



Winter Diets of Sandhill Cranes from Central and Coastal Texas

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Winter Diets of Sandhill Cranes from Central and Coastal Texas

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ABSTRACT.—We determined diet composition of Sandhill Cranes (*Grus canadensis*; $n = 136$) wintering in 4 regions of Texas during November–January 1996–1997 based exclusively on examination of esophageal and proventricular contents. Wintering Sandhill Cranes were predominately herbivorous, with animal matter representing less than 5% of their diet. Agricultural grains comprised most of the diet of wintering Sandhill Cranes from all regions of Texas except the South Texas Plains where nut-grass (*Cyperus* spp.) tubers made up a larger proportion of their diet. Cranes used agricultural and native plant matter and animal matter in different proportions among regions. There were no sex or subspecific related differences in frequency of occurrence or proportional dry mass of foods consumed by wintering Sandhill Cranes. Agricultural foods represented a larger proportion of the diets of Sandhill Cranes in this study than in previous studies conducted along the Gulf Coast, probably because of improved sampling methodology and differences in

habitat conditions. Received 8 Oct. 1999, accepted 16 Feb. 2000.

Diets of migrating and wintering Sandhill Cranes (*Grus canadensis*) from the mid-continental United States consist predominately (88–100% aggregate volume) of agricultural grains throughout most of their range (Iverson et al. 1982, Tacha et al. 1985, Walker and Schemnitz 1987). However, previous researchers on diet composition of Sandhill Cranes wintering in southern Texas found that these birds principally fed (94–100% aggregate volume) on native plant and animal matter (Guthery 1975, Hunt and Slack 1989). Hunt and Slack (1989) investigated winter diets of Sandhill Cranes at Aransas National Wildlife Refuge using fecal samples, and found that wolfberry (*Lycium virginiana*) fruits, live oak (*Quercus virginiana*) acorns, and insects were the predominant foods by volume and frequency of occurrence. Guthery (1975) documented Sandhill Crane food

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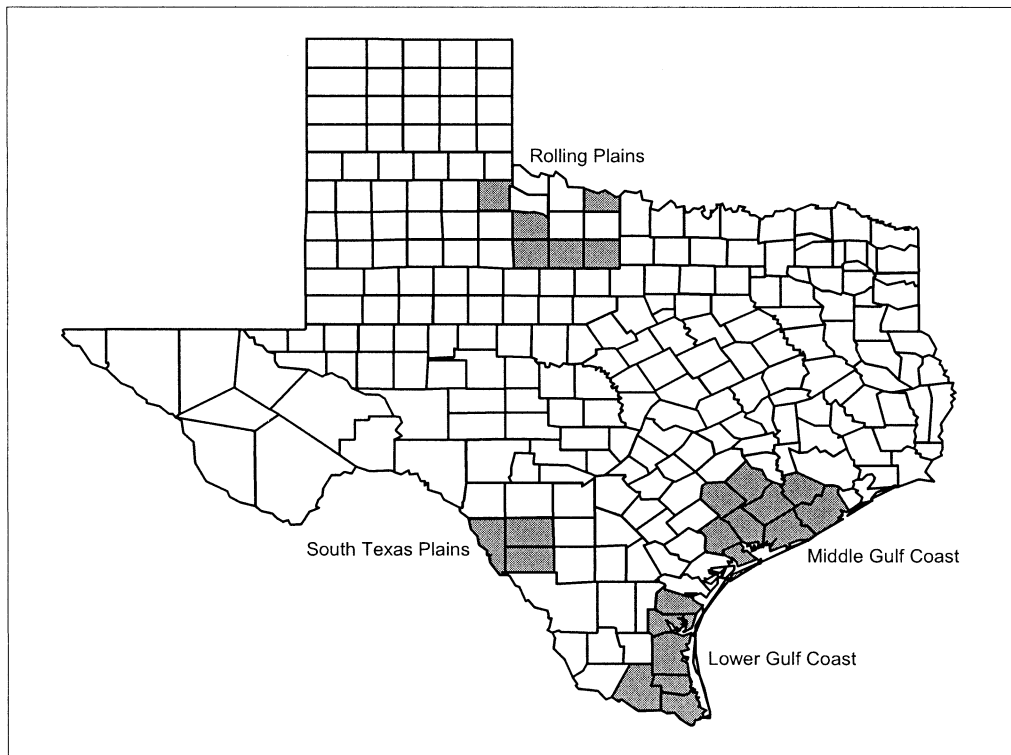


FIG. 1. Shaded areas indicate counties where Sandhill Cranes (*Grus canadensis*) were collected for diet composition analysis during November 1996–January 1997.

habits in coastal Texas using gizzard contents and found that native plant and animal matter comprised 91% of the diet. Additionally, Lewis (1974) determined diets of 20 Sandhill Cranes from the Mid-Coast of Texas using upper digestive tract contents and found that agricultural grains comprised a moderate proportion of their diet (60% total volume) relative to cranes wintering in other regions of Texas. Unfortunately, use of different and often biased methods in previous studies of crane food habits complicates comparison of results. Our objectives were to compare diets of Sandhill Cranes among 4 regions in Texas, including 2 regions for which no previous data exist (i.e., Rolling Plains and South Texas Plains), and to investigate variation in diet composition between sexes and among Sandhill Crane subspecies.

METHODS

We determined winter diets of After Hatch Year (AHY) Sandhill Cranes from the Mid- ($n = 65$) and

Lower ($n = 18$) Coasts of Texas, South Texas Plains ($n = 24$), and Rolling Plains ($n = 29$) during November 1996–January 1997 (Fig. 1). Sandhill Cranes were collected by shooting as they returned to roost sites in the evening or as they left the roost sites in the morning. We attempted to randomly select specimens and collect no more than one crane per flock. Roosts were comprised of at least 30 flocks of cranes and flock size was variable. Flocks generally returned to roosts from many directions suggesting that they were feeding in different areas. We collected 10–20 cranes from each county (see Fig. 1) in each region; however, sample sizes were smaller in some counties in the Rolling Plains and South Texas Plains because of lower densities of cranes. Cranes were frozen as soon as possible after collection to minimize post-mortem digestion of foods. Specimens were sexed by gonadal examination. Discriminant models derived from measurements of AHY Sandhill Cranes of known sex and breeding origin (D. H. Johnson, unpubl. data) were used to partition our sample of cranes into Lesser Sandhill Cranes (*G. c. canadensis*), Canadian Sandhill Cranes (*G. c. rowani*), and Greater Sandhill Cranes (*G. c. tabida*), the 3 subspecies wintering in central and coastal Texas (Guthery and Lewis 1979, Tacha et al. 1986). Food contents were subsequently removed from the upper

TABLE 1. Percent occurrence and aggregate percent dry mass of foods consumed by Sandhill Cranes (*Grus canadensis*) in 4 regions of Texas during November 1996–January 1997.^c

Food item	% occurrence				Aggregate % dry mass			
	Lower Coast (18) ^a	Mid-Coast (65)	Rolling Plains (29)	South Texas Plains (24)	Lower Coast (18)	Mid-Coast (65)	Rolling Plains (29)	South Texas Plains (24)
Total plant material	100	100	100	100	95.2	98.5	99.6	99.9
Agricultural plant material	88.9	53.8	86.2	62.5	82.8	49.5	85.8	49.7
Sorghum seeds (<i>Sorghum bicolor</i>)	88.9	1.5	24.1	12.5	82.8	1.5	23.6	7.8
Rice seeds (<i>Oryza sativa</i>)	0.0	36.9	0.0	0.0	0.0	34.3	0.0	0.0
Corn seeds (<i>Zea mays</i>)	0.0	16.9	6.9	20.8	0.0	13.4	6.9	20.8
Wheat seeds (<i>Triticum</i> spp.)	0.0	1.5	55.2	4.2	0.0	0.3	54.8	4.2
Wheat vegetation (<i>Triticum</i> spp.)	0.0	0.0	3.4	33.3	0.0	0.0	0.5	16.9
Native plant material	11.1	49.2	17.2	62.5	10.8	46.0	13.8	46.0
Nut-grass tubers (<i>Cyperus</i> spp.)	11.1	46.2	6.9	62.5	10.8	44.4	3.6	46.0
Acorns (<i>Quercus</i> spp.)	0.0	1.5	10.3	0.0	0.0	1.5	10.2	0.0
Spike rush seeds (<i>Eleocharis</i> spp.)	0.0	1.5	0.0	0.0	0.0	tr ^b	0.0	0.0
Unidentified roots	11.1	3.1	0.0	4.2	1.6	3.0	0.0	4.2
Unidentified vegetation	0.0	4.6	0.0	4.2	0.0	tr	0.0	0.3
Total animal material	50.0	10.8	31.0	20.8	4.8	1.5	0.4	0.1
Insecta	38.8	9.2	31.0	16.7	1.1	1.3	0.1	tr
Coleoptera	11.1	4.6	24.1	8.3	0.5	0.3	tr	tr
Adult beetles	0.0	3.1	17.2	4.2	0.0	tr	0.1	tr
Larval beetles (Dascillidae)	11.1	1.5	13.8	4.2	0.5	0.3	tr	tr
Orthoptera	27.8	6.2	20.7	8.3	tr	1.0	0.1	tr
Cricket (Gryllidae)	27.8	0.0	0.0	4.2	tr	0.0	0.0	tr
Grasshopper (Acrididae)	0.0	6.2	20.7	4.2	0.0	1.0	0.1	tr
Moth (Lepidoptera)	0.0	0.0	6.9	0.0	0.0	0.0	tr	0.0
Unidentified insects	5.6	1.5	3.4	8.3	tr	tr	tr	tr
Mollusca	11.1	1.5	3.4	4.2	3.7	0.1	tr	tr
Snail (Planorbidae)	0.0	1.5	3.4	0.0	0.0	0.1	tr	0.0
Unidentified shell fragments	11.1	0.0	0.0	4.2	3.7	0.0	0.0	tr

^a *n* in parentheses.^b tr = < 0.1%.^c Inorganic material excluded from samples.

digestive tract (i.e., esophagus and proventriculus) of each bird and individually stored in 80% ethanol. Contents from the gizzard were not included because of potential biases associated with different passage rates of food items through this organ (Swanson and Bartonek 1970). Contents from each upper digestive tract were later identified, sorted, and oven dried to constant mass at 75–80° C.

Diets of wintering cranes were quantified as frequency of occurrence and aggregate percent dry mass for each food. Dry mass was selected to evaluate dietary importance of foods instead of volumetric measurements to provide a better basis for nutritional interpretation of the diet (Reinecke and Owen 1980). χ^2 analysis was used to test for differences in frequency of occurrence of food items among regions, subspecies of cranes, and between sexes (SAS Institute 1997). We investigated variation in aggregate percent dry mass of

foods among regions, subspecies, and between sexes using Kruskal-Wallis 1-way analysis of variance tests (SAS Institute 1997). We then used a Dunn's multiple comparison test (Zar 1996; 227) to determine where differences occurred if the results of the Kruskal-Wallis test were significant. All analyses were made using SAS, version 6.12 for an IBM.

RESULTS

We collected 251 AHY Sandhill Cranes of which 136 (54%) contained food in their upper digestive tracts (Table 1). Subspecific and gender composition of cranes that contained food included 76 Canadian Sandhill Cranes, 33 Lesser Sandhill Cranes, and 27 Greater Sandhill Cranes, and 86 males and 56 females.

Plant materials (predominately agricultural plants and mostly grains) were the primary foods consumed in each region (Table 1). Sorghum (*Sorghum bicolor*) seeds were consumed in all regions, ranging from 83% of the diet in the Lower Coast to 24% in the Rolling Plains where wheat (*Triticum* spp.) seeds predominated the diet (55%); 34% of the diet of cranes from the Mid-Coast consisted of rice (*Oryza sativa*) seeds (Table 1).

Native plant material [nut-grass tubers, acorns, and spike-rush seeds (*Eleocharis* spp.)] represented almost half of the diet of cranes from the Mid-Coast and South Texas Plains, but less than 14% of the diet of cranes from the Lower Coast and Rolling Plains. In particular, nut-grass tubers had been consumed by approximately half of the birds collected from the Mid-Coast and South Texas Plains and represented 44% and 46% of their diets, respectively (Table 1). Nut-grass tubers comprised the largest proportion of any native food in the diet of cranes in each region except the Rolling Plains where acorns (10%) represented a larger fraction of the diet (Table 1).

Animal material consumed by wintering Sandhill Cranes consisted exclusively of insects and mollusk shells. Animal material never represented more than 5% of the aggregate dry mass of crane diets in any region; however, 50% of the cranes collected along the Lower Coast had ingested animal material (Table 1). Insects, particularly adult and larval beetles (Coleoptera), crickets (Gryllidae), and grasshoppers (Acrididae) were the most frequently ingested animals in all regions. Mollusk material in the diet of cranes consisted entirely of empty shells and shell fragments rather than whole organisms.

The frequency of consumption of plant material relative to animal material differed among regions ($\chi^2 = 8.46$, 3 df, $P = 0.04$), as did agricultural and native plant material ($\chi^2 = 13.58$, 3 df, $P = 0.004$). The proportional dry mass of plant and animal material in diets differed ($\chi^2 = 13.8$, 3 df, $P = 0.003$) among regions, with cranes along the Lower Coast consuming a higher ($Q = 2.56$, $P = 0.01$) proportion of animal matter than cranes from the Mid-Coast. Sandhill Cranes used native plant material in different ($\chi^2 = 18.90$, 3 df, $P < 0.001$) proportions among regions,

with native plant material representing a larger proportion of the diet of cranes from the Mid-Coast and South Texas Plains than the diets of birds from the Lower Coast ($Q = 2.55$, $P = 0.011$; $Q = 2.46$, $P = 0.014$, respectively) and Rolling Plains ($Q = 3.0$, $P = 0.002$; $Q = 2.75$, $P = 0.006$, respectively). Agricultural plant material was consumed in different ($\chi^2 = 9.46$, 3 df, $P = 0.024$) proportions among regions; Sandhill Cranes from the Rolling Plains ingested a greater proportion of agricultural plant material than cranes from the Mid-Coast ($Q = 2.23$, $P = 0.026$) and South Texas Plains ($Q = 2.31$, $P = 0.021$; Table 1).

The frequency with which agricultural, native plant, and animal materials occurred in Sandhill Crane diets within regions did not differ between sexes (all $P > 0.05$) or among subspecies (all $P > 0.05$). Additionally, there were no differences between sexes (all $P > 0.05$) in proportional dry-mass of animal, native plant, and agricultural plant material in their diets within regions, nor were there any differences among subspecies (all $P > 0.05$), except along the Lower Coast ($\chi^2 = 6.29$, 2 df, $P = 0.043$) where native plant material represented a larger proportion ($Q = 2.32$, $P = 0.023$) of the diet of Lesser Sandhill Cranes than of Greater Sandhill Cranes.

DISCUSSION

Sandhill Cranes wintering in central and coastal Texas were principally herbivorous with animal matter comprising less than 5% of the diet, which is similar to diets of migrating and wintering Sandhill Cranes from other areas in mid-continent North America (Iverson et al. 1982, Tacha et al. 1985, Walker and Schemnitz 1987). Contrary to previous studies of Sandhill Crane food habits along the Gulf Coast (Guthery 1975, Hunt and Slack 1989), we found that agricultural foods were a large component in the diet. Wintering Sandhill Cranes apparently exploited readily available plant foods with high levels of digestible energy (e.g., rice, sorghum, wheat, and nut-grass tubers). Where agriculture plant material comprised lower proportions of the diet, consumption of nut-grass tubers increased.

The difference in proportional dry mass of animal material between the diets of cranes from the Lower and Mid-Coasts is the result

of cranes from the Lower Coast ingesting more mollusk shell fragments. Lewis (1974) observed snail shells in crane gizzards from coastal Texas and attributed this to cranes picking up shell fragments as grit. The diet of cranes from the Lower Coast was the least diverse of all regions and may have resulted in specific nutritional deficiencies. Reinecke and Krapu (1986) suggested that mollusks and other invertebrates provide nutrients to compensate for protein and calcium deficiencies of agricultural grains during spring migration. The importance of animal matter in the diet of migrating Sandhill Cranes was evident from time budget observations that indicated that cranes spent the same amount of time obtaining animal material (3% of their diet) as they did to obtain corn (97% of their diet; Reinecke and Krapu 1986).

Similar to our findings, Tacha and coworkers (1992, 1994) reported that diets of male and female Sandhill Cranes from other areas in central North America were the same during migration and winter. Sandhill Cranes provide extended bi-parental care for their offspring and the family functions as a single unit throughout the first 10–11 months after the young hatch (Tacha et al. 1992, 1994). Therefore, similarities in diet between sexes and age classes are likely. However, our sample sizes were relatively small for some sex and subspecies classes within regions.

Previous research on Sandhill Crane diet composition along the Gulf Coast of Texas indicated that the cranes relied primarily on natural foods throughout the winter (Guthery 1975, Hunt and Slack 1989). However, differences in techniques used to analyze diet composition in those studies and the corresponding biases toward food items that remain identifiable in the gizzard and feces need to be considered when comparing results. Other factors that may affect diet composition of Sandhill Cranes in Texas include temporal distribution of foods and annual habitat variation. Guthery (1975) obtained 63% of his samples in February and March when sorghum may have been depleted in southern Texas (Ballard and Tacha 1994). Guthery's (1975) sampling period during winter 1971–1972 coincided with above normal (98% higher) precipitation following Hurricane Fern in September 1971. Sorghum is the predominant grain crop in

southern Texas and the availability of waste grain is influenced by precipitation (Ballard and Tacha 1994). During years of above normal precipitation, the amount of grain available can be depleted by early winter through decomposition and germination. During dry years, waste grain can remain available throughout winter. Precipitation amounts along the Lower and Mid-Coasts during 1996–1997 averaged about 7% higher than the long-term average (NOAA 1999).

It is evident from our study that there is probably no marked difference in use of agricultural grains by cranes wintering in coastal Texas compared to those wintering in other areas of mid-continental North America. Sandhill Cranes exploit readily available, high energy foods during migration and throughout winter, but annual variation in habitat conditions can affect food availability. Agricultural grains are important when they are available, but cranes are not limited to agricultural grains and can alter their foraging behavior to obtain high-energy native foods.

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Food Habits of Cattle Egrets on St. Croix, U.S. Virgin Islands

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ABSTRACT.—Cattle Egrets (*Bubulcus ibis*) expanded their range greatly during the twentieth century, making localized food habit studies necessary to determine their impact in newly invaded ecosystems. We examined 44 Cattle Egret stomachs collected in January 1993 from Alexander Hamilton Airport on St. Croix Island, U.S. Virgin Islands. Orthopterans and lepidopterans were the most prevalent invertebrate food items. The St. Croix anole (*Anolis acuta*) was the major vertebrate prey. Meat scraps and ticks occurred in minor quantities. *Received 29 March 1999, accepted 5 Jan. 2000.*

The adaptability of Cattle Egrets (*Bubulcus ibis*) has allowed them to expand their populations from northern South America (A.O.U.

1998) to Canada (Buerkle and Mansell 1963). Cattle Egrets were first reported on St. Croix Island in 1955 (Seaman 1955) and 1500–2000 birds currently inhabit the island (Boyd and Hall, unpubl. data). Because of their opportunistic feeding behavior, studies on localized food habits are important to determine potential effects on vertebrate and invertebrate prey communities. For example, in Queensland, Australia, several species of lizards, northern dwarf tree frogs (*Litoria fallax*), and young marine toads (*Bufo marinus*) are common prey items, although orthopterans are the major prey (McKilligan 1984). Similarly, in northern Florida, orthopterans are the major food item during June and July (Fogarty and Hetrick 1973). In South Africa, lepidopterans were the major prey from December to March, but annelids made up 44.5–67.5% of the prey from April to September (Siegfried 1971). Based on the stomach contents of 1 bird collected on St. Croix in February, Seaman (1955) reported that 92% of the contents were orthopterans, 6% were unidentified arachnids,

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