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Author(s): Edgar Gustavo López-Saut, Felipe Chávez-Ramírez and Ricardo Rodríguez-Estrella
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New Records of Wintering Grounds for Sandhill Cranes in Mexico

EDGAR GUSTAVO LÓPEZ-SAUT[1,*], FELIPE CHÁVEZ-RAMÍREZ[2] AND RICARDO RODRÍGUEZ-ESTRELLA[1,3]

[1]Centro de Investigaciones Biológicas del Noroeste, Mar Bermejo 195, Col. Playa Palo de Santa Rita, Apdo. Postal 128, La Paz, BCS 23090, Mexico

[2]Platte River Whooping Crane Maintenance Trust, Inc., 6611 W. Whooping Crane Drive, Wood River, NE, 68883, USA

[3]Estación Biológica de Doñana, Americo Vespuscio s/n, Sevilla, Spain

*Corresponding author; E-mail: avez_g2002@yahoo.com.mx

Abstract.—Although Sandhill Cranes (*Gras canadensis*) are considered as threatened in Mexico, there are no details on either their present winter distribution or descriptions of wetlands where cranes have been recorded. The objective here was to update the location of their wintering areas in Mexico and characterize the wetlands where they roost in winter. The wetlands were surveyed by ground and air, covering the Chihuahuan Desert in the states of Chihuahua, Coahuila, Nuevo León, Durango, San Luis Potosí, Zacatecas and Guanajuato. Sandhill Cranes were recorded in 31 wetlands, of which 13 were new locations and extended the present distribution 237 km south. Three possible hypotheses, acting either individually or in combination, are proposed to explain the new locations. The main threats to the wetlands are their proximity to urban centers, disturbances to roosting areas due to human activity and land-use change. Some wetlands where cranes have been recorded had not been considered as priorities for waterfowl but would have importance for cranes and other species during migration and winter. Further studies of crane migration and wintering are important for conservation and management of the wetlands. *Received 25 January 2010, accepted 23 March 2011.*

Key words.—Chihuahuan desert, desert wetlands, field crops, Mexico, Nuevo León, Sandhill Crane, San Luis Potosí, wintering distribution, waterbirds, Zacatecas.

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The Sandhill Crane (*Gras canadensis*) breeds in the northern United States, Canada, Alaska and as far as northeastern Siberia, and winters along the Gulf of Mexico, Texas, California and the central region of northern Mexico. Some studies describe the principal wintering habitat for the Sandhill Crane from the mid-continental population of North America as the southern USA (Krapu *et al.* 1984; Iverson *et al.* 1985). Although a threatened species in Mexico (D.O.F. 2002), detailed information on the distribution of the Sandhill Crane in Mexico is lacking. Recent work is based on reviews and the distribution gleaned from waterfowl surveys (Howell and Webb 1985; Tacha *et al.* 1992; Tacha *et al.* 1994; Meine and Archibald 1996; Drewien *et al.* 1996).

Leopold (1965), with information collected before the 1950s, described the Sandhill Crane distribution in Mexico as being from north central Mexico to the northwestern part of the state of San Luis Potosí, the south in the El Carmen, Puebla and even the Yucatán Peninsula. Howell and Webb (1985), based on their own records and bibliographical information, only included the states of Chihuahua and Durango in north central Mexico and along the coast of Sonora and Sinaloa. They believed records on the coast of the Gulf of Mexico and Yucatan to be unlikely. Although historical records mention a wide distribution area in central Mexico, the Crane Status Survey and Action Plan (Meine and Archibald 1996) and The Birds of North America (Tacha *et al.* 1992) only included the states of Chihuahua and the northern part of Durango as the overwinter distribution of Sandhill Cranes in Mexico. Drewien *et al.* (1996) reviewed literature and information from waterfowl surveys and believed the distribution of Sandhill Cranes to be north central Mexico, principally in the states of Chihuahua and Durango. Chavez-Ramirez (2005) used bibliographical information, aerial surveys and unpublished information from local residents

to define the Sandhill Crane distribution and included other areas to the east and south of the previously published overwinter distribution in Mexico. The aim of our study was to update the distribution of Sandhill Cranes in Mexico from the historical and adjacent areas. We required a basis for future conservation and management of wetlands used by cranes during the winter. In addition, we generated new information on the characteristics of wetlands and threats to the roosting and wintering areas of Sandhill Cranes in Mexico.

METHODS

Study Area

Our study area included primarily the Chihuahuan Desert Ecoregion, from south of the USA-Mexico border in the states of Chihuahua, central and southern Coahuila, western Nuevo León, eastern Durango, northeastern Zacatecas, and northwestern San Luis Potosí. The dominant vegetation in the region is desert grassland and desert scrub vegetation with Creosote Bush (*Larrea divaricata*), mesquite (*Prosopis* spp.) and yucca (*Yuca* spp.). Also, agriculture has increased in the desert (McClaran 1997).

Ground Surveys

From November 2007 to February 2008 and December 2008 to February 2009, we visited 125 wetlands throughout the Mexican portion of the Chihuahuan Desert. We determined these wetlands based on the historical known Sandhill Crane distribution. We first located the wetlands on 1:450,000 and 1:720,000 maps. Then we conducted ground counts at least once per season in each wetland. The ground counts of the cranes were made by two observers in the mornings from 06:00h to 10:00h, during which all cranes seen in roost areas or leaving the roosts were recorded. Wetlands with cranes present were visited twice in the same season to assess the habitat characteristics and the habitat used by the cranes. At each wetland, we recorded and described the dominant vegetation and wetland characteristics. Also, we noted human activity as an index of the potential threat for each wetland as habitat for cranes.

Sandhill Cranes use wetlands in flat areas in the wintering areas in Texas (Iverson *et al.* 1985). Wetlands with a low slope having a large shore with little water depth are areas Sandhill Cranes usually use to roost. The slope of the wetland was measured from the water's edge to 10 m inland and we calculated the angle of the slope using the trigonometric formula:

$$\text{Angle} = \cot(\text{depth}/10)$$

The surface area of the wetlands was measured in the field by defining the outer perimeter. We took extreme points of the edge of the wetlands using a GPS and used GoogleEarth to draw the polygon. The area of the polygon was measured with Global Mapper v.10.02.

Aerial Surveys

We flew a total of 2,980 km in a Cessna 20, covering a large portion of the study area through the states of Coahuila, Nuevo León, Durango, Zacatecas, San Luis Potosí, and Guanajuato, with five flights of four hours each. Four persons surveyed cranes, two on each side of the plane. All flights were between 09:00h and 14:00h at an altitude of 800 m following a previously-established transect based on historical reports, maps of the area, and the flight range of the plane. At each wetland, we took photographs and video and flew around using binoculars to search for cranes in the wetland and surrounding area.

RESULTS

We surveyed 52 wetlands on the ground and 83 wetlands via aerial surveys. In the ground surveys, Sandhill Cranes were recorded in 31 wetlands by direct observation (55%) as well as tracks and reports from local inhabitants (45%). In aerial surveys, we recorded only one wetland with cranes. The presence of cranes was confirmed in this particular wetland when surveying by ground. Thirteen of 31 wetlands with cranes were new location records for Sandhill Cranes (Table 1, Fig. 1). The main habitat characteristics of wetlands containing Sandhill Cranes are described in Tables 1 and 2. Mesquite grasslands and creosote bush are the plant species dominating the vegetation around these wetlands (Table 1). Most wetlands were natural (74%; N = 31), but some are artificially maintained by humans. Most wetlands were considered as permanent bodies of water (65%) and have a low slope ($\bar{x} = 6.6 \pm 9.5$ degrees, range 1 to 45 degrees). The low slope means that the shoreline is low, allowing the cranes more space to roost. The area of wetlands with cranes measured 0.001 to 171 km^2 ($\bar{x} = 19.1 \pm 42.9$ km^2). The distance of wetlands containing cranes to human activity varied between 3 km and 6 km on average (crop fields, range 0 to 32 km, $\bar{x} = 3.18 \pm 5.9$; urban settlements, 0 to 31 km, $\bar{x} = 6.16 \pm 7.9$). Human activity was present around all wetlands containing cranes (Table 2). Cattle raising and water extraction were the most common human disturbance to wetlands, followed by tourism, hunting and fishing (Table 2).

During our surveys we found tracks and feathers as evidence of the presence of

Table 1. Sandhill Crane winter grounds in northern Mexico 2007-2009. The location, description, and number of Sandhill Crane surveys is presented. New wintering ground records are in bold *. Wetland where cranes were not counted, but where tracks or feathers were found, or reports from previous crane surveys are shown with "—" in the column "Cranes in survey".

Wetland	Coordinates	Surface (km^2)	Slope (degree)	Cranes in survey	Dominant Vegetation	Wetland Temporality	Wetland Type
CHIHUAHUA							
Camargo-Jimenez*	27°19.308'N 104°55.728'W	0.4	2	960	Desert grassland, Mesquite, Creosote bush	Ephemeral	natural
San Rafael*	28°18.020'N 107°8.452'W	3	4	—	Field crops, Grassland	Permanent	natural
Presa Bustillos	28°33.389'N 106°46.317'W	102	8	3250	Field crops, Grassland, Mesquite	Permanent	artificial
Presa las Virgenes	28°7.172'N 105°40.896'W	19	18	—	Mesquite, Creosote bush, Sen bush	Permanent	artificial
Mexicanos	28°8.979'N 106°57.654'W	39	1	3500	Field crops, Grassland	Ephemeral	natural
Babicora	29°19.767'N 107°50.062'W	171	2	3000	Field crops, Grassland	Permanent	natural
La Nariz 2*	30°17.552'N 107°17.767'W	0.001		1800	Grassland, Mesquite	Ephemeral	natural
La Nariz*	30°17.552'N 107°17.767'W	5	5	—	Grassland	Permanent	natural
Colorada 1*	31°0.284'N 108°6.600'W	2	20	100-500	Mesquite, Creosote bush, Sen bush	Permanent	artificial
Ojo Federico	31°2.953'N 107°54.101'W	2	2	1600	Creosote bush, Mesquite	Permanent	natural
Laguna Seca	31°5.183'N 107°52.500'W	1	2	2800	Mesquite, Creosote bush	Ephemeral	natural
DURANGO							
Presa San Bartolo	24°32.667'N 104°40.119'W	6	8	—	Grassland, Mesquite	Ephemeral	artificial

Table 1. (Continued) Sandhill Crane winter grounds in northern Mexico 2007-2009. The location, description, and number of Sandhill Crane surveys is presented. New wintering ground records are in bold *. Wetland where cranes were not counted, but where tracks or feathers were found, or reports from previous crane surveys are shown with "—" in the column "Cranes in survey".

Wetland	Coordinates	Surface (km^2)	Slope (degree)	Cranes in survey	Dominant Vegetation	Wetland Temporality	Wetland Type
Dry area in Santiaguillo	24°44.885'N 104°48.391'W	134	2	—	Grassland, Creosote, Mesquite	Ephemeral	natural
Presa Guatimape	24°48.405'N 104°55.848'W	0.2	2	—	Mesquite, Creosote bush	Permanent	artificial
Río Malaga	24°5.997'N 104°30.011'W	2	2	—	Mesquite, Grassland	Permanent	natural
Santiaguillo	24°54.132'N 104°53.979'W	82	4	1300	Fields crop, Grassland, Mesquite	Permanent	natural
Malaga	24° 8.748'N 104°28.120'W	0.1	1	—	Grassland	Ephemeral	natural
Presa Villa Hidalgo	26°14.027'N 104°55.934'W	2	26	—	Mesquite, Grassland	Permanent	artificial
Tordillo	26°23.185'N 103°59.393'W	1.2	2	500	Mesquite, Desert grassland	Ephemeral	natural
Presa San Carlos	26°33.733'N 103°45.359'W	0.4	2	56	Creosote bush, Ocotillo	Permanent	artificial
NUEVO LEÓN							
El Carmen*	24°36.678'N 100°29.733'W	0.1	6	—	Grassland, Mesquite, Creosote bush	Permanent	artificial
Baños San Ignacio*	24°51.842'N 99°20.080'W	0.01	1	4	Tamaulipeco shrub	Permanent	natural
Rio Linares*	24°52.255'N 99°22.008'W	2	45	70	Tamaulipeco shrub	Permanent	natural
SAN LUIS POTOSÍ							
El Salitral*	22°52.032'N 102°4.263'W	1	3	160	Mesquite, Desert grassland	Permanent	natural

Table 1. (Continued) Sandhill Crane winter grounds in northern Mexico 2007-2009. The location, description, and number of Sandhill Crane surveys is presented. New wintering ground records are in bold *. Wetland where cranes were not counted, but where tracks or feathers were found, or reports from previous crane surveys are shown with "—" in the column "Cranes in survey".

Wetland	Coordinates	Surface (km^2)	Slope (degree)	Cranes in survey	Dominant Vegetation	Wetland Temporality	Wetland Type
El Perdido	23°18.302'N 101°42.903'W	4	2	110	Yucca, Desert grassland, Creosote bush	Permanent	natural
Santa Clara*	23°18.580'N 102°10.384'W	8	2	212	Mesquite, Grassland, Yucca	Ephemeral	natural
ZACATECAS							
Santa Ana*	23°14.370'N 102°44.919'W	1	12	—	Grassland, Mesquite	Permanent	natural
Laguna San Cosme	23°17.909'N 102°20.722'W	0.3	1	—	Mesquite, Grassland	Permanent	natural
La Salada*	23° 26.343'N 102° 52.388'W	0.5	7	—	Mesquite, Grassland, Creosote bush	Ephemeral	natural
Felipe Cañitas Pescador*	23°37.150'N 102°41.705'W	0.1	4.2	—	Mesquite, Creosote bush, Ocotillo	Permanent	natural
San Juan de Ahorcados	24°1.478'N 102°17.835'W	2	2	536	Mesquite, Desert grassland, Creosote bush, Yucca	Ephemeral	natural

Table 2. Human activity recorded in the wetlands with cranes in northern Mexico, 2007-2009. The * indicates that the activity was recorded around the wetland.

	Human Activity					
Wetland	Cattle	Hunting	Fishing	Water extraction	Waste water	Tourism
Camargo-Jimenez	*			*		
San Rafael	*	*		*		*
Presa Bustillo		*	*	*		*
Presa Las Virgenes			*	*		*
Mexicanos	*	*		*		*
Babícora	*	*		*		*
La Nariz 2						
La Nariz				*		
Colorada 1	*			*		
Ojo Federico	*					
Laguna Seca	*					
Presa San Bartolo	*		*	*		*
Dry area in Santiaguillo	*	*				
Presa Guatimape			*	*		
Santiaguillo	*	*	*	*		*
Río Malaga	*					
Presa Villa Hidalgo		*		*		*
Malaga	*			*		
Tordillo	*					
Presa San Carlos				*		
El Carmen	*			*		
Baño San Ignacio	*				*	
Río Linares	*			*	*	
El Salitral					*	
El Perdido					*	*
Santa Clara					*	
Santa Ana			*		*	
Laguna San Cosme					*	
La Salada					*	
Felipe Cañitas Pescador					*	
San Juan de Ahorcados	*			*		
Total kind of activities in all wetlands	17	7	6	17	9	9

cranes only in five wetlands; El Carmen, El Salitral, Felipe Cañitas Pescador, La Salada and Santa Ana (Table 1).

DISCUSSION

Our findings show that the overwinter distribution of the Sandhill Crane in Mexico is wider than previously reported (see the Recovery Plan, Meine and Archibald 1996) and confirmed the presence of cranes in historical areas (Leopold 1965). The information partially supports the distribution proposed by Chavez-Ramirez (2005). Our new records expand the distribution in Mexico as much as 237-km south of the previously published distribution of the species and increase by 42% the number of published crane locations in Mexico.

The reasons for the new crane locations are not well understood, but we propose three possible hypotheses. One is that previous sampling failed to find cranes in the new locations because of poor or reduced sampling effort, and the cranes never left the historical areas (Drewien *et al.* 1996; Chavez-Ramirez 2005). Another possibility is that an increase of Sandhill Crane population in the new areas in Mexico resulted after the recovery of population. The Sandhill Crane population started to increase in the 1970s and since the 1980s the population has been sta-

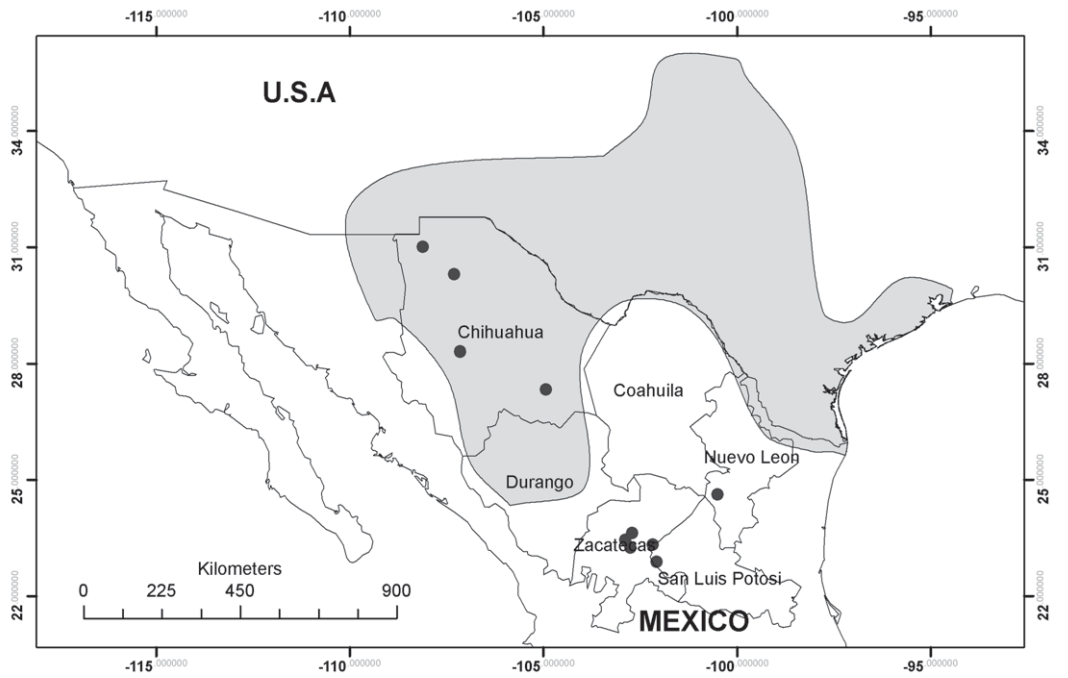

Figure 1. New Sandhill Crane overwintering areas in Mexico. In dark gray is the winter distribution area previously reported (Ridgely *et al.* 2007). A great proportion of our records with cranes (black dots) are outside this distribution, and 13 of them are sites not previously reported.

ble, with small increases in some years (Kinzel *et al.* 2006; Sharp *et al.* 2006). Most published information on population estimates and distribution of Sandhill Cranes in Mexico were made before the reported population increase in the 1970s. Thus, the lack of recent studies may explain why cranes had not been recorded as returning to historical areas. A third possibility is that augmented food availability, because of increased croplands, may provide new resources that Sandhill Cranes are learning to exploit. Both the increase of the Sandhill Crane population and potential food availability may result in an increased use of wetlands in overwintering areas. The use of new crop field areas has been observed in crane species that recover after a period of decrease, as with Common Cranes (*Grus grus*) in Spain (Alonso *et al.* 1994). All three hypotheses appear possible and, either independently or in combination, could explain the new overwintering distribution of the Sandhill Crane in Mexico.

The wetlands with Sandhill Cranes were both natural and artificial; the majority were permanent, although those in the southern and eastern areas are ephemeral. The principal characteristics of the wetlands used by the cranes are that they have a low slope, with shallow water, and generally are flat. Additionally, the roosting areas are near crop fields (mainly corn fields). Although most human activities in wetlands could be considered as threats, the increase in crop availability could provide additional food resources for wintering Sandhill Cranes (Krapu *et al.* 1984). All wetlands have some human activity and are near to urban centers. Only one wetland was very isolated, but in general at least one or more human activity was recorded less than 1 km from roosting areas. The proximity to human activities gives insight into the threats faced by wetlands. The development of urban centers and increased extraction of ground water for agriculture are potential threats for Sandhill Cranes in Mexico due to land-use change and the wetlands becoming desiccated (Drewien *et al.* 2003). Of special concern was non-regulated waste-water discharge into

several wetlands, which could affect the health of cranes by contamination.

Further studies are needed to understand why Sandhill Cranes use particular wetlands in Mexico as overwintering areas and determine the benefits they obtain from these sites. Our results increase understanding of the wintering ecology of Sandhill Cranes in Mexico and may help in the planning and execution of conservation efforts. The conservation of North Mexico wetlands is critical to maintaining the southernmost wintering distribution of the Sandhill Crane. Action is required to encourage overwintering populations of cranes to persist over the long term in Mexico.

We propose that crucial wetlands for overwintering Sandhill Cranes be protected by national or regional agencies to control the degradation of the wetlands. Management plans on a regional scale are needed to preserve habitat characteristics that cranes prefer and for other species, such as wading birds and shorebirds. Crucial wetlands that form a network should be established, based on the abundance of cranes using them during the winter as well as the way they function to connect habitats that maintain the migration process.

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