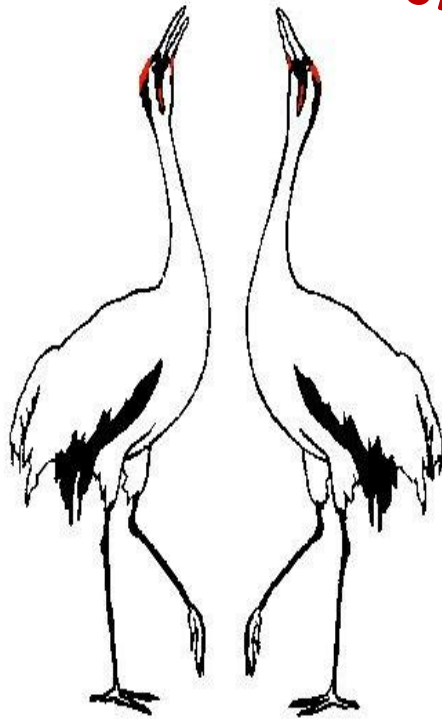


16th NORTH AMERICAN CRANE WORKSHOP PROGRAM & ABSTRACTS

North American Crane Working Group



**23-26 October 2023
Baraboo, Wisconsin**

WELCOME TO BARABOO!



Photo by Sam Lei

Welcome all to the 16th North American Crane Workshop. This year's workshop consists of dozens of oral presentations, and for the first time, *lightning* talks (get ready!). We are excited about the packed and diverse program, as well as our field trip to the Aldo Leopold and International Crane Foundations.

The city of Baraboo lies in the heart of the Baraboo Range National Natural Landmark, and is intertwined with abundant agricultural lands and the Wisconsin River. The area is home to, and an important stopover for, Sandhill Cranes, as well as reintroduced Whooping Cranes. We hope you will take the time to explore the city and its amazing natural surroundings.

Hillary Thompson, president

Sammy King, vice president

Megan Brown, secretary

Barry Hartup, treasurer & 16th NACW coordinator

David Aborn

Antonio Cantu

Tom Leiden

Tommy Michot

Glenn Olsen

Richard Urbanek

Jeannie van Vianen

North American Crane Working Group Board of Directors

16th NORTH AMERICAN CRANE WORKSHOP

MEETING OVERVIEW

MONDAY, OCTOBER 23, 2023

1800-2100 ICEBREAKER AT [BALANCED ROCK WINERY](#), 1065 WALNUT ST, BARABOO, 608-448-2958

TUESDAY, OCTOBER 24

[BARABOO ARTS BANQUET AND CONVENTION CENTER](#), 323 WATER ST, BARABOO 608-356-1096

ALL DAY	REGISTRATION
0800-0810	OPENING REMARKS & HOUSEKEEPING
0810-0820	PLACEMAKING REMARKS
0820-0900	PLENARY 1
0900-1000	SANDHILL CRANE 1 SESSION
1000-1030	MORNING BREAK
1030-1200	SANDHILL CRANE 2 SESSION
1200-1300	LUNCH BREAK
1300-1340	PLENARY 2
1340-1500	WHOOPING CRANE 1 SESSION
1500-1530	AFTERNOON BREAK
1530-1700	WHOOPING CRANE 2 SESSION
EVENING	DINNER ON OWN

WEDNESDAY, OCTOBER 25

[BARABOO ARTS BANQUET AND CONVENTION CENTER](#), 323 WATER ST, BARABOO 608-356-1096

0800-0810	ANNOUNCEMENTS
0810-1000	WHOOPING CRANE 3 SESSION
1000-1025	MORNING BREAK
1025-1130	MISSISSIPPI SANDHILL CRANE REINTRODUCTION SESSION
1130-1200	NACWG BUSINESS MEETING
1200-1300	LUNCH BREAK
1300-1425	WHOOPING CRANE REINTRODUCTION 1 SESSION
1430-1500	AFTERNOON BREAK
1500-1630	WHOOPING CRANE REINTRODUCTION 2 SESSION
1800-2200	HAPPY HOUR, SILENT AUCTION, BANQUET, AWARDS

THURSDAY, OCTOBER 26

0800-1700 FIELD TRIP TO [ALDO LEOPOLD FOUNDATION](#) 0830-1130: E13701 LEVEE RD, BARABOO, 608-355-0279, AND [INTERNATIONAL CRANE FOUNDATION](#) 1200-1630: E11376 SHADY LANE RD, BARABOO, 608-356-9462. TRANSPORTATION PROVIDED – BUS PICKUPS WILL BE ARRANGED THROUGHOUT BARABOO 0800-0815; DROP-OFFS BY 1700. LUNCH PROVIDED AT ICF. HERE IS A [MAP](#) FOR OUR VISIT TO ICF.

16th NORTH AMERICAN CRANE WORKSHOP

SCIENTIFIC PROGRAM

TUESDAY, OCTOBER 24

0800-0810 OPENING REMARKS & ANNOUNCEMENTS

0810-0820 *Cranes, conservation, and community in our local landscape*, Curt Meine

0820-0900 PLENARY 1

50 year of cranes conservation: reflecting back, flying forward, Rich Beilfuss¹

0900-1000 SANDHILL CRANE 1 SESSION

0900-0915 *Cranes of blue water*, Kylee Warren²

0915-0930 *Factors associated with off-channel roosting and early roost departure by sandhill cranes in the central Platte River Valley*, Bethany Ostrom³

0930-0945 *Habitat use by sandhill cranes wintering in the agricultural landscape of the Sacramento-San Joaquin River Delta region of California*, Gary Ivey⁴

0945-1000 *Trends in sandhill crane numbers in Chaves County, eastern New Mexico*, Jim Montgomery⁵

1000-1030 MORNING BREAK

1030-1200 SANDHILL CRANE 2 SESSION

1030-1045 *Florida sandhill crane survival along a wildland-to-urban land use gradient*, Timothy Dellinger⁶

1045-1100 *Territory availability best explains fidelity in sandhill cranes*, Matt Hayes⁷

1100-1115 *Relatedness among sandhill cranes in south-central Wisconsin*, Matt Hayes⁸

1115-1120 *Evidence of polygyny in a greater sandhill crane*, Gary Ivey⁹

1120-1125 *Distribution and spring migration phenology of Alberta's nesting sandhill cranes*, Wyatt Villettard¹⁰

1125-1130 *Fall population and age ratio counts of migrant Canadian sandhill cranes along the lower Columbia River, Oregon and Washington, USA*, Mark Stern¹¹

1130-1150 *A modified raptor bownet for capturing sandhill cranes & demonstration*, Scott Hereford¹³

1200-1300 LUNCH BREAK

1300-1340 PLENARY 2

Merging analysis methods and expert opinion in prioritizing management approaches to species recovery, Dan Doak¹⁴

1340-1500 WHOOPING CRANE 1 SESSION

1340-1355 *Qualitative factors affecting population resilience in whooping cranes: learning from the proposed delisting of the wood stork, Dale Gawlik¹⁵*

1355-1410 *Population expansion and central place foraging affect critical habitat estimation for whooping cranes, Mark Bidwell¹⁶*

1410-1425 *Development of automated, satellite imagery-based methods to monitor breeding whooping cranes, John Conkin¹⁷*

1425-1440 *Whooping crane behavioral patterns at a remote nest in Wood Buffalo National Park, Andrew Caven¹⁸*

1440-1445 *The whooping crane continues to lose genetic diversity despite successful demographic recovery, Andrew Caven¹⁹*

1445-1450 *Trace elements and corticosterone found in feathers of whooping cranes from the Central Flyway, Barry Hartup²⁰*

1450-1455 *Go your own way: cessation of parental care in whooping cranes, Megan Ring²¹*

1455-1500 *Mortality update of fledged whooping cranes in the Aransas/Wood Buffalo Population, Kristin Brightwell²²*

1500-1530 AFTERNOON BREAK

1530-1700 WHOOPING CRANE 2 SESSION

1530-1545 *Threats and conservation opportunities for migrating whooping cranes in the Oil Sands Region of Alberta, Canada, Mark Bidwell²³*

1545-1600 *Whooping cranes respond to drought with flexible migration and habitat use strategies, Aaron Pearse²⁴*

1600-1615 *Potential effect of the proposed R-project transmission line on the Aransas/Wood Buffalo whooping crane population, Jeb Barzen²⁵*

1615-1620 *Whooping crane inland winter habitat selection model, Karen Tyrell²⁶*

1620-1625 *Trends in extent of occurrence and area of occupancy of wintering whooping cranes in Texas for Red List assessment, Matthew Butler²⁷*

1625-1640 *Long-term migratory alterations to whooping crane arrival and departure on the wintering and staging grounds, Matthew Butler²⁸*

1640-1655 *A buffet of corn: use of automated feeders on the wintering grounds by whooping cranes, Dave Brandt²⁹*

1700 END OF DAY 1 SESSIONS

EVENING DINNER ON OWN

WEDNESDAY, OCTOBER 25

0800-0810 ANNOUNCEMENTS

0810-1000 WHOOPING CRANE 3 SESSION

0810-0825 *Aransas/Wood Buffalo population use of inland wintering areas, Carter Crouch³⁰*

0825-0840 *Southern winter range expansion of Aransas/Wood Buffalo whooping cranes into an urban/industrial landscape: coexistence or conflict?, Elizabeth Smith³¹*

0840-0855 *Predicting whooping crane overwintering habitat: implications for conservation, Katherine Golden³²*

0855-0910 *Roost site use of wintering whooping cranes in the Aransas/Wood Buffalo population, Matti Bradshaw³³*

0910-0925 *Site characteristics of freshwater wetlands used by wintering whooping cranes, Katrina Fernald³⁴*

0925-0940 *Update: video behavior analysis of two wintering populations of whooping crane, Virginia van Vianen³⁵*

0940-0955 *Understanding habitat quality degradation for the western continental population of red-crowned crane in Asia, Zhiwei Guo³⁶*

1000-1025 MORNING BREAK

1025-1130 MISSISSIPPI SANDHILL CRANE REINTRODUCTION SESSION

1025-1040 *Mississippi sandhill crane conservation update 2020-23, Scott Hereford³⁷*

1040-1055 *Habitat suitability of Mississippi sandhill crane nest sites, Henry Woolley³⁸*

1055-1110 *Intraocular pressure in whooping cranes and Mississippi sandhill cranes, Rodrigo Garces Torres³⁹*

- 1110-1125 *Evolution of costume rearing techniques for Mississippi sandhill cranes and whooping cranes at Freeport-McMoRan Audubon Species Survival Center, Rebecca Grieser⁴⁰*
- 1125-1130 *Introduction of hatched Mississippi sandhill and whooping crane chicks to adults for parent rearing, Rebecca Grieser⁴¹*
- 1130-1200 NACWG BUSINESS MEETING**
- 1200-1300 LUNCH BREAK**
- 1300-1425 WHOOPING CRANE REINTRODUCTION 1 SESSION**
- 1300-1315 *Assessing the impact of rearing strategy on whooping crane health through the gut microbiome, Jessica Diaz⁴²*
- 1315-1330 *The diets of wild and reintroduced whooping cranes (Grus americana), Glenn Olsen⁴³*
- 1330-1345 *You can lead a (captive-reared) crane to water but you can't make it roost, William Inghram⁴⁴*
- 1345-1400 *Evaluation of conservation education carts for building empathy and conservation action towards whooping cranes, Stephanie Schmidt⁴⁵*
- 1400-1405 *Mercury and lead exposure in eastern whooping cranes: cause for concern?, Barry Hartup⁴⁶*
- 1405-1410 *A pilot study of family unit behaviors in the Eastern Migratory Population, Caleb Clarkson⁴⁷*
- 1410-1425 *Predators of whooping crane chicks on the breeding grounds of the Eastern Migratory Population, Nicole Gordon⁴⁸*
- 1430-1500 AFTERNOON BREAK**
- 1500-1630 WHOOPING CRANE REINTRODUCTION 2 SESSION**
- 1500-1515 *Migration patterns of parent-reared whooping cranes in the Eastern Migratory Population, 2016-2022, Mary Anderson⁴⁹*
- 1515-1530 *Habitat use by reintroduced parent-reared whooping cranes for 2016-2022, Mary Anderson⁵⁰*
- 1530-1535 *Disturbance impacts of black flies on whooping crane nest attendance at White River Marsh, Wisconsin, Markie Feuerhelm⁵¹*

- 1535-1540 *Maximum distance between roost and daytime use points of wintering whooping cranes in Indiana, Alicia Ward⁵²*
- 1540-1555 *Nest success rates and survival of wild-hatched whooping crane chicks in Louisiana, Eva Szyszkoski⁵³*
- 1555-1610 *Translocating non-migratory adult whooping cranes from Florida to Louisiana, Sara Zimorski⁵⁴*
- 1610-1625 *A first record for the species – Louisiana whooping crane pair renests after successfully fledging a chick, Sara Zimorski⁵⁵*
- 1630 END OF DAY 2 SESSIONS**
- 1800-2200 HAPPY HOUR, SILENT AUCTION, BANQUET, AWARDS AT BARABOO ARTS**

16th NORTH AMERICAN CRANE WORKSHOP

PRESENTATION ABSTRACTS

1. 50 YEARS OF CRANE CONSERVATION: REFLECTING BACK, FLYING FORWARD

RICH BEILFUSS, International Crane Foundation, Baraboo, WI, USA

Abstract: Over the past 50 years, global crane conservation efforts have achieved remarkable gains. With their deep cultural connections, ecological sensitivity, and dramatic migrations, cranes have served as indicators, flagships, and ambassadors for conservation on five continents. Yet cranes remain among the most endangered families of birds in the world, facing the same conservation challenges—wetland and grassland destruction, water diversion and regulation, climate change, fires, invasive species, unsustainable hunting, illegal trade, and others—that threaten our global biodiversity. This presentation will share lessons learned from 50 years of conservation action aimed at recovering endangered crane populations and the vital wetlands, grasslands, and agricultural lands they need, and the diverse ways in which crane conservation requires a deep commitment to the communities who share their lands with cranes. The presentation will explore opportunities and challenges for the next 50 years of crane conservation, including innovative ways to think about protected areas and private lands conservation, strengthen community and government partnerships, manage the increasing impacts of climate change and contested waters, and resolve crop depredation and its intersection with crane killings, feeding stations, and bird flu worldwide to find lasting peace between cranes and farmers. We will also reflect on what it will take to fully recover whooping cranes from the brink of extinction and keep sandhill cranes on their successful path.

2. CRANES OF BLUE WATER

KYLEE WARREN, Platte Basin Timelapse, Lincoln, NE, USA

Abstract: Every year, roughly a million sandhill cranes migrate through a narrow corridor of the Platte River Basin. Since the 1990s, more cranes have begun spending their spring on this flyway's western fringe. They stage near Lewellen, a village on the confluence of Blue Water Creek and the North Platte River. First commissioned by Platte Basin Timelapse in 2019, Cranes of Blue Water is an ongoing multimedia conservation project that tells the story of these birds as they navigate an overgrown wilderness of disturbed wetlands, irregular river levels, intermittent playas, and a community of people increasingly enchanted by this annual migration. This presentation uses photography, film, audio recordings, and map-making to summarize five years of observations on Lewellen's sandhill crane migration. It examines discoveries and challenges while documenting migrating cranes in habitats teeming with agricultural production and invasive flora. Finally, this presentation compares Lewellen's

sandhill crane migration and its related research to that on the Central Platte, where conservationists have successfully protected the river habitat for the birds.

3. FACTORS ASSOCIATED WITH OFF-CHANNEL ROOSTING AND EARLY ROOST DEPARTURE BY SANDHILL CRANES IN THE CENTRAL PLATTE RIVER VALLEY

BETHANY OSTROM, Crane Trust, Wood River, NE, USA

ANDREW J. CAVEN, International Crane Foundation, Baraboo, WI, USA

Abstract: During spring migration, more than 1 million sandhill cranes stage along the Platte River in central Nebraska. Appropriate river flows can support ideal depths for roosting and provide protection from terrestrial predators. Cranes and other waterbirds occasionally roost outside of the river channel or reduce diurnal activity therein, but conditions under which this happens remain poorly defined. Despite abilities to adjust flows in this highly managed river system, many hydrological factors remain outside of managers' control. We examine the proportion of sandhill cranes detected in non-riverine habitat during weekly aerial surveys from mid-February to mid-April from 2016 to 2023. Gamma family Generalized Linear Models predicting off-channel relative abundance during surveys were compared using Akaike Information Criterion corrected for small sample sizes to assess the phenological and hydrological conditions associated with increased terrestrial occurrence. The proportion of cranes off-channel peaked when crane densities were ostensibly highest near mid-migration. Incidents of icing and increased daily variation in river flows were positively associated with off-channel relative abundance. Operations appreciably amplifying daily river fluctuations may decrease the suitability of roosting conditions for cranes. Top models included weekly precipitation and the Palmer Drought Severity Index, showing sandhill cranes may be more likely to roost off-channel with wetter hydrological conditions providing more standing water for alternative roosting locations in palustrine wetlands. High flows were not associated with off-channel roosting, but we only observed one instance where mean flows exceeded 5,000 cubic feet per second. In this instance, a large proportion (~40%) of cranes were detected off-channel.

4. HABITAT USE BY SANDHILL CRANES WINTERING IN THE AGRICULTURAL LANDSCAPE OF THE SACRAMENTO-SAN JOAQUIN RIVER DELTA REGION OF CALIFORNIA

GARY IVEY, International Crane Foundation, Bend, OR, USA

BRUCE DUGGER, Oregon State University, Corvallis, OR, USA

CAROLINE HERZIGER, Bend, OR, USA

MICHAEL CASAZZA, U.S. Geological Survey, Dixon, CA, USA

JOSEPH FLESKES, U.S. Geological Survey, Dixon, CA, USA

Abstract: The Sacramento-San Joaquin River Delta region of California is an important wintering region for sympatric greater (*Grus canadensis tabida*) and lesser (*G. c. canadensis*) sandhill cranes. Basic information about sandhill crane use of habitats in their winter landscape is

needed to design biologically driven conservation strategies. We monitored radio-tagged birds of each subspecies for two winters and conducted foraging counts to document habitat use. With the exception of vineyards and orchards, cranes used the major crops and habitat types that were available in the landscapes surrounding their roost sites but focused most of their foraging in grains. Cranes generally avoided dry corn stubble, selected dry rice stubble early in the season, and rarely used dry wild rice (*Zizania palustris*) stubble. Tilled fields were usually avoided but were occasionally used shortly after tillage. Mulched corn ranked high in comparison to other corn treatments while mulched rice was used similarly to dry rice stubble. Both crane subspecies often showed high selection of croplands when fields were initially flooded. Cranes were also attracted to new plantings of pasture and winter wheat. One important difference between the subspecies was that lessers used alfalfa, which was generally avoided by greaterers. If wildlife managers want to favor winter field use by foraging cranes they could provide incentives for favorable practices, such as production of grain crops, reduce or delay tillage and flooding of grain fields, periodically irrigate pasture and grain stubble crop types, and increase the practice of mulching of corn stubble.

5. TRENDS IN SANDHILL CRANE NUMBERS IN CHAVES COUNTY, EASTERN NEW MEXICO

JIM B. MONTGOMERY, Jr., Volunteer, Bitter Lake National Wildlife Refuge, Roswell, NM, USA

Abstract: The combination of shallow perennial ponds at Bitter Lake National Wildlife Refuge, off-refuge sites, and 20,000 hectares of irrigated farmland provides an important area for both migrating and wintering sandhill cranes (*Grus canadensis*) in eastern New Mexico. However, present-day agricultural practices may not provide sufficient food for wintering cranes. Following a decline in the 1980s, fall-migration peak crane numbers increased from 5,640 in 1989 to 13,560 in 2004. Concurrently, hectares of corn (for silage) increased from 1,787 ha to 7,325 ha. In 2005 the fall peak abruptly increased to 22,000. Peak counts as of 2005 averaged $24,800 \pm 1,030$ (SE) through 2022-23, but hectares of corn did not increase (average = 7,075 ha ± 177 [SE]). In Chaves County during 2021-22 and 2022-23, corn was grown for silage and harvested in late summer/early fall. The fields were then planted in winter wheat, barley, or triticale ("green crops"), leaving little stubble after November. Fewer than 400 hectares of sorghum were also grown for fodder. During October and November, cranes divided foraging between stubble (mostly disked) and green crops. From December on, cranes primarily used fields with green crops. Beginning in 2005, except during spring 2022, weekly crane numbers fell after the fall migration peaks to approximately 5,000 in late January and 3,000 in late February. These winter declines indicated agricultural resources in Chaves County did not support larger numbers of cranes throughout the winter.

6. FLORIDA SANDHILL CRANE SURVIVAL ALONG A WILDLAND-TO-URBAN LAND USE GRADIENT

TIMOTHY DELLINGER, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

ANDREA SYLVIA, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

BRITTANY BANKOVICH, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

RONALD BIELEFELD, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA

Abstract: The Florida sandhill crane (*Grus canadensis pratensis*) is a state-threatened non-migratory subspecies. Following the loss of preferred prairie and pasture habitat over recent decades, cranes have begun to use open urbanized areas such as suburban lawns and roadside verges for foraging and loafing. Adult crane survival data have yet to be examined in these rapidly expanding urbanized areas and are also lacking in wildlands and rural areas. We estimated annual survival rate along a wildland-to-urban gradient in 12 central Florida counties using a live-dead capture-recapture multistate model. We marked 118 adult cranes from June 2017 to October 2021; 77 were color-banded and 41 were tagged with Global System for Mobile Communications (GSM) transmitters. Survival was greatest in the least urbanized locations (0.85; 90% credibility interval = 0.79–0.91) and lowest in the most urbanized locations (0.65; 90% credibility interval = 0.52–0.80). Annual survival of cranes at the mean gradient value was 0.78 (90% credibility interval = 0.74–0.83) and survival was marginally influenced by the mean gradient value based on 90% highest density credibility intervals. Twenty cranes died during the study, eight of these from vehicle strikes. The adult survival rates we observed are lower than those reported for other stable or increasing North American populations. Our findings suggest protecting the cranes' wildland and natural habitats because survival was greater in these areas, as well as identifying road segments where cranes are most often struck by cars to help understand and minimize this source of mortality.

7. TERRITORY AVAILABILITY BEST EXPLAINS FIDELITY IN SANDHILL CRANES

MATTHEW HAYES, Illinois Audubon Society, Springfield, IL, USA

JEB A. BARZEN, Private Lands Conservation, Spring Green, WI, USA

Abstract: We investigated dynamics of mate and site fidelity among color-banded sandhill cranes (*Grus canadensis*) in south-central Wisconsin. Over 26 years (1993-2018), 98 permanent mate switches (74%) occurred in 133 pairs. There were 27 permanent divorces and 71 switches following mate death. The asynchronous migration, incompatibility, and better option

hypotheses did not explain divorces in this population well. Productivity of divorced pairs prior to separation was lower than non-divorced pairs. Divorcing, however, did not improve individual productivity and productivity of divorced pairs following separation was lower than nondivorced pairs. Following divorce or mate disappearance, territory retention was high (divorce = 100%, mate loss = 87%) while males and females did not differ in original territory retention. Long-term territory retention led to higher lifetime productivity and divorcing prolonged territory retention, especially for pair bonds that may have been unstable. Divorcing birds typically paired with experienced territory holders, although invasion into a pair bond by a non-territorial bird occurred. Post-divorce, relocating birds moved to adjacent territories with a vacancy rather than re-distribute to random territories. Because territories in this population are limited, this adds an additional constraint to explain long-term monogamy in sandhill cranes. An opening on a proximate territory offers a choice: a bird can stay with a current mate and territory, even if reproductive history is poor, or it can seek a new but familiar mate on an adjacent territory to try and improve productivity in an unknown future. Pairing with familiar birds may minimize risk of losing a territory altogether.

8. RELATEDNESS AMONG SANDHILL CRANES IN SOUTH-CENTRAL WISCONSIN

MATTHEW HAYES, Illinois Audubon Society, Springfield, IL, USA

Abstract: I investigated relatedness among individuals in a population of sandhill cranes in south-central Wisconsin that has been actively banded since 1991. I used blood samples collected 1996-2014 from 175 birds in 41 complete families (both parents banded in tandem or prior to any chicks raised by those parents) to generate alleles at 10 microsatellite loci. Using CERVUS (a software program that uses DNA markers to investigate parentage), I used these data to establish parentage among these families to determine known relationships. The putative parents were matched to chicks raised by those parents in 89% of these families. In the remaining 11%, 6% of chicks belonged to one putative parent while 5% belonged to neither putative parent (adoption). Using these known relationships, I calculated relatedness among family members (parent-offspring, full siblings, half siblings) using ML-Relate. I then compared relatedness values among breeding adults to determine expected relationships. There was no difference between relatedness values of breeding males and breeding females ($F=1.08$, $p=0.30$). I will investigate spatial relationships of relatedness among breeding adults breeding within and among wetlands of the study area. Investigation of relatedness is important within this population since it suffered a demographic bottleneck 100 years ago.

9. EVIDENCE OF POLYGYNY IN A GREATER SANDHILL CRANE

GARY IVEY, International Crane Foundation, Bend, OR, USA

CHAD AUGUST, Wisconsin Dept. of Natural Resources, Madison, WI, USA

Abstract: While visiting a 3-egg crane nest in Ruby Valley, Nevada in July 2006, we observed that one of the eggs was a slightly different shade of brown than other two. The incubating crane stood from the nest as we approached and began a distraction display. We then observed two additional adult cranes in the wetland and all three were exhibiting a distraction display. Assuming the different colored eggs were laid by different females, it appears that the male in that crane territory had two female mates.

10. DISTRIBUTION AND SPRING MIGRATION PHENOLOGY OF ALBERTA'S NESTING SANDHILL CRANES

WYATT VILLETARD, University of Alberta, Edmonton, AB, Canada

ERIN BAYNE, University of Alberta, Edmonton, AB, Canada

MARK BOYCE, University of Alberta, Edmonton, AB, Canada

Abstract: In 2020, the province of Alberta approved a hunting season for sandhill cranes (*Grus canadensis*) occurring in the Mid-Continent Population (MCP). No projects conducted have focused on Alberta's nesting population to date. With Alberta having a large migratory population, but a relatively small nesting population, this knowledge gap has raised concern that small local nesting populations may not be large enough to support a harvest. Our study aims to reduce this knowledge gap by using the Alberta Biodiversity Monitoring Institute's Systematic Ecosystem Health Grid (SEHG), a systematic, 20km grid of autonomous recording units (ARUs) spanning the entire province. Using the data supplied by the SEHG, we will be able to temporally determine spring crane migration phenology across the range of the MCP in Alberta by determining detection probability at various latitudes over time. We also plan to use occupancy models to learn about the distribution of nesting sandhill cranes across the province. By understanding site occupancy and detection probability over time in different regions of Alberta, we will be able to answer important ecological questions surrounding sandhill crane movement in the province while providing information to inform future management. In the future, we may be able to expand and replicate these methods to both determine habitat use and determine fall migration phenology to better inform future management on the new sandhill crane harvest.

11. FALL POPULATION AND AGE RATIO COUNTS OF MIGRANT CANADIAN SANDHILL CRANES ALONG THE LOWER COLUMBIA RIVER, OREGON AND WASHINGTON, USA

MARK STERN, 2640 NE Siskiyou St., Portland, OR, USA

ALEX CHMIELEWSKI, U.S. Fish and Wildlife Service, Ridgefield NWR, Ridgefield, WA, USA

GINNY STERN, 2640 NE Siskiyou St., Portland, OR, USA

KEN POPPER, 3004 NE 32nd Ave., Portland, OR, USA

JEN NEWLIN, 3004 NE 32nd Ave., Portland, OR, USA

MARK NEBEKER, Oregon Department of Fish and Wildlife, Sauvie Island Wildlife Area, Portland, OR, USA

GARY IVEY, International Crane Foundation, Bend, OR, USA

Abstract: Sandhill cranes staging in the fall along the Lower Columbia River in Oregon and Washington are considered a unique population of Canadian sandhill cranes (*Grus canadensis rowani*). This population breeds in coastal regions of British Columbia and southeast Alaska. These cranes stage during fall migration at Sauvie Island Wildlife Area (WA), OR, Ridgefield National Wildlife Refuge (NWR), WA and on adjacent private farmland. Peak numbers of staging cranes occur in late September through mid-October. Most of these cranes spend about a month in this area along the Lower Columbia River, continuing south to winter in the Central Valley of California. From 1993 to 2022, we monitored their status along the Lower Columbia River by conducting “window” counts of cranes during peak migration as cranes flew into their evening roosts at Sauvie Island WA, Ridgefield NWR, and adjacent private lands. Additionally, from 2003-2022, we conducted age ratio counts at one of the primary roost sites on Sauvie Island WA. Population numbers indicated an upward trend ($p < 0.001$) from 1993-2022, with peak annual counts of over 5,000 individuals in 5 of the past 9 years. Annual age ratio counts (% young in the roost) averaged 9.34% + 1.8% annually for the past 20 years. Together, the population numbers and age ratio counts indicate a stable to increasing population for this group of cranes that migrate through the Lower Columbia River in Oregon and Washington.

12. ONE EFFECTIVE STRATEGY IS NOT ALWAYS A SOLUTION; THE JOURNEY TO SOLVE CROP DAMAGE BY CRANES

ANNE LACY, International Crane Foundation, Baraboo, WI, USA

ANDREW J. CAVEN, International Crane Foundation, Baraboo, WI, USA

RYAN MICHALESKO, International Crane Foundation, Baraboo, WI, USA

Abstract: When it comes to the issue of crop damage, providing an effective treatment to prevent cranes and other birds from pulling germinating grain seed from the ground is essential, but not the entire solution. It is only truly a solution when it works for the farmer as well. The International Crane Foundation (ICF) has been incrementally working toward a solution to this problem for decades. When field testing of Avipel® (anthraquinone) was completed and peer reviewed research published, that was merely a beginning, not the

resolution. As conservationists, we are often myopic to any problems that arise from our 'solutions'. In the subsequent decade following the open market availability of a seed treatment capable of preventing crane damage to sprouting corn, ICF has realized that farmers actually need a multitude of tools - in addition to institutional, financial, and expert support - to successfully mitigate the impacts of crop damage. ICF is in the process of developing regional cost reduction programs for Avipel®, advocating for state policy changes, and testing additional viable alternatives. We also continue to investigate harm reduction to other crop types.

13. A MODIFIED RAPTOR BOWNET FOR CAPTURING SANDHILL CRANES

SCOTT HEREFORD, U.S. Fish and Wildlife Service, Mississippi Sandhill Crane National Wildlife Refuge, Gautier, MS, USA

M. LAURIN MCLAURIN, U.S. Fish and Wildlife Service, Mississippi Sandhill Crane National Wildlife Refuge, Gautier, MS, USA

KIM MCLAURIN, U.S. Fish and Wildlife Service, Mississippi Sandhill Crane National Wildlife Refuge, Gautier, MS, USA

Abstract: Several techniques, including a walk-in trap, Indian toe nooses, and coffin trap, have been used to capture Mississippi sandhill cranes over the last 40 years. During 2022-2023, we used a modified raptor bownet to capture single target cranes for attaching leg bands and/or a GPS-GSM transmitter. Eleven target cranes were caught on 10 days at 7 different sites. Although cranes escaped on four occasions, trap success was higher than other methods employed here. We did not observe any capture-related injury or morbidity. This method shows promise to selectively capture sandhill cranes, with a low injury rate, ease of set-up, relatively quick habituation by cranes, low operator training, and the ability to be activated remotely.

14. MERGING ANALYSIS METHODS AND EXPERT OPINION IN PRIORITIZING MANAGEMENT APPROACHES TO SPECIES RECOVERY

DAN DOAK, Department of Environmental Studies, University of Colorado Boulder, Boulder, CO, USA

Abstract: The goals for recovery of any endangered population or species include continued existence, ideally with minimal active human management. Setting goals and priorities for recovery thus need to merge risk of extinction estimation with detailed understanding of a species' biology, the impacts of current or future threats, and also of realistic management approaches to mitigate these threats. However, formal methods to estimate risk of extinction are often not informed by expert knowledge either of threats or, especially, of the limitations or alternatives for management. I will first review methods and results from population viability analysis, used to estimate extinction risk and population growth potential. I will then discuss how to better use these analysis tools to synthesize knowledge about recovery planning and management. In particular, I will present examples of an interactive approach to viability analysis that directly involves expert biologists and managers and that focuses not on extinction risk per se, but on the efficiency and uncertainty of alternative approaches to threat abatement and management and monitoring data. I argue that this closer integration between recovery practice and analysis can improve the formulation of recovery goals and aid endangered species planning.

15. QUALITATIVE FACTORS AFFECTING POPULATION RESILIENCE IN WHOOPING CRANES: LEARNING FROM THE PROPOSED DELISTING OF THE WOOD STORK

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Abstract: As growth of whooping crane populations move the species closer to one of the population size thresholds for down-listing, consideration of qualitative factors, such as the species' flexibility to respond to rapidly changing environmental conditions, become more important. The recent whooping crane Species Status Assessment acknowledged the importance of these qualitative factors and that they represent a knowledge gap. However, there is little guidance on how much weight these qualitative factors should carry when assessing population resilience. Therefore, I used a case-study approach to illustrate how these various factors were used in the recent proposed delisting of the wood stork, a wetland bird like the whooping crane, that is large, long-lived, and has experienced population growth that is reportedly limited by adult survival. Whereas there are many additional similarities between the two species, a key difference is that whooping crane populations increased through intensive interventions such as the purchase and protection of core wintering and breeding

habitat, a captive breeding program, and reintroduction efforts. In contrast, the wood stork population was not managed directly. Rather, its population increase was intrinsically driven. The species expanded its range north and exploited wetlands and novel anthropogenic habitats, demonstrating a remarkable degree of flexibility in diet and habitat use, ultimately linked to higher productivity. Whooping cranes are also reportedly flexible in their use of novel habitat; however, the largest population is reportedly not limited by habitat, suggesting that their use of novel habitat could carry more risk than benefit.

16. POPULATION EXPANSION AND CENTRAL PLACE FORAGING AFFECT CRITICAL HABITAT ESTIMATION FOR WHOOPING CRANES

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Abstract: The Aransas-Wood Buffalo population (AWBP) of the highly endangered whooping crane (*Grus americana*), composed of approximately 550 individuals, nests exclusively in and around Wood Buffalo National Park in northern Alberta and adjacent Northwest Territories, Canada. A requirement for reaching and maintaining population recovery goals for the AWBP is to protect sufficient breeding habitat to support the desired number of breeding pairs. While the AWBP continues to grow and expand its nesting range, little is known about breeding habitat selection by AWBP cranes outside of a small number of nest location habitat studies. Therefore, our objective was to delineate critical nesting habitat for cranes while accounting for expansion of the nesting range, clustering of breeding pairs into nesting areas, and central place foraging behaviour while on nesting home ranges. We developed sequential, hierarchically structured habitat selection models that accounted for multiple levels of habitat selection. Our within-home range model explicitly incorporated central place foraging behavior. Our models showed that controlling for distance from the centroid of the original nesting area was important for modelling nesting area and home range habitat selection. We found evidence for functional responses to distance from the nest in our within-home-range models, suggesting that central place foraging influences foraging habitat decisions. Our modelling framework allowed us to develop maps of current and potential breeding range habitat that were independent of distance from a central location at all levels, which is critical for delineating areas of potential importance for breeding range and population expansion.

17. DEVELOPMENT OF AUTOMATED, SATELLITE IMAGERY-BASED METHODS TO MONITOR BREEDING WHOOPING CRANES

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Abstract: Conventional methods of monitoring wild animal populations can be challenging due to their cost and time requirements, sampling and detection biases, disturbance and occupational health and safety considerations. These challenges are more acute for rare species in remote areas. Where possible, the detection of individual animals in very high-resolution satellite imagery as a means to monitor populations circumvents some of these challenges. Most past imagery-based efforts to monitor populations were implemented manually and over small spatial extents and were not intended to estimate abundance of an entire breeding population. We aim to develop accurate, precise, and automated methods to detect individual animals in very high-resolution satellite imagery over large spatial extents to advance the use of remote sensing to monitor wild animal populations. Here, we present results of satellite imagery-based approaches to monitor breeding of the entire Aransas-Wood Buffalo population of whooping cranes (*Grus americana*) in northern Canada. In 50-cm resolution satellite imagery, we discovered that nesting whooping cranes appear as distinct large, white objects, often surrounded by a dark halo of open water or trampled vegetation. Over small extents, the detection rate of previously-confirmed nests via manual inspection of imagery was >95%. We present preliminary omission and commission rates from new automated methods based on object-based image analysis, deep learning and crowdsourcing across a large spatial extent. We also discuss performance and limitations of new methods relative to conventional aerial surveys to monitor this population.

18. WHOOPING CRANE BEHAVIORAL PATTERNS AT A REMOTE NEST IN WOOD BUFFALO NATIONAL PARK

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Abstract: We studied whooping crane nesting behavior and movement patterns at Wood Buffalo National Park using an instantaneous scan sampling approach. Data was collected 2 – 9 June from before 03:00 to after 22:00 hours. We completed 88 hours of observation and documented nest swapping about every 3.2 hours. The female incubated/brooded 3.3–10.9% more than the male and incubation/brooding rates declined by 49% after the second chick began pipping and by 99% after both chicks had hatched. The eldest chick was successfully provisioned 16 hours and 33 minutes after hatching. The provisioning rate declined from morning to evening daily and increased with time since hatch. Parents stayed significantly closer to the elder chick ($\bar{x} = 0.32$ m) than the second chick ($\bar{x} = 6.70$ m), despite the first moving 9% further from the nest per hour after hatch. The second chick hatched nearly 40 hours after the first. The eldest chick consumed mainly Odonata spp. and Araneae spp. Adults had a more diverse diet that also included snails (Gastropoda spp.), small fish (Osteichthyes spp.), leeches (Hirudinea spp.), and biting flies (Diptera spp.), which were consumed at a rate of about 4 per minute while adults incubated during midday. The male appeared flightless with only a couple primary feathers remaining on each wing when the eldest chick hatched. Though insights are based on data from a single nest, they provide a rich description that can improve our understanding of nesting ecology in a remote landscape.

19. THE WHOOPING CRANE CONTINUES TO LOSE GENETIC DIVERSITY DESPITE SUCCESSFUL DEMOGRAPHIC RECOVERY

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Abstract: Species' conservation status and extinction risk are commonly linked to external threats (e.g., harvesting or land-use change) that can have immediate effects on populations. Limited genetic diversity can represent an endogenous risk to population recovery, however, as it can lead to increased occurrences of harmful and maladaptive traits. Genetic diversity is essential for a species' long-term viability and adaptive potential to future environmental change. Many endangered wildlife that have recovered from extreme population bottlenecks continue to lose genetic diversity, even after demographic recovery; this time-lag between demographic and genetic effects may underestimate the long-term threat to species survival and impose an "extinction debt." Here we compared re-sequenced whole-genomes preceding and during (100+ year-old museum samples), as well as after (modern samples of captive and wild individuals) the species' population collapse, which reached its nadir of <16 individuals in the early 1940s. Using a population genomics approach, we show that the species has lost substantial genomic diversity, and that loss continues despite partial demographic recovery (~840 individuals globally). Mean heterozygosity is significantly lower for all existing populations than for historic museum samples. Also, mean heterozygosity is higher for the individuals used to establish the captive flock >30 years ago than for the existing remnant Aransas-Wood Buffalo and reintroduced/captive populations, indicating continued loss of genetic diversity. Future research will examine the genetic load of deleterious traits as a result of high relatedness within and across populations. These results can inform conservation planning efforts.

20. TRACE ELEMENTS AND CORTICOSTERONE FOUND IN FEATHERS OF WHOOPING CRANES FROM THE CENTRAL FLYWAY

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Abstract: Whooping cranes (*Grus americana*) are potentially threatened by Alberta oils sands contaminants exposure during migration and an array of energy production activities that disturb and pollute their coastal Texas wintering grounds. Conservationists lack basic knowledge, however, of current contaminant levels and stress markers in wild whooping cranes, which limits our understanding of the biological and population level risks from these threats. To fill this knowledge gap, we tested feathers for 33 trace elements and the stress hormone corticosterone from 62 cranes, including 28 pre-fledging juveniles from Wood Buffalo NP and 34 birds exhibiting adult plumage from Aransas NWR. All feather samples were taken from clinically normal wild cranes captured for telemetry application. There were only minor age differences found between juvenile and adult whooping cranes among the trace elements (e.g., Ca, Cu, Mg feather concentrations from juveniles < adults; Cd, Hg, Pb, Se, Zn from juveniles ≈ adults). Overall, juvenile whooping cranes had marginally greater corticosterone concentrations in feathers by length (pg/mm) and mass (ng/g) compared to adults, likely reflecting the residual elevation of corticosterone known to occur around the time of hatching (which declines to baseline in the first month of life, overlapping with initial contour feather growth). Both the feather trace element and corticosterone concentrations appear to reflect baselines for the respective age classes.

21. GO YOUR OWN WAY: CESSATION OF PARENTAL CARE IN WHOOPING CRANES

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Abstract: Whooping cranes (*Grus americana*) exhibit extended parental care of their young, persisting for approximately 10 months post hatch. From 2009 to present, we have marked individuals of the Aransas-Wood Buffalo population with remote-telemetry devices at wintering

and breeding areas. During this time, we simultaneously monitored locations of 8 family groups, where a juvenile and 1 adult each had an active transmitter, allowing identification of the location and timing of family break up, which we defined as the time of juvenile and adult(s) separation during spring migration. All separations occurred prior to reaching Wood Buffalo National Park (WBNP). Two juveniles continued migrating north to WBNP after separation while 6 juveniles stayed below the boreal forest edge in the Canadian prairies and agricultural lands after separation.

22. MORTALITY UPDATE OF FLEDGED WHOOPING CRANES IN THE ARANSAS/WOOD BUFFALO POPULATION

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Abstract: Maintaining accurate mortality records for endangered species is important for guiding management and conservation actions. Whooping crane (*Grus americana*) mortality in the Aransas/Wood Buffalo Population (AWBP) has been documented since 1950, with published records for 1950 through 2010. Our paper provides publicly available documentation of known mortalities from 2010 through February 2023, and updates to historic records from 1950 to 2010. Public sightings and telemetry carcass records were compiled to include data from the U.S. Fish and Wildlife Service, Environment Canada, and U. S. Geological Survey. Data were restricted to fledged cranes from the AWBP and stratified by confirmed, suspected, and unknown causes across the range (i.e., nesting, migration, wintering grounds). This mortality update provides more certainty associated with available carcass data and reduces discrepancies in existing published information.

23. THREATS AND CONSERVATION OPPORTUNITIES FOR MIGRATING WHOOPING CRANES IN THE OIL SANDS REGION OF ALBERTA, CANADA

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Abstract: The Aransas-Wood Buffalo population of endangered whooping cranes (*Grus americana*) contains approximately 550 individuals, and migrates twice annually through the Oil Sands Region (OSR) of Alberta, Canada. The OSR contains a great deal of industrial disturbance, particularly in the mineable area, and thus migratory stopover sites are likely to be in areas with high amounts of anthropogenic activity. This poses many direct potential hazards to migrating cranes. Moreover, cranes may avoid areas with high levels of development, thus functionally reducing the availability of stopover habitat. There are currently no estimates of migratory habitat selection within the OSR. Thus, our objectives were to model and map habitat selection by migrating whooping cranes within the OSR, estimate reductions in available stopover habitat caused by oil sands development, and delineate areas of highest conservation value for cranes. We developed a scale-integrated resource selection function (SRSF) including selection of stopover sites and habitat selection within sites. Our models indicated that cranes avoid certain types of anthropogenic disturbance at all scales, and suggested reductions in available habitat caused by industrial development. Our maps showed areas of high potential risk within the mineable area, and adjacent areas with high conservation value due to good quality habitat and reduced risk. Our work provides a scientifically defensible tool for land-use planners to delineate threats and help mitigate risks to migrating whooping cranes in the OSR.

24. WHOOPING CRANES RESPOND TO DROUGHT WITH FLEXIBLE MIGRATION AND HABITAT USE STRATEGIES

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Abstract: Climate and land use change are inevitable threats faced by wildlife; however, these threats may exacerbate how extreme events influence population persistence. We assessed how whooping cranes (*Grus americana*) modified migration and habitat use strategies during hydrologic drought to understand the species' resilience to changing conditions and provide insight into their adaptive capacity. After categorizing >8,000 night-roost sites used during

migration (2010–2022) by 145 cranes under normal conditions, moderate drought, and extreme drought, we found that cultivated and uncultivated palustrine and lacustrine wetlands were generally vulnerable to drought (used less than under normal conditions). Conversely, impounded palustrine and lacustrine systems and rivers served more frequently as drought refugia (used more during drought than normal conditions). Night roosts occurred primarily on private lands (86% overall); public land use decreased with latitude and increased with drought severity (e.g., 66% during severe drought in the southern Great Plains). Quantifying use of critical habitat indicated that Cheyenne Bottoms and Quivira NWR were vulnerable to drought, and the Platte River and Salt Plains NWR was resilient to drought. Across seasons and locations, whooping cranes increased migration movement bouts 18% during spring and reduced bouts 9% during autumn during extreme droughts. Our findings provide insights regarding the compensatory use of habitats, where impounded surface water may function in a complementary fashion with natural wetlands, collectively providing a more reliable network of habitat in variable environments across the Great Plains.

25. POTENTIAL EFFECT OF THE PROPOSED R-PROJECT TRANSMISSION LINE ON THE ARANSAS/WOOD BUFFALO WHOOPING CRANE POPULATION

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Abstract: Whooping cranes frequently encounter electrical transmission or distribution lines located throughout their habitats. We were asked to estimate the probability of at least one whooping crane being killed by colliding with a proposed transmission line (the R-project) planned to cross the primary whooping crane migration corridor in Nebraska. We also estimated the number of individuals that might be killed by the line. We used telemetry data provided by the U.S. Geological Survey and its partners, collected from 2009 to 2018, as well as published data, to estimate: 1) the probability that a migrating whooping crane would stop within the area surrounding the planned line; 2) if a bird stopped there, the probability that it would cross the proposed transmission line at an elevation where a collision could occur; and 3) if exposed to a line, the probability that a fatal collision would occur. These sequential probabilities were then applied to future, simulated whooping crane populations by running 1,000 times a 50-year population model we constructed in SAS. After 50 years, the average \pm SD simulated whooping crane population reached $4,699 \pm 4,455$ individuals and the probability of at least one Whooping Crane being killed by colliding with the proposed line (2021-2071) was 0.628 (95% CI = 0.606 to 0.649). The average number of Whooping Cranes killed from collisions was 1.239 (95% CI = 1.177 - 1.301). Although mortality from any one line may be small, the collective mortality from collisions with lines located throughout a flyway might become significant.

26. WHOOPING CRANE INLAND WINTER HABITAT SELECTION MODEL

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Abstract: Wintering habitat use of the Aransas/Wood Buffalo whooping crane (*Grus americana*) population is heavily concentrated in coastal marshes; however, given projections of continued population growth and observations that whooping cranes currently utilize inland habitat during the wintering season, inland habitat use is expected to increase in the future. We developed resource utilization functions to model whooping crane winter habitat relationships and predict spatial use of inland winter habitat. We compiled a set of environmental data layers for habitat characteristics considered important for whooping crane use to include as covariates. We used ‘random forests’ to model whooping crane use as a function of the environmental covariates. Overall, the model estimated that 50% of use was contained within an area of approximately 86,000 acres (50% use contour), whereas the 75% and 95% of use was encompassed by 228,881 and 812,800 acres, respectively. While presently limited by the small sample size of available observations at inland wintering areas, this model can be expanded to incorporate future habitat use data to reduce uncertainty and in turn better evaluate potential impacts to whooping crane inland habitat use in proximity to anthropogenic development. As the population increases and winter habitat use expands, the potential for habitat fragmentation, behavioral impacts from disturbance, and infrastructure collision risk related to project build-out may also increase. This model should be helpful in determining where project interactions with whooping cranes are likely and provides a tool for development of conservation measures.

27. TRENDS IN EXTENT OF OCCURRENCE AND AREA OF OCCUPANCY OF WINTERING WHOOPING CRANES IN TEXAS FOR RED LIST ASSESSMENT

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Abstract: The extent of occurrence (EOO) and area of occupancy (AOO) are two metrics used by the International Union for Conservation of Nature in risk assessment for species. We estimated EOO and AOO for whooping cranes on their wintering grounds in Texas, USA, for winters 1950–1951 through 2019–2020. We examined their trends and forecasted future sizes using an autoregressive integrated moving average process. We found EOO increased from 209.8 km² in

winter 1950–1951 to 2,674.2 km² in winter 2019–2020 (maximum = 5,074.7 km² in winter 2011–2012). We found AOO increased from 140 km² in winter 1950–1951 to 488 km² in winter 2019–2020 (maximum = 1,000 km² in winter 2011–2012). In combination with other criteria (e.g., population size), the Committee on the Status of Endangered Wildlife in Canada guidelines recommended an endangered status when EOO size is <5,000 km² and AOO is <500 km² and a threatened status when EOO size is between 5,000 and 20,000 km² and AOO size is between 500 and 2,000 km². Although the EOO and AOO thresholds were reached in winter 2011–2012, they were not sustained through time. AOO has exceeded the 500- km² threshold every winter since winter 2008–2009 except one, but EOO has remained below 5,000- km² since winter 2012–2013. We predict EOO will reach 5,000 km² by winter 2031–2032 and predict AOO will remain above 500 km². Our results provide valuable information for assessment of whooping crane conservation status.

28. LONG-TERM MIGRATORY ALTERATIONS TO WHOOPING CRANE ARRIVAL AND DEPARTURE ON THE WINTERING AND STAGING GROUNDS

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Abstract: We assessed long-term changes in whooping crane (*Grus americana*) migration phenology. We modeled timing of abundance peaks on the wintering grounds in Texas as a function of date and year. During spring and fall migration in central Saskatchewan, we modeled the timing of earliest and latest observations, and the period of occurrence between them, as a function of year. During winters 1950–2010, the peak abundance period (>90% of population) shortened 40 days. In winter 1950–1951, the peak was 28 November–12 March, but by winter 2010–2011, it was 18 December–20 February. We predict it may shrink to 2 January–6 February by winter 2035–2036. During fall migration 1972–2021, the period cranes occurred in central Saskatchewan lengthened 20.3 days. In 1971, cranes arrived by 16 September and departed by 17 October, but by 2021 they were arriving 12 days earlier (4 September) and departing 17 days later (3 November). We predict it may increase to 62.6 days by fall 2035, with arrival by 1 September and departure by 7 November. During spring migration 1979–2021, there was no trend in arrival, departure, or period of occurrence. On average, cranes occurred for 32 days during spring, arriving by 10 April and departing by 11 May. Alterations in migration phenology may require managers to change conservation approaches because food resources and weather may not synchronize well with migration. These circumstances may limit the time cranes spent on the wintering grounds, requiring greater investment in migratory stopover areas.

29. A BUFFET OF CORN: USE OF AUTOMATED FEEDERS ON THE WINTERING GROUNDS BY WHOOPING CRANES

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Abstract: Automated feeders placed on private property that dispense corn to attract wildlife for viewing and hunting is a common practice in the wintering range of the Aransas–Wood Buffalo whooping crane population. Whereas supplemental food resources provided by feeders have been available to wintering endangered whooping cranes for some time, little information exists on the magnitude of use at private feeders. We identified feeders used by whooping cranes at two primary locations within the wintering grounds which, based on personal experience of the authors, were placed for potentially different purposes. Feeders on the more intensively developed and inhabited Lamar Peninsula were placed largely to attract wildlife for viewing opportunities, whereas those on the Port O’Connor ridge were primarily used to attract game (e.g., deer or feral pigs) for hunting purposes. During winter 2022-2023, 5 whooping cranes with transmitters used the Lamar Peninsula for greater than one week of which 3 birds intensively used 11 feeders scattered on private lands. During that same winter, 12 of 14 birds with transmitters on the Port O’Connor ridge made extensive use of 50 identified feeders. Our preliminary findings could be used to speculate on hazards and benefits of feeder use by wintering whooping cranes.

30. ARANSAS/WOOD BUFFALO POPULATION USE OF INLAND WINTERING AREAS

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Abstract: Aransas-Wood Buffalo Population (AWBP) whooping cranes are increasingly utilizing inland areas for a portion of the winter. Per a compilation of publicly available data sources and Global Positioning System transmitter data, there have been individuals near Granger Lake during 5 of the last 12 winters and 9 of the last 12 winters in Colorado and Wharton counties. At least 11 individuals used Colorado County in 2022–2023. Seven birds across 11 bird-winters from 2011–2021 spent between 3.1-100% of their winter at inland areas. We summarized data from 62 whooping cranes tracked with transmitters from 2009–2018 and 3 cranes from 2017–2022, and we compared 95% auto-correlated kernel density estimates and daily distance movements for coastal wintering cranes and those that spent a portion of their winter inland.

Our results suggest that cranes utilizing inland areas move more than birds that spend the winter in coastal areas. The top Generalized Linear Mixed Model predicted that spending a portion of the winter at inland areas equated to a $77.1 \pm 4.3\%$ increase in daily movement during the winter. We found that several other factors influenced movement patterns, which warrant consideration when comparing between the groups. Whooping cranes tended to move further in the fall, particularly in October, than in the winter and early spring, females generally moved further than males, and juvenile and subadult cranes tended to move more than adults. Continued use of these inland areas has implications for what we consider whooping crane wintering habitat and how we manage for this species.

31. SOUTHERN WINTER RANGE EXPANSION OF ARANSAS/WOOD BUFFALO WHOOPING CRANES INTO AN URBAN/INDUSTRIAL LANDSCAPE: COEXISTENCE OR CONFLICT?

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Abstract: The only naturally occurring population of endangered Whooping Cranes has increased from 16 individuals in 1941 to over 500 through conservation efforts from federal laws, protecting habitat, and public outreach. Whooping cranes face unprecedented challenges within their winter range along a narrow 90-km coastal corridor in Texas. We report an expansion of the southernmost extent that overlaps with increasing urban development on Mustang Island and proposed projects along the Corpus Christi Ship Channel serving a major shipping port. A pair of whooping cranes first arrived in 2018 and returned annually through 2022-2023. Their winter residency was established via collection and analyses of timed videos utilizing the back-barrier flats and marshes within a 445 ha nature preserve. Limited public access was established in January 2023, but early efforts to reduce crane disturbance produced limited success. We have initiated stakeholder input among federal, state, county, and city representatives as well as several local environmental organizations to develop a coexistence plan between humans and wildlife. Tidal passes connect the crane habitat with the 14-m deep ship channel providing water exchange and ingress of essential prey items. Industrial expansion plans include deepening the channel to 23 m that will severely disrupt estuarine organism life cycles throughout two bay systems. Desalinization plant construction would discharge brine and further impact water quality and a Very Large Cargo Carrier terminal would increase the potential for oil spills. Continued Whooping Crane monitoring within the close proximity of this industrial expansion under review will provide additional information of addressing these conflicts.

32. PREDICTING WHOOPING CRANE OVERWINTERING HABITAT: IMPLICATIONS FOR CONSERVATION

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Abstract: Habitat alteration and loss threaten vulnerable species at risk of extinction. Predicting changes in landcover and available, unoccupied habitat is essential to protect threatened and endangered species, including whooping cranes. The endangered whooping crane is susceptible to habitat loss from anthropogenic development and climate change, particularly the only wild population that overwinters along a limited range of the Texas Gulf Coast. To increase protection of habitat, we identify preferred landcover types and which areas along the Gulf Coast are likely to be impacted by sea level rise using ecological niche modeling and exploratory spatial data analysis. Results indicate a preference for a mix of emergent herbaceous wetlands and water, but the finer scale landscape patterns characterizing these areas are difficult to discern from Landsat-based imagery. We characterize those finer-scale patterns using high resolution imagery for the Aransas National Wildlife Refuge and the Wood Buffalo National Park in Canada to determine whether there is a specific land cover signal that can be used to protect additional habitat.

33. ROOST SITE USE OF WINTERING WHOOPING CRANES IN THE ARANSAS-WOOD BUFFALO POPULATION

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Abstract: Little is known about the nocturnal roost site use patterns of the Aransas-Wood Buffalo Population of whooping cranes (*Grus americana*) on their wintering grounds. Roost site use patterns are important for habitat managers to understand space use, depredation risk, and habitat needs. We identified roost sites of whooping cranes wintering in Texas using data from cranes tracked with Global Positioning System transmitters. We analyzed 66 bird winters across 37 individuals that had at least 1 location exceeding accuracy thresholds for 90% of the winter nights and at least 90 nights of data in a winter season. A hierarchical clustering approach was used to group roost locations that were within 100 meters of each other and

identify unique roost sites by individual ($n = 1,960$). We found that on average, whooping cranes used 29.7 (range 8–71; SE = 2.03) roost sites per winter and spent an average of 4.6 nights (range 1–109; SE = 0.21) total at each site throughout the winter. In addition, roost sites were used on average 2.8 (range 1–33; SE = 0.09) different times throughout the winter, indicating revisitation of sites during the season. Roost sites overlapped with 23.5% (range 0–64.7%; SE = 0.03) of the area visited in a previous year. These results indicate that whooping cranes rely on many roost sites during the winter and return to some of the sites both within and between winters.

34. SITE CHARACTERISTICS OF FRESHWATER WETLANDS USED BY WINTERING WHOOPING CRANES

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Abstract: The Aransas-Wood Buffalo population of whooping cranes (*Grus americana*) winters primarily in saltmarsh along the Texas coast, but little is known about site-level characteristics of nearby freshwater wetlands they use for foraging habitat and dietary water. In early 2023, we collected site-level and landscape-level data at 14 wetlands used by wintering whooping cranes during the winters 2019-2020 and 2020-2021. The wetlands were dominated by graminoids, primarily seashore paspalum (*Paspalum vaginatum*), cordgrasses (*Spartina* spp.), and spike rush species (*Eleocharis* spp.). Common forbs included sea oxeye daisy (*Borrchia frutescens*) and Herb-of-Grace (*Bacopa monnieri*). Average vegetation height was 23 cm (SD = 18 cm). Average distance to obstructions >1.5 m tall was 328 m (SD = 285 m). Standing water was present at 12 of the sites during our surveys, with average depth 11.3 cm (SD = 6.56). Salinity of those wetlands averaged 1.69 ppt (SD = 1.22 ppt), pH 7.45 (SD = 0.81), and wetted width 131.6 m (SD = 89.9 m). Used wetlands averaged 528 m from the nearest two track road, 799 m from a gravel road, and 2436 m from a paved road. Land cover within 1 km of used wetlands averaged 25% coastal prairie, 23% woodland, 20% saltmarsh, 19% salty prairie, 2.5% freshwater wetland, and 0.4% developed. These preliminary results suggest that freshwater wetlands used by whooping cranes were away from major human disturbance with short, graminoid-dominated vegetation, and few tall obstructions. We plan to continue this sampling effort including data from nearby, unused wetlands to provide inference into habitat selection.

35. UPDATE: VIDEO BEHAVIOR ANALYSIS OF TWO WINTERING POPULATIONS OF WHOOPING CRANE

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Abstract: The Aransas Wood Buffalo (AWBP) and Eastern Migratory (EMP) Populations of whooping cranes (*Grus americana*) use very different landscapes during the non-breeding season. We aimed to develop a baseline understanding of wintering behaviors of whooping cranes in the EMP, compare behaviors between whooping cranes in the AWBP and EMP, and gain greater understanding of other factors, including habitat, that affect behaviors of wintering whooping cranes. We analyzed 20-minute videos of groups of whooping cranes wintering in Texas, Indiana, Illinois, and Alabama during winters 2018-2019, 2019-2020, and 2020-2021. We prepared time budgets for each population and used a generalized linear model selection process to determine what factors had the highest impacts on winter behavior. At the 15th North American Crane Workshop, we presented preliminary results based on our first year of data collection that suggested that there were distinct behavioral differences between the two populations and between rural and coastal habitats in the AWBP. Preliminary results also suggested that the presence of sandhill cranes (*Grus canadensis*) influenced behavior. We now find that the top behavior models comprised of three years of data suggest that there is no difference in time budgets based on population or sandhill presence. However, the preliminary findings may not have accounted for the differences in habitats used between populations. Additional significant factors of time budgets include the type of group a bird was in, winter month, weather, and human presence (measured by road density). These more complete findings have relevance for habitat conservation, human interactions, and response to climate change.

36. UNDERSTANDING HABITAT QUALITY DEGRADATION FOR THE WESTERN CONTINENTAL POPULATION OF RED-CROWNED CRANE IN ASIA

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Abstract: Habitat degradation is a serious threat to the western continental population of red-crowned cranes (*Grus japonensis*). Habitat quality for cranes can be assessed by understanding wetland biophysical attributes including hydrology, floral and faunal communities, climatic conditions, and anthropogenic effects. Moreover, this wetland knowledge is necessary for

effective habitat management. Therefore, we conducted a literature review focusing on habitat quality and determining processes within their critical habitats and used Zhalong and Yancheng National Nature Reserves, China, as examples of breeding and wintering grounds, respectively. In Zhalong, the red-crowned cranes breed in inland freshwater reed marsh. Water diversion projects since the 1990s and increased evapotranspiration have significantly changed wetland hydrology and reduced wetland size. This has transformed some freshwater reed marshes to saline-alkali marshes. Additionally, overharvesting and wetland degradation have led to a decline in natural crane food, particularly fish. Therefore, highly altered hydrology and subsequent change of floral and faunal communities due to anthropogenic modification and climate change can significantly affect crane habitat quality. In the coastal area of Yancheng, over 70% of the coastal marsh has been converted to other land cover types by humans, resulting in a significant loss of preferred freshwater reed marsh and saline seepweed marsh for wintering cranes. In addition, invasive *Spartina alterniflora* has gradually replaced seepweed and limited food accessibility. In this region, significant habitat loss with vegetation succession is the ecological restriction on crane habitat quality and population growth. In these habitats, specific wetland knowledge concerning red-crowned crane habitat quality is necessary for habitat management and research.

37. MISSISSIPPI SANDHILL CRANE CONSERVATION UPDATE 2020-23

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Abstract: The Mississippi sandhill crane (*Grus canadensis pulla*) is an endangered non-migratory subspecies found on and near the Mississippi Sandhill Crane National Wildlife Refuge in southeastern Mississippi. From 2020 to 2023, conservation efforts for the recovery of this population included management activities such as protection and law enforcement, restocking, predator management, mowing, prescribed burning, mechanical vegetation removal, hydrological restoration, pest plant management, and education. To maintain open savanna, Refuge staff burned 8,885 ha (21,955 acres), with 53.8 % occurring during the growing season. Over 344 ha (851 acres) of woody vegetation were removed using mechanical methods to restore open savanna. To maintain grassland, over 427 ha (1,055 acres) were mowed. We released 32 captive-reared juveniles as part of 6 cohorts to bolster the crane population. To protect cranes, nests and young, a contractor conducted predator trapping totaling 16,746 trap-nights, removing 106 large predators and 300 raccoons. We monitored the crane response and assessed progress towards recovery, collecting over 10,400 observation records (visual, camera, and VHF fix) and over 700,000 GPS-GSM transmitter locations. Of 11 carcasses with known or suspected causes of death, 10 were due to trauma and 1 to disease. During the 4-year period, there were over 257 nests resulting in 37 fledglings. The December 2022 population was approximately 161 cranes, up 16% from December 2019.

38. HABITAT SUITABILITY OF MISSISSIPPI SANDHILL CRANE NEST SITES

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Abstract: Certain nesting territories at Mississippi Sandhill Crane National Wildlife Refuge have consistently produced more Mississippi sandhill crane nests and chicks. Understanding the drivers of this pattern would aid in achieving the goal of a self-sustaining wild Mississippi sandhill crane population. By adapting a Habitat Suitability Index (HSI) for Florida sandhill cranes to Mississippi sandhill cranes, we examined whether differential habitat suitability explains the historical variation in nesting production across the refuge. Between 1991 – 2022, mean HSI of nest sites ($\bar{X} = 0.52$, $n = 554$) was significantly higher than that of an equal number of random points across the refuge ($\bar{X} = 0.24$). This indicates that our HSI model corresponds to historical nest site choice. However, fledging rate as measured by number of chicks surviving to fledge divided by number of nests did not differ between high and low HSI nest sites, suggesting that factors outside of habitat suitability may contribute to chick survival. Extensions of future work related to proportion of high HSI habitat in more successful areas of the refuge are also discussed.

39. INTRAOCULAR PRESSURE IN WHOOPING CRANES AND MISSISSIPPI-SANDHILL CRANES

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Abstract: Intraocular pressure (IOP) is an important component of a complete ophthalmologic examination. Species-specific results are paramount due to variations across avian taxa, and values during development are important for health assessments in intensive breeding programs such as whooping cranes (*Grus americana*, WHCR), and Mississippi sandhill cranes (*Grus canadensis pulla*, MSCR). The current study reports IOP in both species, documenting variations in age, weight, species, head position, and sex. Chicks were manually restrained on days 1-3, 7, 21, 35, 60, 75, and 120 for routine examinations. IOP was opportunistically measured utilizing the Tonovet Plus® in D setting with the head above the heart (AH) and below the heart (BH). Values were also obtained longitudinally in adults upon presentation in one year. Intraocular pressure measured during development in chicks was highly correlated with age and weight. For every kilogram gained, IOP increased 2.46 ± 0.08 mmHg in WHCR and 2.66 ± 0.11 mmHg in MSCR. Once hatched, IOP increased 1.13 ± 0.04 mmHg in WHCR and 0.87 ± 0.04 mmHg in MSCR every 10 days. In adults, there was a significant difference in IOP with the

head AH and BH. IOP AH in WHCR was 24.0 ± 0.4 mmHg, and BH was 27.9 ± 0.4 mmHg; in adult MSCR, IOP AH was 20.7 ± 0.4 mmHg, and BH was 24.6 ± 0.4 mmHg. Sex was a significant factor in WHCR, females (25.3 ± 0.4 mm Hg) had lower IOP than males (26.5 ± 0.4 mmHg).

40. EVOLUTION OF COSTUME REARING TECHNIQUES FOR MISSISSIPPI SANDHILL CRANES AND WHOOPING CRANES AT FREEPORT-McMORAN AUDUBON SPECIES SURVIVAL CENTER

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RICHARD DUNN, Audubon Nature Institute, New Orleans, LA, USA

Abstract: The Freeport McMoran Audubon Species Survival Center (SSC) has been successfully costume raising cranes since 1996. There have been over 250 Mississippi sandhill cranes (*Grus canadensis pulla*) released from the SSC since 1996 (57% costume reared since 2008) and 23 whooping cranes (*Grus americana*) since 2017 (78% costume reared). Historically, costume rearing was labor intensive, chicks never saw humans, had frequent medical examinations, and pen maintenance was done in costume. Currently, there are many new approaches to husbandry practices for raising and capturing chicks, and pen maintenance. The costume itself has evolved; it fully covers the keeper, and the puppet head is manipulatable. Interactions with costumed personnel have also been decreased. While under 500 grams, chicks receive five 15-minute walks a day; after 500 grams, they are in a 50 ft x 60 ft yard and receive one visit per day from the crane costume. The chicks still have access to either an adult role model or a plastic role model. Cohorts incorporate both parent- and costume-reared chicks. This helps expose the parent-reared chicks to the costume and the two types of chicks can learn from each other. During capture events, a costumed keeper is present to 'attack' or run away from the humans coming in to catch the chick. Predator aversion training has also been implemented with Mississippi sandhill cranes. Overall, the current approach to costume rearing has reduced time constraints on staff, improved independence of the chicks, and encourages the birds to exhibit more natural behaviors.

41. INTRODUCTION OF HATCHED MISSISSIPPI SANDHILL AND WHOOPING CRANE CHICKS TO ADULTS FOR PARENT REARING

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Abstract: At Freeport-McMoRan Audubon Species Survival Center, the introduction of a chick following its hatch day has been successful in breeding whooping cranes (*Grus americana*) and Mississippi sandhill cranes (*Grus canadensis pulla*) that have laid, not laid, or did not incubate eggs during the season. Chicks have also been successfully accepted by parents after the death of an offspring or in replacement of chicks with intensive medical issues. Understanding the

breeding pair or individual is critical to the successful placement of chicks. In pairs or individuals that have raised chicks in previous years, the parents were more likely to accept chicks (88%). Since 2015, there have been 18 introduction attempts, varying from Day 1 of age to Day 199, with an 83% success rate. The oldest successful acceptance was Day 80. When under a week old, chicks are placed into the nest and staff watch as parents would return to the nest and begin purring or investigating the chick. Staff wait to see brooding from the adults before confirming a successful acceptance. With older chicks, the chick is released anywhere in the yard, while staff monitor closely for longer periods of time. In successful cases, parents would vocalize with a growl or defensive rattle and herd the chick away from humans. Eventually keepers were watching for parenting behavior (e.g., brood call or feeding). In the case of rejection, adults would almost immediately attack the chick: pecking, chasing, or attempting to jump rake them. Introduction of a chick following its hatch day can be a useful tool when looking to parent rear a chick.

42. ASSESSING THE IMPACT OF REARING STRATEGY ON WHOOPING CRANE HEALTH THROUGH THE GUT MICROBIOME

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Abstract: Whooping Cranes (*Grus americana*) reared using artificial (costume) methods are susceptible to fatal fungal infections and are more likely than parentally-reared cranes to develop skeletal abnormalities. The reasons for these health disparities between rearing strategies is often unclear, limiting the development and application of remedies. The gut microbiome is emerging as an important, but overlooked, dimension of captive animal health through influences on host metabolism and immunity. We hypothesized that cranes reared using artificial methods lacked microbial exposure from adult cranes in early life, and that the gut microbiome could underlie health disparities. We have analyzed the gut microbiomes of 21 artificially-reared (AR) and 8 parentally-reared (PR) Whooping Crane chicks over five breeding seasons. Additionally, five AR chicks (AR-FMT) were given a fecal microbiome transplant shortly after hatching to simulate microbial sources from adult cranes. Initial results show that the gut microbiome composition of PR chicks is distinct from those of AR and AR-FMT chicks (pairwise adonis; $p = 0.003$). Parent-reared chicks had a higher diversity (Shannon index) of gut bacteria compared to AR or AR-FMT chicks at day 14 post-hatching ($p < 0.0002$), but all three groups had similar microbial diversity at days 30, 50, and 70 ($p > 0.11$). These initial effects could still manifest later, however, as the gut microbiome during early developmental windows can prime metabolic and immune maturation for adulthood. Integration of microbiome data with clinical metadata from chick health reports will help to reveal whether these microbial differences between rearing strategies are associated with chick health.

43. THE DIETS OF WILD AND REINTRODUCED WHOOPING CRANES

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Abstract: Whooping cranes (*Grus americana*) were re-introduced into a Wisconsin to Florida flyway starting in 2001 using ultralight aircraft to teach the migration pathway. Comparisons between this new Eastern Migratory Population (EMP) and the existing Aransas-Wood Buffalo population (AWBP) are being studied. Frozen contents from the proventriculus and ventriculus collected from dead whooping cranes of both populations were examined to identify dietary items and quantity. The EMP whooping cranes (n = 29) consumed benthic macro-invertebrates, beetles, crabs/crayfish, vegetation, seeds, mollusks, and unidentifiable vertebrates. The diets of AWBP whooping cranes (n = 7) included all the same food items except benthic macro-invertebrates, while crabs/crayfish held the top dietary category. Both populations also consumed a variety of non-food items, including plastic and metal. Estimates were performed using the dietary items and quantities to evaluate the energy consumption of whooping cranes in the two populations. There were no statistical differences found between the quantities of each food type consumed nor the energy values of the consumed food items by each population. We can conclude, therefore, that the wild and reintroduced whooping crane populations are consuming similar types and amounts of food items to meet their dietary requirements.

44. YOU CAN LEAD A (CAPTIVE-REARED) CRANE TO WATER BUT YOU CAN'T MAKE IT ROOST

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Abstract: One of the primary sources of mortality in the Eastern Migratory Population (EMP) of whooping cranes (*Grus americana*) is predation, which inhibits the establishment of a self-sustaining population as required by the species recovery plan. The roosting behavior of birds has evolved as a means to avoid predators. Released birds in the EMP are raised by one of two methods at the International Crane Foundation: by a human in a costume (CR) or by a bonded pair of whooping cranes (PR). This inherently results in differences in behaviors to which the chicks are exposed. Thus, we hypothesize that the rearing methods in captivity have an impact on roosting behavior in the wild. We predict that CR birds will roost less often in water than PR birds both in captivity and upon release in the wild. As part of the conservation efforts for the whooping crane, we believe that this hypothesis creates an opportunity to better understand the outcomes of the mechanisms of chick rearing after release into the wild. In this presentation, we present the results of the first season of captive data collection.

45. EVALUATION OF CONSERVATION EDUCATION CARTS FOR BUILDING EMPATHY AND CONSERVATION ACTION TOWARDS WHOOPING CRANES

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Abstract: Interactive and mobile conservation education carts used alongside a crane ambassador fulfill an important role in building empathy towards and conservation engagement benefiting whooping cranes (*Grus americana*). In the summer of 2022, crane conservation carts were piloted at two Wisconsin zoos, the Henry Vilas Zoo and the Milwaukee County Zoo, each of which houses a sandhill crane and a whooping crane, respectively. We developed methods and gathered data to assess the impact of these carts on (1) stimulating visitor engagement with educational artifacts and activities about whooping crane biology, ecology, and conservation, (2) building confidence in identifying whooping cranes, (3) understanding and building support to mitigate threats to whooping cranes, (4) encouraging visitors to seek out additional information or opportunities to support whooping crane conservation, and (5) understanding the role zoos and conservation organizations play in protecting an endangered species. In the 2022 pilot study, these carts reached 2,981 people over 3 months, of which 94% resided in regions with wild whooping cranes. Visitors of the carts were surveyed, and responses indicated they experienced a 1.94 point knowledge gain (1-little knowledge to 5-very knowledgeable) after engaging with the cart, 94.24% of visitors felt comfortable identifying a whooping crane, and 58.43% of visitors engaged with the cart's calls to action (i.e. pledge, poaching hotline, and "I Give a Whoop" stickers). Our data imply that conservation carts lead to conservation attitudes and support and can be a valuable resource for conservation outreach programs.

46. MERCURY AND LEAD EXPOSURE IN EASTERN WHOOPING CRANES: CAUSE FOR CONCERN?

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Abstract: Pollutants such as lead (Pb) and mercury (Hg), known toxicants to wetland birds such as whooping cranes, may represent risks to health and productivity throughout its range. We measured Pb and Hg in blood samples from 11 adults and 16 wild-hatched juveniles of the Eastern Migratory Population (EMP) taken in Wisconsin between 2016 and 2022 to assess recent exposure to these two non-essential elements. In adults, Pb was detected in 91% (10/11) of samples with a mean \pm SD concentration of 15.9 ± 7.8 ppb. The proportion of samples that contained Pb > 20 ppb (above background) was 30%, similar to that reported in trumpeter

swans in Wisconsin, but lower than commonly accepted toxic thresholds for birds. Lead was detected in 12% (2/16) of samples from juveniles, but only at the lowest detection limit of 5 ppb. Mercury was detected in 82% (9/11) of samples from adults with a mean of 132 ± 121 ppb. The adult Hg concentrations were similar to previously published data from wintering AWBP cranes, and two outlying values remained below a suggested toxic risk threshold and markedly below concentrations seen in loons from Wisconsin. Though Hg was found in 94% (15/16) of samples from juveniles, concentrations were lower than adults (61 ± 33 ppb, $p = 0.02$). Ongoing exposure of whooping cranes to both Pb and Hg is common within the EMP in Wisconsin, particularly among adult birds, but appears variable and may result in a limited, episodic pattern of toxic impact(s).

47. A PILOT STUDY OF FAMILY UNIT BEHAVIORS IN THE EASTERN MIGRATORY POPULATION

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HILLARY THOMPSON, International Crane Foundation, Baraboo, WI, USA

Abstract: Productivity and chick survival tend to be low in the early stages of reintroduction, and it can take many years for individuals to adjust to environmental factors in novel breeding areas. This remains true in the Eastern Migratory Population of Whooping Cranes (*Grus americana*), where chick survival to fledging is less than 18% and continues to be one of the biggest hurdles for population growth. Parental care is incredibly important for chick survival: preliminary results indicate that the age and breeding experience of a chick's parents greatly effects survivability. By observing family groups and recording their behaviors, this pilot study attempts to understand which behaviors successful parents demonstrate. In this study, we observed wild whooping crane family groups in central Wisconsin and recorded videos of their behaviors. Simultaneously, we recorded data on habitat associations, distances to human development, and time of observation. Collected videos were uploaded into BORIS to document the following behavior states: foraging, locomotion, alert, social, resting, or comfort. Further analysis of these behavior states and the frequency will increase understanding of whooping crane parenting strategies and how they impact chick survival.

48. PREDATORS OF WHOOPING CRANE CHICKS ON THE BREEDING GROUNDS OF THE EASTERN MIGRATORY POPULATION

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Abstract: Predation is one of the major causes of whooping crane (*Grus americana*) chick mortality in the Eastern Migratory Population (EMP). Recruitment is low for the EMP due to chicks not surviving to fledging. The objective of this study is to evaluate the presence and diversity of potential mammalian predator species in relation to whooping crane chick-rearing habitat. We hope to (1) compare predator prevalence and occupancy at Necedah National Wildlife Refuge (NWR), Horicon NWR, and White River Marsh State Wildlife Area (SWA), (2) evaluate seasonal habitat preferences of predators and how that overlaps with chick-rearing habitat and location, and (3) create a predator risk map for future whooping crane management plans. Over a 2-year period we deployed a total of 138 motion activated trail cameras over a 1 km² grid, at the 3 study areas. We captured 2,046 independent predator detections over all sites (Horicon NWR > Necedah NWR > White River Marsh SWA). Fourteen predatory mammal species were seen at Necedah NWR, 11 at Horicon NWR, and 8 at White River Marsh SWA. Multi-species occupancy models will be used to identify relationships between coyote (*Canis latrans*), racoon (*Procyon lotor*), bobcat (*Lynx rufus*), and gray wolf (*Canis lupus*) detections, along with habitat and other ecological variables. This occupancy data will then be compared to whooping crane chick locations. This information will help understand predator communities in areas where whooping cranes are breeding and which habitats are most dangerous for young whooping cranes.

49. MIGRATION PATTERNS OF PARENT-REARED WHOOPING CRANES IN THE EASTERN MIGRATORY POPULATION, 2016-2022

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Abstract: Whooping cranes (*Grus americana*) have been raised and released into the Eastern Migratory Population (EMP) by costume rearing and guided migration with an ultralight aircraft with release the following spring, by costume-rearing and direct first autumn release, and by parent-rearing by captive adult whooping crane pairs with releases in the first autumn. Parent-

rearing encourages conspecific learning compared to other methods used to raise whooping cranes in captivity, but needs further research to understand how it may influence post-release behaviors including migration. This study describes migratory timing and behavior of parent-reared whooping cranes. Using GPS data from satellite transmitters, we determined when cranes were migrating or stationary, and categorized movements as summering, stopover (2 or more relocations in an area that spanned overnight hours), migratory, or wintering. We identified 14 spring migrations, 19 fall migrations, 12 fall stopover sites, and 17 spring stopover sites from 7 individual cranes during 2016-2022. The average fall migration start and end dates were 9 and 21 November, respectively. The average spring migration start and end dates were 1 and 25 March, respectively. Median migration duration during the fall was 16.2 days (25-75% interquartile range {IQR}: 6.1 - 29.0 days), and during the spring was 14.6 days (IQR: 9.2 - 27.2 days). Migration routes varied between cranes and sometimes an individual's route would change between years. These results need to be compared to the migratory behavior of EMP cranes raised using other rearing methods.

50. HABITAT USE BY REINTRODUCED PARENT-REARED WHOOPING CRANES FOR 2016-2022

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Abstract: Captive whooping cranes (*Grus americana*) have been raised with two different rearing methods prior to release during the fall into Eastern North America: costume-rearing by human caregivers (with subsequent releases after an ultralight aircraft-led migration or by direct release into the wild) and parent-rearing (PR) with the young cranes raised by adult whooping crane pairs prior to direct release into the wild. Using leg band mounted satellite transmitters, we have documented habitat use patterns by PR whooping cranes in the years after their releases from 2016 to 2022. We used moving hotspot analysis to identify summering and wintering home ranges and calculated resource selection ratios for these cranes when they are summering or wintering. During the summer, non-nesting cranes selected for open water and herbaceous wetland and avoided forest, development, barren, shrub, woody wetlands, and non-grain or soybean crops. During the winter, cranes avoided shrub, grassland, forest, non-grain or soybean crops, and used other land cover types in similar proportion to availability. The average summer home range size was 56.4 km² (range: 4.0-221.5 km²) for non-nesting cranes and 1.7 km² (range 1.1-2.5 km²) for nesting cranes, and the average winter home range size for all cranes was 25.2 km² (range: 1.1-101.2 km²). During summers, some young whooping cranes wandered over several counties and even states, while others stayed in relatively small areas. Further comparisons need to be done with the habitat use by costume-reared cranes in the eastern population and with cranes from the Aransas-Wood Buffalo population.

51. DISTURBANCE IMPACTS OF BLACK FLIES ON WHOOPING CRANE NEST ATTENDANCE AT WHITE RIVER MARSH, WISCONSIN

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Abstract: Black flies are a cause of nest abandonment and nest failure in whooping cranes (*Grus americana*) in the reintroduced Eastern Migratory Population (EMP). These parasitic insects have been recorded harassing nesting birds at Necedah National Wildlife Refuge, where management actions have been taken, and recently, their presence has been observed at White River Marsh State Wildlife Area (WRM). Located in Green Lake County, Wisconsin, WRM was first used for Whooping Crane reintroductions in 2011. This study will investigate the disturbance impacts of black flies on nesting Whooping Cranes at WRM. Recent monitoring efforts indicate black flies are present at WRM, however, we have yet to understand their impact on incubating cranes and nest success. We plan to analyze trail camera photos of nesting Whooping Cranes at WRM to determine (1) black fly presence and severity, (2) crane behaviors in response to black flies, and (3) the impacts of black flies on nest fate. The results of this study will help the whooping crane reintroduction teams understand the impacts of black flies on nesting birds at WRM to better manage reintroduction and natural recruitment strategies for Whooping Cranes in the EMP.

52. MAXIMUM DISTANCE BETWEEN ROOST AND DAYTIME USE POINTS OF WINTERING WHOOPING CRANES IN INDIANA

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Abstract: Migratory birds on their wintering grounds make daily movements to gain access to resources, and selection favors those who only travel as far as necessary to obtain optimal net energetic intake. Natural and artificial obstacles in an individual's flight path can decrease fitness and cause mortality. Whooping cranes (*Grus americana*) are an endangered species consisting of 4 populations, including the Eastern Migratory Population (EMP), a reintroduced population breeding in Wisconsin and wintering primarily in Indiana and Alabama. This population continues to face multiple threats throughout the flyway, including habitat loss and degradation as the result of growing infrastructure. By analyzing GPS data from whooping cranes wintering at Goose Pond Fish and Wildlife Area (FWA) in Greene County, Indiana, we can better understand daily movement patterns and habitat use. Here we investigate the environmental factors affecting the maximum distance traveled by whooping cranes from their

roost site. We will examine the effects of proximity to human development and temperature on maximum distance traveled. The results of this study can be used to inform land management and protection in the area surrounding Goose Pond FWA, aiding in the preservation and successful reintroduction of whooping cranes in the EMP.

53. NEST SUCCESS RATES AND SURVIVAL OF WILD-HATCHED WHOOPING CRANE CHICKS IN LOUISIANA

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Abstract: Whooping cranes (*Grus americana*) were first released into southern Louisiana in March 2011 as part of an effort to create a self-sustaining non-migratory population within the historical range of the species. Nesting began with a single pair in 2014, and in 2016, the first chicks hatched in Jefferson Davis Parish to a pair nesting for the first time. Since nesting began, a variety of factors have been documented affecting individual nest or egg success each year, but high embryo mortality rates appear to be a major cause. Of 179 unhatched eggs that were examined, 91 (50.8%) were determined to contain dead embryos of various ages. Despite these issues, 60 eggs produced by Louisiana cranes have hatched (54 in the wild, 6 in captivity). An additional 11 chicks hatched from eggs produced in the eastern migratory population or in captivity that were swapped into Louisiana nests. Overall, greater than 35% of all chicks reared in the wild in Louisiana have survived to fledge. This rate may be higher once the final fledging rate for 2023 has been determined. The remaining chicks were 1-57 days old when they were last confirmed or suspected to be alive and had disappeared, or were confirmed dead, at 1-72 days old. Most fledged chicks were hatched and reared in actively farmed crawfish fields with only a small number successfully fledging from natural marsh environments.

54. TRANSLOCATING NON-MIGRATORY ADULT WHOOPING CRANES FROM FLORIDA TO LOUISIANA

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Abstract: The Florida non-migratory whooping crane (*Grus americana*) reintroduction project ended in 2012 with 18 cranes remaining. With hopes of these cranes continuing to contribute to the conservation of the species, researchers decided to translocate them to the newly established Louisiana non-migratory population. From January 2019 to October 2022, 3 females and 2 males were captured and transferred to White Oak Conservation, a new whooping crane conservation breeding facility in Yulee, Florida, where they received a thorough medical exam and were held for a brief quarantine period. The 5 cranes ranged in age from 2.5 to 21 years old, with 4 of them being wild-hatched and reared. Each crane was individually marked to allow for identification and tracking following release. All individuals were released on White Lake Wetlands Conservation Area property in Vermilion Parish, Louisiana the same day or the day following their transfer. Four of the released cranes began to associate with Louisiana whooping cranes within several weeks of their release. All 5 translocated cranes made exploratory movements in the weeks and months following their release, primarily to areas north and west of the release location, but none farther than 160 km away. Four individuals have been confirmed or are suspected of having molted at least once since being released in Louisiana. All 3 females paired within 1.5 years of their release, and all have nested, though none have yet succeeded in hatching their own chick. Post-transfer and release survival is 80%.

55. A FIRST RECORD FOR THE SPECIES - LOUISIANA WHOOPING CRANE PAIR RENESTS AFTER SUCCESSFULLY FLEDGING A CHICK

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Abstract: Although whooping cranes (*Grus americana*) are known to renest if their first nest fails, those in migratory populations are more limited in their ability to do this given the more northern latitudes they nest at, which shortens the duration of their breeding season. In contrast, non-migratory populations, like those reintroduced in Louisiana, and previously in Florida, often begin nesting in February and may continue into early July. Since 2014, when the first pair nested and renested, Louisiana cranes have demonstrated a high propensity for making multiple nesting attempts within a single season. In some instances, first nests have failed prior to full term, leading the pair to try again, but in 21 cases from 12 different pairs, first nests have been incubated full term prior to the pair nesting again and incubating for another full period. Additionally, in 9 instances, pairs have renested after successfully hatching but then losing a chick, sometimes having reared the chick for 3-4 weeks. In 2023, in a first record for the species, a pair of Louisiana whooping cranes renested after successfully fledging a chick. Although the second nesting attempt did not result in a hatched chick, the egg was fertile and the pair incubated past full term.