Priority Information Needs for Sandhill Cranes II

A FUNDING STRATEGY

An Update to the First Priority Needs Document Developed by the Association of Fish and Wildlife Agencies' Migratory Shore and Upland Game Bird Support Task Force

22 April 2016

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Table of Contents

Executive Summary

This strategy contains recommendations for updated priority information needs that build upon previous priorities identified in the first Priority Information Needs Workshop for sandhill cranes. The development of these updated needs was shaped from work that was completed since the first workshop in April 2009. The strategy is intended to focus stakeholder coordination for completing priorities that will improve management of the six migratory sandhill crane populations. It is also intended to increase financial support for management and research activities over the next 5 to 10 years with thoughtful and deliberate planning built on basic scientific principles.

Originally, the Migratory Shore and Upland Game Bird Support Task Force determined that convening a workshop of sandhill crane experts with knowledge about each of the six migratory populations would be the most efficient and effective process to develop the first strategy. Experts from state and federal agencies and from universities in the United States and Canada were invited to the initial workshop in 2009. Since that time, much progress has been made on the original set of priorities. Therefore, a second workshop was held 14-15 April 2014, at the U.S. Geological Survey, National Wetlands Research Center Office in Lafayette, Louisiana.

The 2014 workshop resulted in the identification of four priority information needs for sandhill cranes:

1. Assessing Finer-scale Management of the Mid-Continent Population.
2. Assessing Effects of Habitat Changes on the Rocky Mountain Population of Sandhill Cranes.
3. Improving the Monitoring of Eastern Population Sandhill Cranes.
4. Improving Population Abundance Estimates for the Mid-Continent Population of Sandhill Cranes.

Workshop participants also reaffirmed the following overarching guidelines, identified during the first workshop, that should be considered in further development of each priority information need: (1) increase involvement of Canada, Mexico, and Russia, which support significant portions of North American crane populations, yet are not fully integrated into the management decisions that affect these birds; (2) consider the effects of climate or system change on crane habitats and ultimately on the abundance and distribution of cranes; (3) recognize that agricultural practices at both the landscape scale and locally have a fundamental influence on all sandhill crane populations, that sandhill crane populations can have a negative impact on agriculture through crop depredation, and that large-scale changes in agriculture due to development, climate change or other factors can affect sandhill crane populations rapidly and significantly; (4) sandhill crane populations are sustained in large

part by the collective habitat conservation efforts of a variety of conservation partners, and that landowners must be substantial partners in their conservation; and (5) sandhill cranes have significant economic effects on local economies through recreational hunting, wildlife festivals, and wildlife watchers which bring money to local communities and support their conservation, so keeping these partners engaged is critical to sustaining crane populations. Ultimately, these priorities help build on the foundation of current efforts in a way that ensures the long-term conservation and informed management of these critically important birds in the face of a changing environment.

Introduction

In 2006, the Migratory Shore and Upland Game Bird Working Group (Working Group) of the Association of Fish and Wildlife Agencies established a Migratory Shore and Upland Game Bird Support Task Force (Task Force). The Task Force was composed of nine representatives of state, federal and non-governmental organizations. The Task Force was directed to update the research and management needs of the 16 species of migratory shore and upland game birds (MSUGB) and to develop a strategy for funding priority research and management needs. The sandhill crane (*Grus canadensis*) is one of the webless game bird species that was targeted for development of a funding strategy. The Task Force determined that convening a workshop of sandhill crane experts with knowledge about each of the six migratory populations would be the most efficient and effective process to develop the strategy. The first Sandhill Crane Priority Information Needs Workshop was held in April 2009. Experts from Flyways, universities, non-governmental organizations, and from state and federal agencies in the United States and Canada were invited to the workshop. Five priorities were identified at the first workshop and included in the first Priority Information Needs Strategy (Case and Sanders 2009). Over the past several years, cooperators have accomplished work on many of the priorities identified in the first strategy. As such, it was determined that stakeholders should revisit the priorities identified in the first strategy in order to update or develop new priorities. The second workshop was held during 14-15 April 2014, at the U.S. Geological Survey, National Wetlands Research Center in Lafayette, Louisiana. The priorities identified at that workshop are presented in this updated strategy. A list of the second workshop participants is included in Appendix A.

STRATEGY PURPOSE

This Strategy contains recommendations for obtaining priority information needed to improve management decisions for migratory populations of sandhill cranes, focusing on initiating or enhancing monitoring efforts and estimating vital rates during the annual cycle of these birds. The Strategy is intended to increase financial support for management and research activities over the next 5-10 years with thoughtful and deliberate planning built on basic scientific principles. Resulting priorities will be used to guide the acquisition and expenditure of funds, as well as provide the means to attract additional funds from partners interested in migratory shore and upland game birds.

Status of Sandhill Cranes

The sandhill crane is one of the most ancient species of birds that inhabits North America (fossil records date back at least 2.5 million years). They are large, vocal, spectacular birds with unique breeding displays and have become symbols of international cooperation for bird conservation. They are long-lived (annual adult survival: 85-95%) and have the lowest recruitment rates (5-15% juveniles/total cranes) of any game bird in North America. Generally, sandhill cranes do not breed successfully until 3-5 years of age and lay two eggs each year. Less than twenty percent of pairs are successful in raising young each year, and most successful pairs fledge only one young per year.

North American sandhill cranes are collectively the most abundant of the world's crane species and are divided into three non-migratory and three migratory subspecies. The non-migratory subspecies (*Florida [G. c. pratensis*], Cuban [*G. c. nesiote*s], and Mississippi [*G. c. pulla*]) are small populations with restricted ranges and have specialized conservation programs developed for their recovery and management.

Migratory sandhill cranes occupy a vast range that includes Russia (Siberia), Canada, the United States, and Mexico. Historically, sandhill cranes were thought to be comprised of three subspecies (greater, Canadian, and lesser). Genetic evidence from recent studies suggests that there are two subspecies of sandhill cranes (greater and lesser) and that the former Canadian subspecies is a hybrid of greater and lesser cranes. For management purposes, migratory sandhill cranes have been grouped into six populations: Central Valley, Eastern, Lower Colorado River Valley, Mid-Continent, Pacific Coast (also called the Pacific Flyway), and the Rocky Mountain (Figure 1). The Mid-Continent Population is comprised of both subspecies of sandhill cranes, whereas the other populations are comprised almost exclusively of either the greater or lesser subspecies.

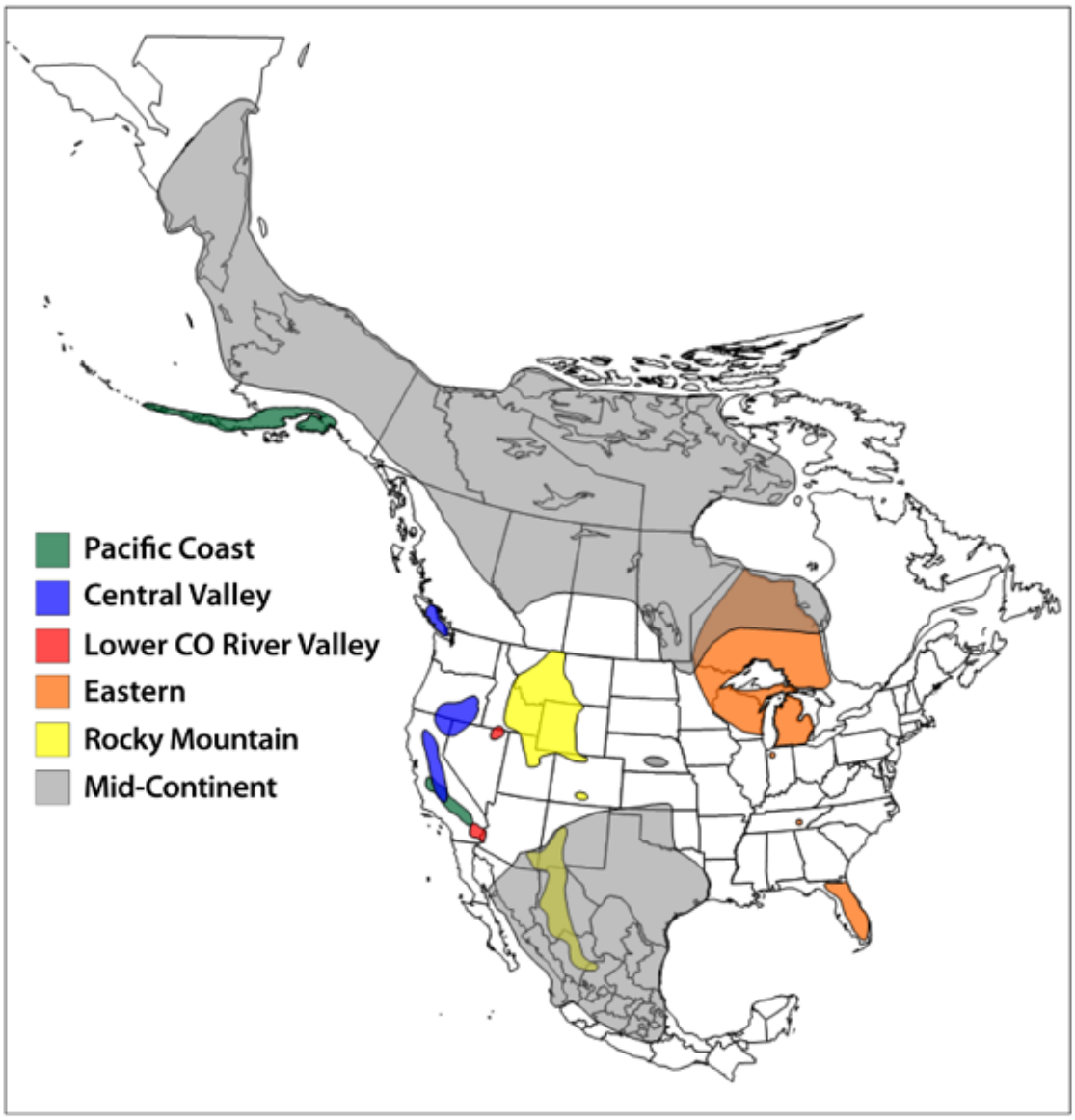
These six populations occupy multiple habitats during the course of their round-trip movements from nesting to wintering areas, and each of the six populations poses different management challenges. Because of their unique life history characteristics, the migratory sandhill crane populations were selected as a focus for development of an individual funding strategy for priority research and management needs, separate from the other hunted species of webless migratory birds. For the hunted populations, harvest strategies are dependent upon accurate information on abundance, recruitment, and mortality to monitor population levels.

SOCIO-ECONOMIC VALUE

Each year, sandhill cranes attract thousands of people to witness the migration spectacles at traditional staging and wintering areas. Some of the most well-known festivals occur near San Antonio, New Mexico; Monte Vista, Colorado; Othello, Washington; Lodi, California; Fairbanks, Alaska; Bellevue, Michigan; Birchwood, Tennessee; and Kearney, Nebraska. Probably the best-known area for crane viewing occurs along the Platte River in central Nebraska during late March. Over 90,000 visitors travel to the Platte River Valley each spring and add about $30 million to the local economy.

Sandhill cranes also are important migratory game birds for both North American subsistence hunters and sport hunters and the economic impact of sandhill crane hunting is considerable. In the United States, approximately 12,000 active sport hunters harvested nearly 24,300

FIGURE 1. APPROXIMATE NESTING, WINTER, AND PRIMARY MIGRATION STAGING AREAS OF THE SIX MIGRATORY SANDHILL CRANE POPULATIONS (Compiled from information in Lewis 1977, Drewien and Lewis 1987, Sharp et al. 2000, Tacha et al. 1994, and more recent data from satellite transmitters provided by Krapu et al. 2011, Fronczak 2014 and Hanna et al. 2014).



sandhill cranes during the 2013 hunting season. An additional 13,000 cranes were harvested by hunters in Canada and Mexico. According to the National Survey of Fishing, Hunting, and Wildlife Associated Recreation, the estimated average per capita expenditures for migratory game bird hunters was $700 in 2011.

POPULATION STATUS AND TRENDS OF MIGRATORY POPULATIONS

Cooperative Flyway Management Plans have been developed and implemented for all six of the migratory populations. In total, about 726,000 sandhill cranes occur in the six migratory populations. Currently, all populations are stable to increasing and are near objective levels set in those plans (Table 1). Harvest strategies have been developed for the Mid-Continent, Rocky Mountain, and Eastern Populations and annual sport hunting seasons for these populations occur in Canada, Mexico and the United States. A low level of harvest occurs in southern Alaska for the Pacific Coast Population. An experimental hunting season has been approved for the Lower Colorado River Valley Population, but has not been implemented to date. The Central Valley Population is not hunted. Minimal numbers of sandhill cranes and their eggs are harvested opportunistically for subsistence by aboriginal communities in North America and Asia.

TABLE 1. ABUNDANCE, TRENDS, AND HARVEST STATISTICS FOR MIGRATORY SANDHILL CRANE POPULATIONS

Migratory Population	Approximate Hunter Harvest	Approximate Population Size	Recent Population Trend
Central Valley	N/A	11,000[1]	Increasing
Eastern	400	75,000[2]	Increasing
Lower Colorado River Valley	N/A	3,000[2]	Stable
Mid-Continent	41,000	590,000[2]	Stable
Pacific Coast	N/A	29,000[1]	Increasing
Rocky Mountain	700	18,000[2]	Stable

[1]Gary Ivey, International Crane Foundation, In Press
[2]based on the most recent 3-year average as of May 2014

Priority Information Needs

Priority 1.
Assessing Finer Scale Management of the Mid-Continent Population

RATIONALE

The Mid-Continent Population (MCP) is currently managed as one large population. However, managers also have long-recognized that the eastern portion of MCP was comprised mostly of greater sandhill cranes. These birds migrate predominately along the easternmost extent of the MCP migration corridor, and are much less numerous than birds farther west in the breeding range and migration corridor. However, other than a difference in abundance, managers have not had much empirical demographic data on which to base management decisions. Nonetheless, harvest regulations (i.e., season lengths and/or bag limits) are more restrictive along the eastern edge of the migration corridor and wintering areas in an effort to maintain those greater sandhill cranes at historic abundances.

Over the last decade, U. S. Geological Survey (USGS) researchers and partners have gathered more information about the MCP, specifically data regarding migration distribution and chronology, delineation of breeding affiliations, and potential harvest pressure on various segments of the MCP. The most recent revision (2006) of the management plan for the MCP acknowledged this work was ongoing and that preliminary results suggested differences in demographic parameters among the breeding affiliations, but at the time the plan was revised the results of the work were not yet finalized. Therefore, the plan stated that "the MCP will continue to be managed as a single population until breeding affiliations are adequately defined, and population and harvest parameters can be monitored separately."

Since that revision, most of this research has been published (Krapu et al. 2011, 2014). Results indicate that four, largely geographically distinct, breeding affiliations can be identified that have different migration patterns and those groups may differ in their exposure to hunting pressure from east to west. Although research has not been completed to determine whether vital rates used in management (i.e., survival, recruitment) differ among breeding affiliations, data are sufficient to warrant examination as to whether management of the MCP should be targeted toward finer scales of the population. The following two issues need to be addressed: (1) an assessment of differences in vital rates among the breeding affiliations, and (2) if such differences exist, whether managers can derive estimates of those parameters through operational monitoring programs.

DESCRIPTION

Spatial and temporal distributions of the four breeding affiliations in the Central Platte River Valley of Nebraska during spring staging overlap significantly; therefore, it may not be possible to partition the spring MCP count into breeding-affiliation-specific abundances during that timeframe. Relatively distinct seasonal distributions of the breeding affiliations outside of the Platte River Valley provide greater opportunities to obtain affiliation-specific

vital rate information. The extent to which demographic rates could be monitored currently is unknown. Established methods, such as mark-resighting approaches, may provide opportunities to investigate demographic differences. Managers and researchers should work together to assess the feasibility and cost-effectiveness of obtaining this information, recognizing that such monitoring efforts would ultimately need to be operational and routinely conducted.

TIMETABLE AND COST

Potential demographic parameters to study include recruitment, age-specific survival and harvest, and abundance. Gender may also be an important covariate for some variables. Anticipated resource needs are three to five years of field work with an estimated cost of $500K.

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Priority 2. Assessing Effects of Habitat Changes on the Rocky Mountain Population of Sandhill Cranes

RATIONALE

Water scarcity in the arid west has shaped the distribution and abundance of the Rocky Mountain Population (RMP) of greater sandhill cranes and is also a driver of human economic development (Gleick 2010). Private lands encompass <30% of the landscape in the west, but account for >70% of all the wetland habitats (Donnelly and Vest 2012). Continued exurban development now places unprecedented pressure on these scarce water resources. Sustainability of irrigated rangeland and wetland systems are at risk as water demand shifts from agricultural to domestic and industrial uses. Mineral and energy industries are water-intensive growth sectors that are also competing for water resources. Predicted long-term fluctuations in climate patterns portend forecasted shortages in already stressed systems that will undoubtedly impact future crane populations.

Identification of the ecological stressors affecting cranes is essential to informing meaningful conservation for RMP across its entire range (i.e., breeding, staging, and wintering). For example, their longevity, delayed maturation, and low recruitment may be masking habitat impacts already occurring, further heightening the need to understand impacts of range-wide habitat changes to RMP cranes. Overcoming this information gap will better inform harvest management of the RMP, and provide land managers with decision-support tools to strategically focus conservation resources in areas of highest biological benefit.

Wintering

Impacts to RMP habitats are best known in distinct wintering areas which concentrate birds

in relatively small geographic regions. Approximately 80% of the population winter in the Middle Rio Grande Valley (MRGV), New Mexico (Valencia and Socorro counties), which encompass 34 river miles, containing approximately 5,000 acres of managed wetlands, and a limited abundance of agricultural foraging sites. The majority of the food resources for wildlife on state and federal refuges are provided by native vegetation or supplemental farming. Increased demands for limited water resources and the transition to agricultural operations that reduce the ability of cranes to meet their energetic needs threatens the long-term carrying capacity of this area to support cranes at population objectives.

Increased concentrations of light geese in the MRGV have triggered avian cholera outbreaks that have the potential to increase disease mortality events for cranes. Interspecies competition for dwindling food and wetland resources is the suspected cause. Suitable roost sites in the MRGV have become increasingly limited due to drought and encroachment of invasive woody plants (Russian olive [*Elaeagnus angustifolia*] and salt cedar [*Tamarix sp*.]) in the active channel of the Rio Grande. Also, expansion of foraging distances can increase nutri-tional stress, potentially making birds more susceptible to disease.

Demand for housing in rural MRGV communities south of Albuquerque has increased the urban footprint within the Rio Grande floodplain, further constricting available agricultural and wetland habitats. The rising human population has increased the rate of agricultural water rights transfer to meet increasing urban demand. The extent of these transfers has yet to be accurately quantified, but is anticipated to have long-term effects on the availability of agricultural habitats and future ability to conserve and manage wildlife habitats.

Summer/Staging

Rural development in significant portions of the RMP summer range and staging sites has increased 350% in recent decades (Gude et al. 2006). Subdivision of expansive tracts of land and land-management change (e.g., conversion from flood to sprinkler irrigation and reduced grain production) are resulting in elevated rates of habitat fragmentation. Regional population trends in Idaho and Montana suggest large-scale changes in crane distribution, which correspond to disproportionately high rates of habitat impacts in some areas. Increasing demands for water coupled with fluctuations in climate patterns are expected to accelerate impacts. For example, the San Luis Valley is the largest staging area for RMP sandhill cranes and is currently experiencing mandated shifts in agricultural water-use practices. These practices are altering the distribution and abundance of available wetland resources and will most likely reduce available roosting sites and increase foraging distances for staging RMP cranes.

Past studies have identified land-use change as a profound and long-term risk to RMP summer habitats, and identified the need for additional research and monitoring to alleviate this threat (McWethy and Austin 2009) and identify areas of greatest biological importance to RMP cranes. Impacts of rural development on the RMP are currently unknown due to a lack of data depicting the areal extent of crane habitat and rates of land-use change in these areas through time.

DESCRIPTION

Coordinate research and management efforts to identify limiting factors throughout the range of RMP cranes. This priority has two parts:

1. Map the extent of summer, staging, and wintering habitat and assess patterns of associated ownership and land use that characterize the RMP landscape.

2. Develop spatially explicit range-wide models that predict landscape carrying capacity and anthropogenic changes (e.g., water-use and rural development) that are impacting habitat availability, abundance, and configuration as well as identify and examine broad-scale landscape stressors (e.g., drought and anthropogenic changes) influencing range-wide demographic patterns in RMP cranes.

TIMETABLE AND COST

Continued satellite telemetry studies as well as GIS analysis and modeling exercises are needed to continue to improve and enhance decisions made at many different scales. Three to five years of field work and data analysis for up to $350k is anticipated.

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McWethy, D.B. and J.E. Austin. 2009. Nesting ecology of greater sandhill cranes (*Grus canadensis tabida*) in riparian and palustrine wetlands of eastern Idaho. Waterbirds 32:106-115

Priority 3. Improving the monitoring of Eastern Population Greater Sandhill Cranes

RATIONALE

The Eastern Population (EP) of greater sandhill cranes has expanded in both population size and geographic range in the last several decades (Amundson and Johnson 2011). The increase in abundance has also been accompanied by issues related to crop depredation and an interest in allowing sport harvest. In 2010, the Mississippi and Atlantic Flyway Councils completed a management plan for EP cranes that included consumptive and non-consumptive uses and addressed other interactions with humans (e.g., crop depredation; Van Horn et al. 2010). Since the establishment of the management plan, two states (Tennessee and Kentucky) within the Mississippi Flyway have implemented a hunting season on EP cranes and other states are likely to explore opportunities in the future.

Since 1979, an ad hoc fall survey coordinated by the U.S. Fish and Wildlife Service (USFWS) has provided the necessary data for responsible management for EP cranes. In response to the first priorities document, Amundson and Johnson (2011) completed a critical review of existing fall survey data as well as other data sources including the North American Breeding Bird Survey (BBS) and the Christmas Bird Count (CBC). Their analyses indicated that the fall survey tracks abundance well, but not the geographic expansion of the

population. They found that the BBS survey, conducted in late spring and early summer, has tracked both the population increase and range expansion for EP cranes, while the CBC did not. Further analysis of BBS data is needed to determine whether if this monitoring program is a viable alternative to assessing the status of the EP.

The fall survey traditionally occurs during the last week of October under the assumption that the majority of EP cranes that breed in Canada have migrated to traditional staging areas in the United States and are available to be counted. Recent satellite telemetry studies have provided better information about breeding, migration, and wintering ranges and migration chronology for the EP (Fronczak 2014, Hanna et al. 2014, and D. Sherman, Ohio DNR, unpublished data). This research has identified that cranes breeding in Canada are in the United States during the current timing of the fall survey; however, between 20%-30% of marked EP cranes that summer in Wisconsin and Michigan are not present on staging areas during the current survey period and therefore are not available to be counted during the survey.

Results from the recent telemetry studies also show that summer areas of marked cranes were widely distributed throughout Minnesota, Wisconsin, Michigan, Ohio, and in the southeastern portion of Ontario, Canada. Recent observations indicate new staging areas are developing in southern Ontario and cranes are still on these areas during the fall survey period (E. Hanna, Bird Studies Canada, personal communication). Finally, as EP cranes have expanded over the last several decades, breeding and staging EP cranes have been observed in southeastern Ontario and the Atlantic Flyway states of Maine, New York, and Pennsylvania. A better understanding of the abundance and migration of birds in these areas is needed to complement the current information of EP distribution and migration chronology and further evaluate the adequacy of the fall survey for assessing population status.

DESCRIPTION

This priority has four parts:

1. Further explore the use of BBS data for estimating EP crane abundance, distribution, and population change as recommended by Amundson and Johnson (2011).

2. Use extant citizen-science and other crane data sources to map and characterize breeding and staging areas of EP cranes.

3. Use satellite transmitters to document movements, distribution, and migration chronology of EP cranes using southern Ontario and Atlantic Flyway staging areas.

4. Further investigate and recommend an optimal time to conduct the USFWS fall survey.

TIMETABLE AND COST

1. Examine and evaluate the BBS data set as an additional method for estimating abundance and distribution of EP sandhill cranes: one-year post-doctoral project costing ~ $55,000K

2. Mapping and characterization of areas utilized by EP cranes in Atlantic Flyway states: one-year project costing ~ $55,000.

3. Document geographic range and migration chronology of EP cranes using staging areas in Eastern Ontario and Western Quebec: a multi-year satellite telemetry project costing ~$150,000.

4. Re-evaluation of the starting period to conduct the USFWS fall survey: analysis of current satellite telemetry data to identify an alternative starting date for the fall abundance survey in order to make the survey more efficient at capturing migrating sandhill cranes (no cost).

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Amundson, C.L., and D.H. Johnson. 2011. Assessment of the Eastern Population of greater sandhill cranes (*Grus canadensis tabida*) fall migration survey, 1979-2009. Report to the U.S. Fish and Wildlife Service, Region 3, Bloomington, Minnesota, USA.

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Priority 4.
Improving Abundance Estimates for the Mid-Continent Population

RATIONALE

The Mid-Continent Population (MCP) is the largest sandhill crane population in the world, and provides substantial recreational opportunities in many regions of the United States and Canada. Annual abundance estimates are used to inform the amount of subsistence and sport hunting opportunity that can be provided in 12 states in the United States, three provinces/territories in Canada, and in Mexico and Russia.

The current survey used to estimate abundance of the MCP has been in place since 1982. The survey effort primarily consists of a transect-based aerial count in the Central Platte River Valley (CPRV) of Nebraska, which is corrected for visibility bias using photographs of a sample of flocks. Additional areas outside of the CPRV are surveyed by supporting aerial or ground efforts, primarily to provide supplemental information to assess whether the survey in the CPRV captures >90% of the total MCP. The survey effort is coordinated across areas, and is conducted during a fixed time period, the fourth week of March in each year. A review of

the abundance estimates indicated that (1) although historically the data indicate that the 90% threshold has been met in the majority of years, in recent years the threshold has not been met as frequently, and (2) the year-to-year variation in point estimates are biologically improbable given information on recruitment and survival, suggesting a systemic problem with the survey methodology.

The first issue above was identified in the 2009 priority information needs document for sandhill cranes. As a result, information was analyzed to assess the appropriateness of the timing of the annual survey. Data from cranes fitted with VHF transmitters were analyzed to determine the proportion of these marked cranes (assumed to be a random sample of the MCP) in the CPRV during the time of the March survey. Results indicate that in 4 of the 7 years examined <90% of the marked cranes were in the CPRV. However, there was no relationship between the proportion of marked cranes present in the survey area and the point estimates of abundance, suggesting that abundance estimates do not accurately reflect whether the survey was timed appropriately. Further, the data also suggest that changing the timing of the survey (i.e., moving the survey to one week before or one week after the current fixed timeframe) would not improve abundance estimates. Therefore, the survey timing is appro-priate given the current logistical constraints (i.e., the survey must be completed in a fixed versus a floating timeframe).

Although this recent work suggests the estimates derived are the best possible using the current methods, year-to-year variation in those counts are biologically untenable (Pearse et al. 2015). Attention should focus on potential problems in the survey design itself, and post-survey analytical techniques that may improve survey estimates. Given the changing landscape (e.g., timing of spring phenology, reduction in food availability) that could affect timing of migration and distribution of birds in the surveyed area, managers need to know whether the current monitoring scheme and/or fixed timing of the survey is still sufficient, or if alternative methods would be more appropriate.

DESCRIPTION

Climate change, evolving agricultural practices, and dramatic increases in the abundances of Canada (*Branta canadensis and B. hutchinsii*), Lesser snow (*Chen caerulescens caerulescens*), and Ross's (*C. rossii*) geese likely have altered the ways that sandhill cranes use habitats in the CPRV compared to when the current survey was developed in the 1980s. Crane distribution has been affected by changes in corn availability, and they currently use edges of fields more than during the 1970s. Inter-annual changes in spring phenology may become more dramatic in the future, and may already be contributing to fewer birds being in the CPRV during the time of the survey in some years. Although birds might be either south or north of the CPRV in a given year due to the extent of snow-and ice-free areas, biologists have not located other areas in which they are as largely concentrated as in the CPRV.

Several avenues of research could be pursued to make progress on this issue. First, historic data could be examined to determine whether changes in distribution of cranes could be accounted for with different post-survey analytical methods to derive more accurate and precise estimates of abundance. Second, current surveys are conducted during the day when cranes are greatly dispersed over the landscape and feeding in fields. Thus, a large area and relatively uniform distribution of birds is necessary to obtain unbiased and precise

estimates of abundance. Researchers could explore other methodologies (e.g., nighttime aerial surveys using infrared imagery; high-altitude surveys; conducting >1 survey during spring; using mark-resighting techniques) to estimate abundance. In particular, advances in remote-sensing technologies could be explored to take advantage of these birds' behavior of nocturnal roosting on the Platte River . During the night, the birds largely are confined to the river channel and are much more concentrated, which could significantly reduce the areal extent of the monitoring program and also "capture" a higher proportion of birds that are in the CPRV compared to diurnal surveys. Finally, potential weather and habitat correlates of crane abundance in the CPRV could be explored to determine whether any are related to the abundance of birds. Such information might be useful to determine whether the timing of the survey could be altered annually to better account for migration chronology of the cranes, and therefore ensure that most cranes are in the survey area when it is conducted.

TIMETABLE AND COST

1. Examination of historical data and exploration with different post-survey analytical techniques: one year and $60K (post-doctoral project)

2. Explore the use of different survey techniques (e.g., nocturnal infrared imagery) as an alternative to the current survey methods: three years and $200K

3. Explore potential habitat/weather correlates of spring migration chronology to aid in determining appropriate annual timing of the survey: three years and $150K (Master's student)

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[1]Nocturnal infrared photography also was identified as a priority in the initial priority information needs document for this species. However, it was not pursued because managers wanted to first investigate whether the timing of surveys could be altered to improve estimates.

Measuring Success

All of the priorities described in this strategy promote efforts to reduce uncertainty in current management practices or initiate studies on poorly monitored populations. Success in addressing these priority needs will increase our knowledge of the ecology and habitat requirements of migratory sandhill crane populations. The improved information will better enable managers to target site-specific and range-wide management and monitoring programs, increasing the cost-effectiveness of management.

Appendix A

2014 Workshop Participants

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