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## FRESHWATER POND USE BY WHOOPING CRANES DURING A WET WINTER IN COASTAL TEXAS

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**Abstract:** Wintering whooping cranes (*Grus americana*) in the Aransas-Wood Buffalo Population have a restricted range along coastal Texas, and they rely on coastal salt marshes and tidal ponds for feeding and roosting habitat as well as upland freshwater ponds for dietary drinking water during drought periods. These upland ponds were used extensively by wintering whooping cranes during a multi-year drought (2011-2014), and use terminated when frequent localized rainfall events occurred across the wintering range. Despite optimum bay salinities that occurred during this study (February-March 2016) in a 6-week winter period, whooping cranes continued to use at least 1 of the 3 upland ponds when tidal pond salinities were >23 ppt, suggesting that need for dietary water is influenced by tidal pond salinities rather than bay salinities.

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**Key words:** Aransas-Wood Buffalo Population, drought, freshwater, game cameras, *Grus americana*, management, Texas, whooping crane.

The Aransas-Wood Buffalo Population (AWBP) of the whooping crane (*Grus americana*) is a wetland-dependent species that nests in the northeastern section of Wood Buffalo National Park in the Northwest Territories Province of Canada and winters in the estuarine marsh complexes within and adjacent to the Aransas National Wildlife Refuge (ANWR) area of the central Texas coast. During periods of normal rainfall and freshwater flows from the rivers emptying into the bay system surrounding the cranes' wintering habitat, the estuaries typically support the cranes with primary and secondary food resources and dietary water. However, under drought conditions the estuarine waters become too saline (>23 parts per thousand [ppt]) for the cranes to drink (Stehn 2008, Chavez-Ramirez and Wehtje 2012). Moreover, under extremes of drought and low river water flows, the tidal ponds within the coastal marsh can become hypersaline, depleting relative abundance and availability of blue crabs (*Callinectes sapidus*). The cranes then expend energy searching for lower quality food and drinkable water in the uplands adjacent to their winter coastal marsh territories (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2005, Ritenour et al. 2016).

ANWR is located within the Gulf Coast Prairies and Marshes Ecoregion (NatureServe 2009), and hundreds of natural wetland depressions and swales are located on the sandy Blackjack Peninsula. Even during drought conditions, several upland freshwater ponds are available that were excavated as stock tanks built prior to the creation of the refuge. In some ponds,

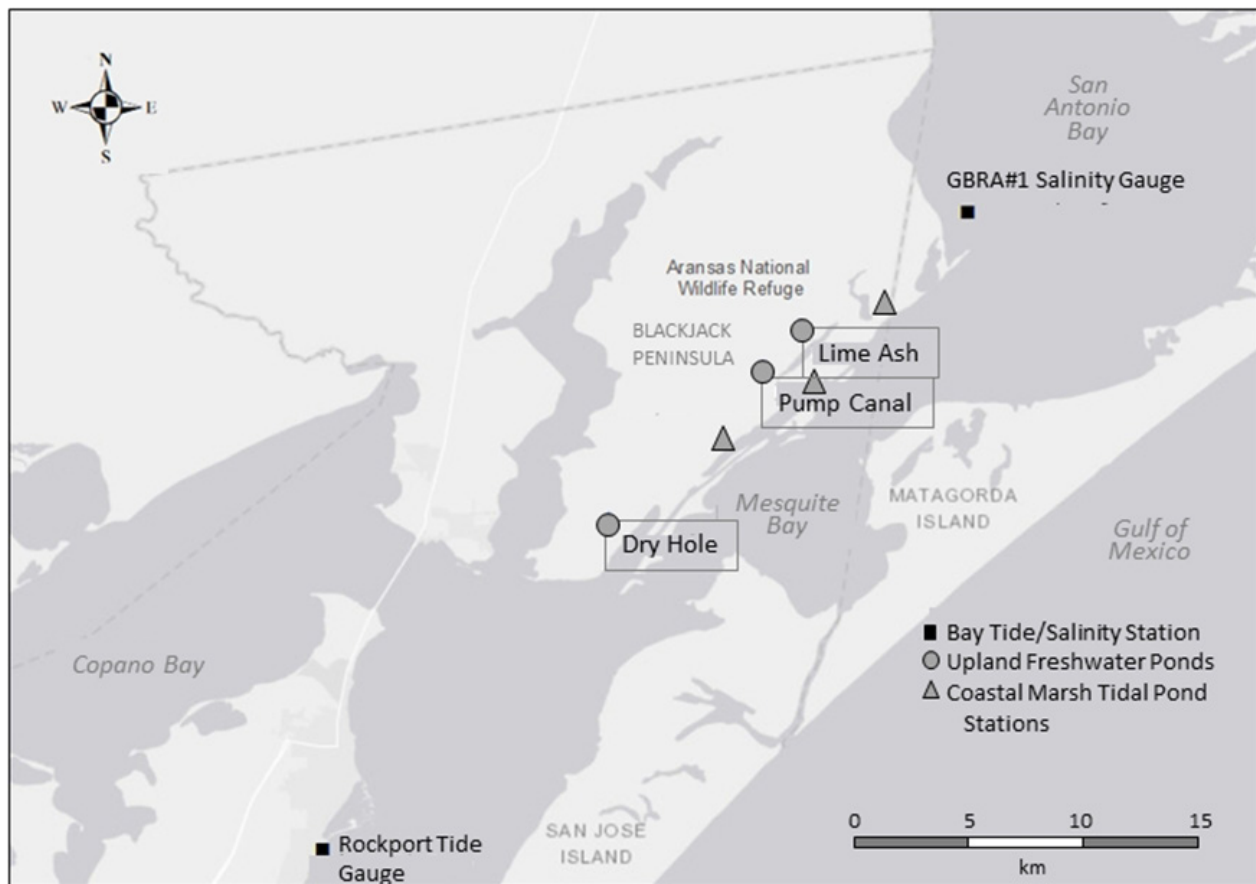
water levels were maintained historically by shallow windmills and have recently been replaced by solar-powered wells to increase water permanence. A spatial, decision-support tool was developed to identify priority locations for solar well installation that would benefit wintering cranes across the wintering landscape (Stanzel and Smith 2016). In coordination with U.S. Fish and Wildlife Service personnel, a site (Dry Hole) was chosen within the southwestern section of Blackjack Peninsula on ANWR. Criteria used to determine the location included that it was close to several established wintering crane territories and that the southern portion of the peninsula had few useable upland ponds during droughts. The well water was piped to a shallow depression pond located approximately 50 m away.

Extreme drought conditions occurred in the region in winter 2011-12 (2011 precipitation total = 40.3 cm) and drought conditions continued through winter 2013-14 (SRCC 2018). Based on a study conducted by Ritenour et al. (2016) using game cameras to document whooping crane use of upland ponds for dietary water, ponds were actively used in November-December 2014 until a localized rainfall event (~4 cm) occurred 9-11 January 2015. However, salinity conditions in the coastal marshes and bays were not affected by this precipitation event and remained above 23 ppt. Ritenour et al. (2016) suggested that more frequent precipitation events continued throughout the remainder of the season and were providing freshwater in natural swales in the coastal marsh and adjacent prairies, as cranes were not observed

at the upland ponds after mid-January. In addition, whooping cranes were observed drinking water from shallow depressions in the marshes and flats during this latter period (E. Smith, personal observation). This study was conducted the following winter 2015-16 to determine if cranes would 1) resume using the upland freshwater ponds for dietary water if drought conditions returned, and 2) if use is triggered by bay or tidal marsh pond salinities.

Data were collected at 2 excavated ponds and 1 depressional pond within the ANWR. Both excavated ponds were monitored in previous winters, Lime Ash (2013-14, 2014-15) (28°12'3.47"N, 96°51'43.85"W), Pump Canal (2012-13, 2013-14, 2014-15) (28°12'3.47"N, 96°51'43.85"W), and located north of the depressional pond Dry Hole (28°08'41.57"N, 96°55'34.52"W) (11.1 km and 8.8 km, respectively) (Fig. 1). Two game cameras (Trophy Cam HD Aggressor; Bushnell, Overland Park, KS, USA) were installed 1.5 m high on metal T-posts

at each pond and positioned on opposite sides of the pond, facing each other and activated 11 February 2016. This method allows for a cost-effective and noninvasive method to collect data, particularly with an endangered species (Newey et al. 2015). Since whooping cranes are active across the coastal landscape during daylight hours, a less expensive camera model was sufficient for the study (Rovero et al. 2013). The cameras were programed to take a picture every 5 minutes during daylight hours; cameras were downloaded every 7-14 days in February through 31 March 2016. Each image was batch processed so that each file was titled with a unique name including pond name, date, and time. One primary camera was selected from each pond for analyses, although the secondary camera images were used if the primary camera malfunctioned. Images were reviewed by a crew of dedicated volunteers with quality assurance processes undertaken by the authors to verify each image identified as having whooping cranes.



**Figure 1.** Location of the freshwater ponds on Blackjack Peninsula, Aransas National Wildlife Refuge, and selected environmental gauge stations along the Texas coast.

Image data were summarized by the number of frames, defined as the count of all images containing cranes, and number of sequences, i.e., the number of times consecutive images documented whooping cranes. Time spent at each upland pond was calculated as the sum from crane arrival to departure (time of first images to time of last image) in each of the sequences, average time spent, minimum and maximum time spent, longest duration, and shortest duration in H:MM format. We calculated time spent using a conservative approach since images were taken at 5-minute intervals. For example, if cranes were documented on 2 consecutive images (e.g., 1035 and 1040 hr), the time calculated for that sequence would be 6 minutes.

Salinity data from the GBRA#1 station and water level data from Rockport station (see Fig. 1) were downloaded for January-March 2016 to evaluate conditions in the bay system prior to and including the study period (<http://lighthouse.tamucc.edu/pq>). Salinity averages were also collected in an independent study during a 1-week period each month (Jan-Mar) from 3 locations in coastal marsh tidal ponds adjacent to the study area (J. Wozniak, Sam Houston State University,

unpublished data). These data were used to determine to what extent bay conditions affect salinities of tidal ponds, which are only connected to the bay during high tide events. Hydrologic connectivity may influence salinities within the marsh complex and potentially affect use of the upland freshwater ponds on the adjacent uplands.

Approximately 20,000 photos were analyzed from 11 February to 31 March 2016. Whooping cranes were first detected at Lime Ash pond on the first day (Fig. 2). Whooping cranes were documented each day in at least 1 of the 3 ponds during the period from 11 February to 8 March. Cranes were not detected at any of the ponds between 9 and 31 March. Cranes were present at least once each day, a little less than 50% of the time at Lime Ash (42%) and Pump Canal (46%) with fewer days spent at Dry Hole (28%). At least 1 crane visited all 3 ponds in a day about 25% of the time (26.5%) during the study. When only 1 out of the 3 ponds was used by whooping cranes in 1 day (14.7%), the singular pond was either Lime Ash or Pump Canal. If 2 out of the 3 ponds had whooping crane use within 1 day (38.2%), it was typically Lime Ash and Pump Canal (61.5%), followed by Pump Canal and Dry Hole (30.8%), and

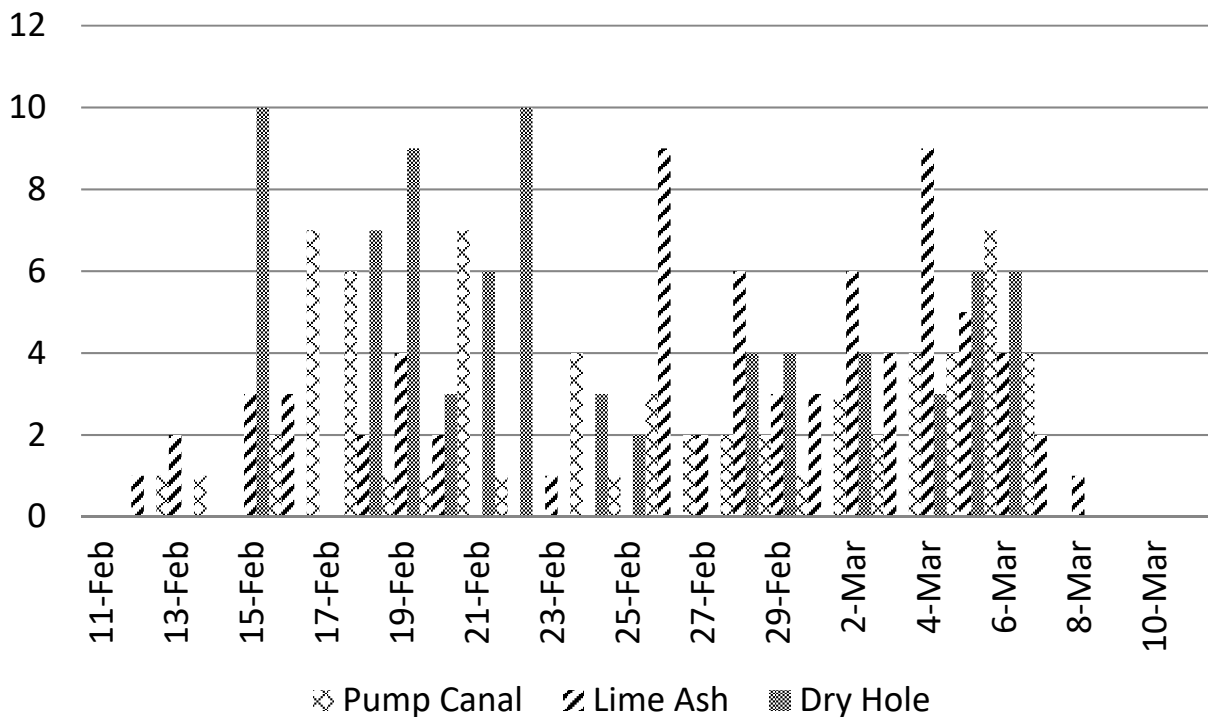


Figure 2. Daily whooping crane presence (no. images/day) at 3 study ponds on Blackjack Peninsula, Aransas National Wildlife Refuge, Texas, during 11 February-11 March 2016. Cranes were not documented during 9-31 March at any pond.

least likely Lime Ash and Dry Hole (7.7%).

Whooping crane presence at each of the upland ponds, delineated as number of frames with at least 1 crane, was similar at Pump Canal and Lime Ash and slightly higher at Dry Hole (Table 1). Total time spent at each pond increased from Pump Canal to Lime Ash to Dry Hole. The number of sequences where cranes were present in consecutive frames was about 33% less at Dry Hole than the other 2 ponds. In contrast, the average time spent at Dry Hole during a sequence was almost twice as long as in the other 2 ponds and the minimum-maximum time spent at the pond was higher.

Hydrologic connectivity between bay waters and coastal marsh tidal ponds were evaluated using tide levels and salt marsh salinity data; 1 high tide event occurred prior to the beginning of the study and 1 event during the study (Fig. 3). Each event lasted 4 days (6-9 January and 8-11 March), and in the first event tides were above the 0.24-m threshold for flooding the salt marsh 57% of the time. In the second event, tides exceeded the threshold 76% of the time. The salinity values in the salt marsh were consistently below 20 ppt throughout January-March and averaged 15.9 ppt in the first flooding event and 14.9 ppt in second event.

At least 1 of the 3 upland ponds was used by whooping cranes each day during the study period, and use of these ponds on a given day was about 25%. It appears that when cranes are using 2 out of the 3 ponds in 1 day, the 2 northernmost ponds, Lime Ash and Pump Canal, were used over 50% the time, and the 2 southernmost ponds, Pump Canal and Dry Hole, were used about 33% of the time. Interestingly, rarely did cranes use the northernmost and southernmost ponds in 1 day. It is possible that the location of Dry Hole, located on the southern tip of Blackjack Peninsula, reduces the potential number of cranes frequenting the pond. The southern tip of the peninsula supports fewer whooping cranes in the adjacent marshes along the

eastern shoreline compared to the northern portion of the peninsula where the other 2 ponds are located.

Although whooping cranes visited Dry Hole fewer times than the other ponds, they actually spent much more time in the area of Dry Hole (Table 1). We propose that the shallow, open pond area of Dry Hole afforded more visibility of adjacent prairie for the cranes than the steep-sided, deep-water ponds of the traditional ponds, which may increase a sense of security from potential mammalian predators. The different configuration of this site from the other 2 sites provided shallower vegetated habitat, as compared to deep pond conditions. While we did not evaluate other activities (e.g., foraging), the cranes appeared to move around Dry Hole more during time spent within sequences, and these bear further evaluation in future studies.

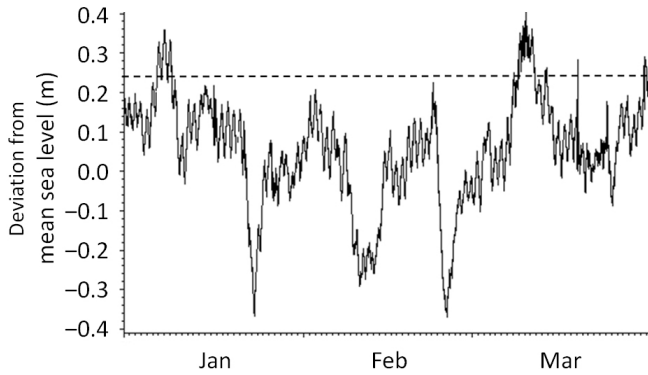
Bay salinities during this study indicated that this winter was not defined as drought conditions for whooping cranes in regards to availability of dietary water, as salinities were consistently below 23 ppt (Fig. 4). The question then arises, why were the cranes using the freshwater ponds at all? Whooping cranes predominantly use coastal salt marsh habitat during the winter, and salinities of the coastal marshes and ponds may be more important than adjacent bay salinities. When the bay tide levels increase more than approximately 0.24 m (0.8 ft) above MSL (mean sea level), the marsh and coastal ponds become flooded with bay water, potentially changing the salinities in the ponds.

Although this study did not begin until 9 February, salinity conditions were most likely favorable for drinking water within the marsh during the latter part of January. In the first high tide event in January, bay salinities ranged from about 14 to 16 ppt; therefore, the coastal marshes and ponds were flooded with water suitable for dietary water. In a separate study, salinities measured from over 30 coastal ponds along Blackjack Peninsula averaged 17 ppt during that high tide event (J. Wozniak, Sam Houston State University, unpublished data).

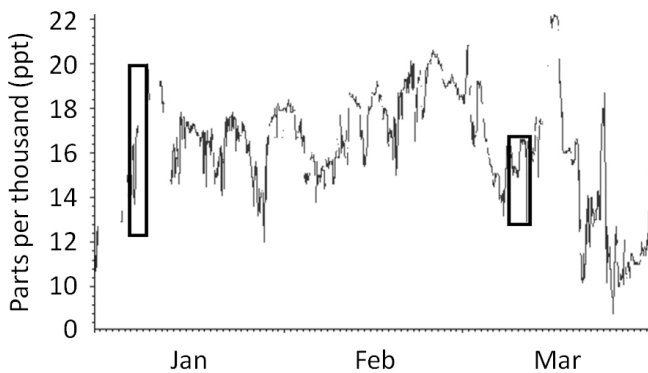
The use of freshwater ponds by whooping cranes in February bears more investigation. Whereas bay salinities remained below the 23 ppt threshold (see Fig. 4), salinities measured in the coastal marsh ponds 12-17 February had increased to an average of 27 ppt (J. Wozniak, Sam Houston State University, unpublished data). In coastal Texas, the evaporative potential from the sun increases pond-water salinity, even in winter, and can result in hypersaline (>35 ppt) pond conditions. These higher salinities in the marsh ponds may explain

**Table 1. Summary data for images that documented whooping crane usage at the 3 study ponds on Blackjack Peninsula, Aransas National Wildlife Refuge, Texas, February-March 2016.**

	Dry Hole	Pump Canal	Lime Ash
Number of frames	86	72	74
Total time spent (hr:min)	8:47	7:44	8:10
Number of sequences	19	33	32
Mean time spent (hr:min)	0:27	0:14	0:15
(min.-max.)	(0:16-0:51)	(0:06-0:31)	(0:06-0:26)



**Figure 3.** Tide levels at nearest National Oceanic and Atmospheric Administration (NOAA) Rockport station located in Aransas Bay about 15 km southeast of Blackjack Peninsula study area, Texas, 2016. Dotted line indicates tide height when coastal marsh surface begins to flood with bay water and coastal ponds become reconnected in the salt marsh complex.



**Figure 4.** Salinity levels at nearest NOAA GBRA#1 station located in San Antonio Bay about 1.5 km northeast of Blackjack Peninsula study area, Texas, 2016. Black boxes indicate salinities when coastal marsh begins to flood (see Fig. 3).

why whooping cranes used the freshwater ponds throughout February and into the beginning of March.

The other high tide event occurred 8 through 11 March 2016 and bay salinities that re-flooded the coastal marshes and ponds were similar (14–16 ppt) to the January event (see Fig. 3). Coastal pond salinities averaged 18 ppt in the 3 days following the high tide event (J. Wozniak, Houston State University, unpublished data), suggesting that cranes could drink water in the coastal marshes and ponds. Whooping crane use of the 3 ponds ceased on 8 March 2016 and no further pond use was documented through the end of the study.

Since a majority of the cranes are unmarked, we were not able to verify if individual cranes use 1

specific pond, or if they move from pond to pond. In previous winters, some paired cranes and families that were banded from 2009 to 2015 were documented using the freshwater pond closest to their winter territory (E. Smith, unpublished data). In this study, we were unable to verify color bands in the images. Small groups of subadult birds are known to move around the winter range (Bishop 1984, Stehn and Johnson 1987) and may use different ponds throughout the winter.

We suggest that monitoring of crane use on freshwater ponds within the AWBP wintering range continue under wet/drought cycles concomitant with regular monitoring of coastal marsh and pond salinities. By integrating the current telemetry project data into future projects, we can determine if whooping crane groups (e.g., subadults, pairs, families) frequent certain ponds across the landscape. These criteria can then be included in the decision-support tool to prioritize where future water well projects should be located. Behavior of the cranes at ponds with different configurations can also be used in deciding whether excavated ponds, which retain water longer, or shallow depressions, which may provide more shallow foraging habitat, are most beneficial to whooping cranes during varying winter conditions.

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