has increased greatly over the past 2 decades in the Great Plains, a region that also serves as the migration corridor for whooping cranes (*Grus americana*). From 2010 to 2016, the number of wind towers tripled in the 95% migration corridor and quadrupled in the 50% corridor. Impacts of wind energy infrastructure are not known for whooping cranes; direct mortality and indirect habitat loss are possible outcomes. Therefore, we quantified exposure and potential displacement of migrating whooping cranes by wind towers. Median distance to nearest wind tower was 52 km and 1% of locations were within 4.5 km. Median distance from crane locations to towers decreased by year and was correlated with number of towers present ($r = -0.78$). A habitat selection model revealed that whooping cranes used areas within 3.75 km of towers less than expected (i.e., a zone of influence). Extrapolating this zone of influence to wind towers active in 2016, 3% of the migration corridor was potentially impacted. Habitat selection analyses also revealed that wind towers have been constructed in locations that, on average, were similar to random locations in terms of crane habitat preference, suggesting that towers had not been necessarily constructed to avoid potential whooping crane habitat. These results can be used to identify towers placed in good and poor crane habitat and to identify places that would have reduced impact on whooping crane habitat.

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Key words: displacement, disturbance, *Grus americana*, migration, whooping crane, wind energy.

ENVIRONMENTAL FACTORS DRIVING NOCTURNAL WHOOPING CRANE MOVEMENT PATTERNS ON THE TEXAS WINTERING GROUNDS

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Abstract: The whooping crane (*Grus americana*) is one of most endangered bird species in North America; an estimated 504 individuals occur in the natural, wild flock. This species migrates from breeding grounds at Wood Buffalo National Park in Canada to wintering grounds in and around Aransas National Wildlife Refuge (ANWR) along the mid-Texas coastline. As the population continues to increase, its range is expanding away from ANWR and into unprotected areas. Studies have assessed diurnal whooping crane use, but little is known about roost site locations and fidelity. We used 30,000 telemetry data points from 2009 to 2013 provided by the Whooping Crane Tracking Partnership in ArcGIS and R programming to evaluate family roost site selection and movement as they relate to environmental factors (water surface level, wind speed and direction, Palmer Hydrological Drought Index). We created a 95% and 50% kernel density estimate (KDE) home range using the reproducible home range package in R for marked juveniles representing each family. Whooping crane decisions to roost in coastal marsh or open bay habitats are strongly influenced by surface water levels. When long-distance night movements are identified, wind speed was a significant factor. Cranes traveled farther distances, increased the number of core use areas, and had less nocturnal/diurnal site overlap during drought years. These outcomes will be useful to prioritize future conservation locations as the population recovers and becomes more likely to interact with humans across the landscape.

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Key words: ArcGIS, *Grus americana*, movements, wet/drought cycle, whooping crane.

FACTORS AFFECTING COLT SURVIVAL OF WILD-HATCHED WHOOPING CRANES IN THE EASTERN MIGRATORY POPULATION

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Abstract: The reintroduced Eastern Migratory Population (EMP) of whooping cranes (*Grus americana*) has exhibited appropriate breeding behavior, including pair and territory formation, nesting, and colt hatching and rearing. However, recruitment has been much lower than what is needed for a self-sustaining population due to poor nest success and high colt mortality. From 2006 to 2019, there have been 134 successful hatches, with only 13 of those birds remaining in the population today. In order for the EMP to survive without continued releases of captive-reared individuals, we must develop management strategies that increase recruitment to a level higher than mortality rates. We examined long-term monitoring data collected via aerial and ground surveys using radio telemetry and observations of all wild-hatched whooping cranes from 2006 to 2019. In this study, we explore relationships between colt survival and parental experience, spatial or habitat data, and nest characteristics. Preliminary results suggest that wild-hatched whooping cranes tended to have an increased chance of survival past 40 days if they had older parents, mothers that had nested for more years, or fathers that had previously hatched a colt. Colts were more likely to live for longer if parents had prior nesting experience or had previously hatched a colt. Since colt survival is positively related to parental experience, we can expect colt survival and recruitment to improve in the future. We should also continue to address gaps in the data, specifically related to colt habitat use, cause-specific mortality, and the effects of land management strategies on crane productivity.

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Key words: breeding success, colt survival, Eastern Migratory Population, experience, *Grus americana*, habitat, whooping crane, Wisconsin.

MURAVIOVKA PARK–SPECIALLY USED NATURE AREA

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Abstract: Muraviovka Park, the first area of sustainable land use in Russia, was established in 1996 on "working" lands (i.e., where economic activities take precedence) to improve habitat conditions for endangered and threatened cranes, other animals and plants, test sustainable forms of land use, conduct environmental education, and involve local communities in conservation of this place and its wildlife. The park boasts over 700 species of plants and 300 species of birds, including red-crowned, Siberian, white-naped, hooded, Eurasian, and sandhill cranes (*Grus japonensis*, *G. leucogeranus*, *G. vipio*, *G. monacha*, ***G. grus***, and *G. canadensis*, respectively). The park area (~5,666 ha) and adjacent Amur River floodlands represent wetlands of international importance. The presentation describes the park's goals and objectives, its history and current activities, challenges and successes, and the community of its friends and supporters.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 15:170

Key words: biodiversity, community support, education, environmental, specially used nature area, sustainable land use.

HIGH VECTOR-BORNE HAEMOSPORIDIA PREVALENCE IN EASTERN SANDHILL CRANES OVER TWO DECADES

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***Abstract*:** Haemosporidians are a diverse group of vector-transmitted blood parasites that include the agents of human and avian malaria. In birds, the impacts of haemosporidian infection can range from asymptomatic to acute mortality or population-level impacts on fecundity and survival. These parasites have been found in sandhill cranes (*Grus canadensis*), a migratory species that may serve as a sentinel for understanding health threats to the endangered whooping crane (*G. americana*). We used molecular techniques to compare prevalence and diversity of Haemosporidia in wild sandhill cranes from the Eastern Migratory Population that migrates annually between Wisconsin and the southeastern U.S. Using archived blood samples collected over a 20-year period (1997-2017), we amplified the mitochondrial cytB gene of *Plasmodium* and *Haemoproteus*. Phylogenetic analysis is being conducted to identify parasite lineages. Overall the infection prevalence in birds (n = 175) was 71.4%, with no difference across early versus late time period sampled (P = 0.43) or between sexes (P = 0.53). Infection prevalence in young (hatch-year) birds (80.7%; n = 109) was significantly greater than that of older birds (66%; n = 66; P = 0.0009); this may be related to the immune status or relative lack of anti-vector defense of immature individuals. In at least 1 recaptured individual, PCR and sequencing revealed evidence of co-infection with both a *Plasmodium* sp. and a *Haemoproteus* sp. The baseline data gathered from this study will contribute to our understanding of the factors that influence haemosporidian prevalence in sandhill cranes over time and inform directions for future epidemiologic studies and conservation efforts.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 15:171

Key words: blood parasites, eastern sandhill cranes, *Grus canadensis*, Haemosporidia, molecular detection, prevalence.

MONITORING WHOOPING CRANE NESTS IN LOUISIANA THROUGH THE USE OF TRAIL CAMERAS

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Abstract: Nesting in the Louisiana nonmigratory population of whooping cranes (*Grus americana*) began in 2014 with a single pair. Breeding propensity increased as more cranes in the population matured and paired in subsequent years. To help supplement nest monitoring efforts, we began deploying trail cameras at a subset of nest sites in 2016. Each trail camera was programmed to photograph the nest every minute to document nest attendance and potential causes of nest failure. Cameras have been deployed on nests from as early as 7 days prior to incubation initiation to as late as 27 days into incubation ($\bar{x}$ = 11.4-12.7) and placed at distances of 4.7-25.2 m ($\bar{x}$ = 12.1) from the nest. Through 2018, trail cameras were deployed at 21 nests, mainly in agricultural fields where cranes are already somewhat accustomed to human activity, with only 1 nest abandoned due to the disturbance or the presence of the camera after deployment. Total time pairs were off the nest due to deployment disturbance ranged from 7 to 88 minutes ($\bar{x}$ = 33.6 min). In 2016, all cameras were mounted on 1.8-m (6-foot) t-posts driven into the ground; however, beginning in 2017, we began using lightning bolt mounts (Reconyx, Holmen, WI, USA*)* that are attached to both a 16-mm-diameter 1.2-m (4-foot) steel electric fence post and an 8-mm-diameter 1.2-m weldable steel rod, which provided extra stability. This mounting system allows for a quicker and quieter deployment in the field in addition to a lower profile setup.

PROCEEDINGS OF THE NORTH AMERICAN CRANE WORKSHOP 15:171

Key words: breeding, *Grus americana*, Louisiana, nesting, trail camera, whooping crane.

AN UPDATE ON THE LOUISIANA NON-MIGRATORY WHOOPING CRANE REINTRODUCTION

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Abstract: Since the first release of captive-reared whooping cranes (*Grus americana*) in 2011, 147 cranes have been members of the non-migratory population in southwestern Louisiana. This total includes 138 captive-reared cranes, 7 wild-fledged cranes, and 2 adult females translocated from the remnant Florida reintroduction effort. Through September 2019, a maximum of 69 (46.9%) currently survive, with 11 juveniles slated to be released by the end of the year. Gunshot remains a prominent cause of known mortality, and power line collisions have increased in recent years. Released whooping cranes continue to exhibit excellent nesting efforts, with a 57.5% renesting rate, and some pairs nesting up to 3 ($n = 3$) and 4 ($n = 3$) times in 1 season. Additionally, multiple young cranes (2 males, 1 female) have reached sexual maturity at 2 years old, the youngest ever documented for males in any whooping crane population, including captivity. Hatchability of eggs remains poor, however, with 30 documented embryo deaths of 43 known fertile eggs. In order to collect more information on possible causes of embryo mortality, we increased the use of data-logging eggs and began sending egg samples for toxicology testing. When chicks are reared by parents in the wild, survivability to independence has been 43.8% (7/16). Unfortunately, extreme weather has played a major role in nesting failures and likely contributed to the failure of 5 nests and the death of 2 young chicks in 2019 alone.

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Key words: embryo mortality, *Grus americana*, Louisiana, non-migratory, reintroduction, whooping crane.

POPULATION UPDATE FOR THE EASTERN MIGRATORY POPULATION OF WHOOPING CRANES 2017-2019

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Abstract: The reintroduced Eastern Migratory Population of whooping cranes (*Grus americana*) was established in 2001 in the eastern United States. During 2001-2019, 293 captive-reared cranes have been released into the population. In the last 3 years (2017-2019), we have released 1 costume-reared adult, 17 parent-reared juvenile, and 7 costume-reared juvenile whooping cranes in Wisconsin. As of fall 2019 the estimated population size is about 85 whooping cranes, and we plan to release 2 additional parent-reared juveniles before the end of the year. There have been 17–25 breeding pairs of whooping cranes in the past 3 years that have hatched a total of 47 chicks in the wild, 10 of which are still alive. Management actions taken at Necedah National Wildlife Refuge, including collecting eggs prior to black fly (*Simulium* spp.) emergence and water level management, have improved breeding success of whooping cranes. We have confirmed 26 mortalities during the past 3 years. Of the 18 with known causes of death, 7 were due to predation (39%), 5 were due to powerline collisions (28%), 2 were due to bacterial infections (11%), and 2 were due to poaching (11%). Ongoing studies of nesting behavior, habitat use of territorial birds, and causes of mortality will contribute to our understanding of the challenges faced by whooping cranes in the Eastern Migratory Population.

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Key words: breeding, Eastern Migratory Population, *Grus americana*, mortality, population monitoring, reintroduction, survival, whooping crane.

COUNTDOWN TO ENGAGEMENT: HABITAT AND ADULT-FOCUSED OUTREACH IN TEXAS

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Abstract: While outreach programs are often thought to be synonymous with youth programming, the outreach done by the Texas Program of the International Crane Foundation focuses primarily on adult audiences. Our core audiences include both resident and migratory adults primarily in the areas surrounding whooping crane (*Grus americana*) habitat. The small population of our primary areas lends itself to more in-depth and personal outreach, often leading nature-inclined audiences to the next step of whooping crane appreciation and habitat protection. We will highlight examples of adult- and habitat-focused outreach including 4 stakeholder-driven conservation workshops held in Summer 2019 and a collaborative landowner brochure published in Fall 2019.

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Key words: adult education, *Grus americana*, International Crane Foundation, outreach, stakeholder, Texas, whooping crane.

PUBLIC COMMUNICATION OF CRANE RESEARCH: SCICOMM PRINCIPLES AND METHODS

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Abstract: How do we let the world outside of this working group know about the work inside of it? This research-based session will cover concepts of Science Communication, or SciComm. This communication goes beyond publications and abstracts to infographics, selfies, hashtags, blogs–overall using modern, personal methods to directly spread scientific research and knowledge to new audiences, especially those who have the chance to influence the conservation issues that crane species face. The concept of science communication hinges on ideas of importance of public understanding, that less formality does not mean less accuracy, the 'post-truth' society, and that social media is an excellent tool for reaching broad audiences including every age range. With more threats mounting on crane species and their habitat, extending the scientific work of the North American Crane Working Group through Science Communication becomes an important conservation action.

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Key words: communication, dissemination, public, SciComm, science communication, social media.

VIDEO BEHAVIOR ANALYSIS OF TWO WINTERING POPULATIONS OF WHOOPING CRANES USING PROGRAM BORIS

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Abstract: The Aransas Wood Buffalo (AWBP) and Eastern Migratory (EMP) Populations of whooping cranes (*Grus americana)* utilize very different landscapes in the non-breeding season. By knowing what the distinct behavioral and habitat use differences are between the 2 migratory populations, managers can make better informed decisions. To gather this information, we analyzed 20-minute videos of groups of whooping cranes wintering in Aransas National Wildlife Refuge, Texas, and Goose Pond Fish and Wildlife Area, Indiana, collected by International Crane Foundation staff and volunteers in winter 2018-19. We prepared time budgets for each population to determine differences in behaviors and habitat use. Preparing behavior videos of cranes for data analysis can be a tedious and time-consuming process. We aimed to identify new time-efficient methods for coding behavior data from videos using a program that was open source, easy to use, and faster than the manual coding that had been done in the past. The program BORIS was found to be intuitive, easy to learn, and increased the speed of coding videos. The open-source nature of the program also makes it a viable candidate for citizen science participation in research. Summarized behaviors from 6 categories (foraging, locomotion, alert, comfort, social, or resting) indicated there are differences between wintering locations, social groups, and habitats. This information will aid whooping crane recovery by restructuring previously held assumptions regarding winter habitat use. Results will help refine management decisions, such as where habitat acquisition should be focused on the Texas coast and outreach efforts in the EMP.

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Key words: Aransas, behavior, Eastern Migratory Population, *Grus americana*, habitat use, video analysis, winter.

DIURNAL TIME-ACTIVITY BUDGETS AND HABITAT USE OF WHOOPING CRANES IN THE REINTRODUCED LOUISIANA NONMIGRATORY POPULATION

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Abstract: Time-activity budget studies have provided valuable insights for better understanding whooping crane (*Grus americana*) behavior relative to spatial and temporal habitat use. Much of this research has focused on the Aransas-Wood Buffalo Population on its wintering grounds in coastal Texas. We examined the reintroduced Louisiana Nonmigratory Population to determine how time-activity budgets change relative to crane age, habitat type, and season. Our study area encompassed natural marshes and working wetlands primarily in southwestern Louisiana. During June 2012-January 2016, we opportunistically conducted continuous focal sampling on individuals (n = 27) from the first 4 cohorts for a total of 1,635 minutes of observations. Overall, foraging was most often observed, accounting for 52.5% of the average diurnal time-activity budget of all cranes sampled, followed by maintenance/rest (27.7%), vigilance (11.5%), locomotion (6.3%), and other/unknown (2.1%). We classified age groups as juveniles, subadults, and adults, and we identified 5 main habitat types utilized by cranes in Louisiana including crawfish ponds, rice fields, agricultural levees/farm roads, fallow fields, and natural wetlands. We will further analyze the dataset to examine the spatio-temporal behavioral responses of the Louisiana Nonmigratory Population to improve our understanding of how the cranes utilize the natural marsh and working wetland habitats in order to facilitate the development of management options to enhance their persistence in these types of environments.

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Key words: behavior, continuous focal sampling, *Grus americana*, habitat, Louisiana, marsh, nonmigratory, time-activity budget, whooping crane, working wetland.

BEHAVIOR ANALYSIS AND LONG-TERM SURVIVAL OF CAPTIVE-REARED JUVENILE WHOOPING CRANES IN THE REINTRODUCED LOUISIANA NONMIGRATORY POPULATION

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Abstract: Captive-reared, juvenile whooping cranes (*Grus americana*) have been released annually in southwest Louisiana since 2011 with the goal of establishing a self-sustaining population in the region. Fifty costume-reared chicks were released at White Lake Wetlands Conservation Area in Vermilion Parish between March 2011 and January 2014. Chicks raised in captivity by human caretakers may face behavioral challenges that could impact their post-release survival. We conducted continuous focal sampling (2,905 min of observations over 3 years) to quantify behavioral patterns in an acclimation pen setting and develop time-activity budgets for each cohort. Overall, foraging accounted for 44.2% of the average diurnal time-activity budget of all cranes sampled, followed by maintenance/rest (25.5%), locomotion (12.2%), vigilance (10.9%), and other/unknown (7.2%). The observed vigilance in this study was much lower than the vigilance reported in the Florida Nonmigratory Population (19.2%), which was comprised of both parent- and costume-reared whooping cranes. Other studies have shown less vigilance in costume-reared chicks compared to their parent-reared counterparts. Survival rates were comparable to rates reported in the Eastern Migratory Population. The 1-year post-release survival rate in our study was higher than those reported in the Florida Nonmigratory Population. Long-term survival rates (up to 5 yr post release) were comparable to those observed in costume-reared Mississippi sandhill cranes (*G. canadensis pulla*) released in coastal Mississippi.

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Key words: behavior, continuous focal sampling, costume-reared, *Grus americana*, Louisiana, survival, time-activity budget, vigilance, whooping crane.

COMPARISON OF HUMAN- AND CAMERA-MONITORED WHOOPING CRANE NESTS TO DETERMINE AN EFFECTIVE SURVEILLANCE RATE

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Abstract: Trail cameras have been used to supplement human monitoring of whooping crane (*Grus americana*) nests in the Louisiana Nonmigratory Population since 2016. Human monitoring efforts began with the first active nest in 2014, and since then, 141 3-hr monitoring sessions have been conducted on 40 nests with the primary goal of recording incubation behavior. Thirty-two human monitoring sessions occurred at nests that were simultaneously being monitored by cameras programmed to photograph the nest every minute. We first investigated how accurately the data collected by cameras matched the field data collected by humans. We then examined different camera surveillance rates if pictures were taken every 3, 5, or 10 minutes instead of every minute. Preliminary data analysis indicates no significant differences in total nest attendance, incubation, or time left unattended among all of the various camera surveillance rates compared to human observations. However, nest attendance and incubation rates of females and males documented by cameras differed from human observations on average by >5% at the 3-min interval, >10% at the 5-min interval, and >20% at the 10-min interval. There was more uncertainty as to the sex of the parent tending the nest as the picture intervals increased. Determining parental sex based on nest camera pictures may be difficult or unwarranted if only concerned with total incubation rates. Furthermore, other factors should be considered before camera deployment to determine an effective surveillance rate based on study objectives such as documenting predation or minimizing disruptions to change batteries or check memory cards.

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Key words: camera, *Grus americana*, human monitoring, incubation, Louisiana, nest, surveillance rate, whooping crane.

DISPERSAL OF CAPTIVE-REARED YEARLING WHOOPING CRANES FROM RELEASE SITES IN SOUTHWEST LOUISIANA

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Abstract: From 2011 to 2018, 138 captive-reared whooping cranes (*Grus americana*) were released in Louisiana in an effort to re-establish a non-migratory population. We calculated the distances traveled by individuals soft-released at White Lake Wetlands Conservation Area (WLWCA) and Rockefeller Wildlife Refuge (RWR), Vermilion and Cameron Parishes, by using roost locations obtained during March 2011-August 2019 from remote transmitters (satellite or cellular) attached to 119 juvenile cranes (57 males, 62 females). The maximum distance for individuals released at WLWCA ranged from 3.9 to 998.7 km and for individuals released at RWR 0.77-2,866.6 km. Average maximum dispersal from WLWCA was 214.8 km (n = 89) and 274.3 km from RWR (n = 30). Although many of these movements occurred in the spring when yearling cranes were newly independent, similar to spring wandering documented in the reintroduced Eastern Migratory Population, some occurred later in the summer and fall. Additionally, the density of points was mapped at 50-km increments from the cranes' respective release sites through a distance of 400 km, at which point we increased the increment to 100 km. The greatest density of total points (50.8%) was located closest to the release locations. Results indicated that 56.1% of total points for cranes released at WLWCA were within 50 km of the release site, however only 33.6% of points for cranes released at RWR were located within that same distance. Cranes have not remained in the freshwater marsh habitat where they were released, as was initially expected, and have instead dispersed to numerous agricultural locations, with only a few later returning to the marsh habitat where they were originally released.

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Key words: dispersal, *Grus americana*, Louisiana, release site, transmitter, whooping crane.