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Habitat assessment and subspecies identification of Sandhill Cranes wintering in Louisiana

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HABITAT ASSESSMENT AND SUBSPECIES IDENTIFICATION OF SANDHILL CRANES WINTERING IN LOUISIANA

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ABSTRACT

The two biggest flocks of Sandhill Cranes (*Grus canadensis*) wintering in Louisiana are located in Cheneyville and Holmwood, LA. Resident Sandhill Cranes were once located in Louisiana, but because of habitat loss and over harvest these residents were extirpated from Louisiana in the early 1900's. In the 1960's, migrating Sandhill Cranes had returned to LA and were wintering in Cheneyville. Observations and habitat characteristics were conducted on these two flocks in the winter of 2002 and 2003 because of the lack data on these flocks. The two flocks contained about 1,300 individuals with four other known flocks throughout Louisiana ranging from 16-400 individuals. There were an estimated 2,200 Sandhill Cranes wintering in Louisiana. Morphometric measurements for eight birds fell within the range of the Greater Sandhill Crane (*G. c. tabida*) subspecies. Middle toe imprint measurements in the winter of 2003 showed no difference in size of cranes in the two flocks during January and February, however there was a difference in middle toe size in December. One radio-marked bird was radio tracked to Cheneyville and Holmwood. Cranes selected roost sites in rice fields with water less than 20 cm deep. Cranes feeding in Cheneyville selected rice fields and corn fields, while the Holmwood birds used rice fields and pastures. Fecal analysis showed that nutsedge tubers (*Cyperus* spp.), rice (*Oryza sativa*), and corn (*Zea maize*) were the major foods consumed in Cheneyville, while the Holmwood birds used mostly nutsedge tubers and rice. Rice was found in feces earlier in the winter and nutsedge was found more frequently later in the winter.

INTRODUCTION

Sandhill Cranes (*Grus canadensis)* have been recorded breeding in Louisiana since the late 1800's (McIlhenny 1938). However, due to habitat loss and over harvest, the breeding pairs of Sandhill Cranes were extirpated from Louisiana in 1919 (Walkinshaw 1949). Although no breeding pairs of Sandhill Cranes are known to remain in Louisiana in 2003, flocks of Sandhill Cranes do spend the winter in Louisiana.

There were two known flocks wintering in Louisiana. The Cheneyville flock, was first recorded in 1966, and consisted of 17-100 individuals (Smith 1978). In 1980, 12 cranes were reported in the Holmwood flock (Dewhurst and Zwank 1985). In 1998, the estimates for the Cheneyville and Holmwood flocks were 650 and 250, respectively (R. Crosette, Biologist at Lake Ophelia NWR and M. Hoff, assistant manager of Cameron Prairie NWR pers. commun.). In 2000, these same individuals estimated the Cheneyville flock had as many as 1100 and the Holmwood flock had up to 670 cranes.

Most Sandhill Cranes from the Mid-continent utilize agricultural crops, particularly waste corn, in their diet. Habitat requirements for the Sandhill Cranes wintering in Louisiana are unknown. The Cheneyville flock was reported to feed in harvested corn fields; however the Holmwood flock was not located near any corn fields. Therefore, they were probably using other food sources.

Sandhill Cranes have been studied in many states in North America, but no studies have been conducted in Louisiana. In the past, Sandhill Cranes not only wintered in Louisiana, but before 1907 there were breeding resident Sandhill Cranes in southwestern Louisiana (Smith 1978). There are six subspecies of Sandhill Cranes: Lesser Sandhill Crane (*Grus canadensis canadensis*), Canadian Sandhill Crane (*G. c. rowani*), Greater Sandhill Crane (*G. c. tabida*),

Florida Sandhill Crane (*G. c. pratensis*), Mississippi Sandhill Crane (*G. c. pulla*), and the Cuban Sandhill Crane (*G. c. nesiotes*) (Walkinshaw 1973). The three migrating subspecies, which might winter in Louisiana, are the Lesser, Greater, and Canadian subspecies. The Lesser Sandhill Crane, which is the smallest of the three migratory subspecies, has the longest migration route and is the most abundant Sandhill Crane subspecies (Johnsgard 1998). The Lesser Sandhill Crane breeds from northeastern Siberia to Hudson Bay in mostly arctic tundra habitats. The majority of these cranes winter in the Southwestern Great Plains (Johnsgard 1998).

The intermediate migratory subspecies, or Canadian Sandhill Crane, breeds in southern to central Canada from British Columbia to eastern Ontario. The birds breeding in the eastern part of Canada winter along coastal Texas (Johnsgard 1998). The Platte River Valley, in Nebraska harbors most of these birds during early spring staging.

The largest in size and smallest in number of these three migratory subspecies is the Greater Sandhill Crane. According to Johnsgard (1998), there are four breeding populations of these birds. A Great lakes population, which breeds in Michigan and Wisconsin, migrates to Florida. A flock breeding in northwest Minnesota that winters along the Texas gulf coast. Populations that breed in the Rocky Mountains and Central Valley winter in New Mexico and southern California, respectively.

The subspecies of the two wintering flocks in LA are unclear because of the lack of data. In Texas however, Guthery and Lewis (1978) classified Sandhill Cranes into subpopulations from the southern most point of Texas in Cameron County, along the coast to the city of Houston. Greater Sandhill Cranes made up 9% of the population, 71 % were Canadian, and 20 % were the Lesser subspecies. The “Northern Coast” group included 32% Greater, 47% Canadian, and 21% Lesser subspecies. These birds are only 225 km from Holmwood, LA. If

the larger number of the Greater subspecies in Guthery and Lewis's (1978) study came from the breeding flock in Michigan and Wisconsin, then we might assume the Holmwood and Cheneyville flocks will contain many Greater Sandhill Cranes because the Texas birds probably fly over Louisiana to get to the Texas coast.

Ballard et al. (1999), found 4-8% Lesser, 62-68% Canadian and 28-32% Greater Sandhill Cranes in the Texas Gulf coast population. They suggested that the Mid-continent Sandhill Crane population, which is currently managed as a single population, should be managed as two populations. The eastern portion of the Gulf coast population has a higher number of Greater Sandhill Cranes. The Western population is mostly the Lesser subspecies with fewer Canadian subspecies. The gulf coast of Texas winters 70% of all the Canadian sub-species (Johnsgard 1983). However, Glen et al. (2002) and Rhymer et al. (2001) recently examined the mtDNA of Sandhill Cranes collected in Texas and on the breeding grounds, respectively. The Lesser and Greater subspecies were clearly separate, but the Canadian and Greater subspecies could not be distinguished. Therefore, I will classify the Canadian subspecies as the Greater subspecies.

Unlike subspecies composition, roosting preferences seem to be more generalized. Roost affinities were more specific in fall than in spring, at Jasper-Pulaski Fish and Wildlife Area in Indiana. The cranes only roosted within the refuge during fall migration, but during spring the cranes would roost in agriculture fields (Lovvorn and Kirkpatrick 1981). The Sandhill Cranes in Indiana utilized three categories of wetlands, including the following: seasonally flooded basins and inland fresh meadows, inland fresh meadows, and marshes bordered by trees. Sandhill Cranes favored roosts that were shallowly flooded. Norling et al. (1992) stated that roosting Sandhill Cranes favored water depths less than 20 cm deep. However, several other studies indicated different water depth levels. Lataka and Yahnke (1986) suggested 0-12 cm, Frith

(1974) listed 2-15 cm, and Lewis (1974) believed a depth of 10-15 cm was optimum roosting habitat. Furthermore, Iverson et al. (1985) stated that Sandhill Cranes would roost in sites up to 40 cm deep.

Sandhill Cranes rely heavily on site to locate predators and prefer to roost in open areas (Norling et. al. 1992). Cranes roosting on the Platte River utilized channels 100-200 m wide. Cranes did not roost in channels less than 50 m wide, but over 80% roosted in channels greater than 150 m wide (Norling et al. 1992). Lataka and Yahnke (1986) believe wider channels have more shallow water, whereas channels that are less than 100 m do not have as much shallow water for roosting. They suggest cranes were limited by water depth more than channel width.

According to Norling et al. (1992), Sandhill Cranes would not roost closer than five meters to a visual obstruction (>2 m in height). The cranes roosted in waters that did not reach above the tibiotarsal joint (Lovvorn and Kirkpatrick 1981). They also suggested that cranes would use wooded vegetation as long as open, shallow water was available. Bennett (1978) said Sandhill Cranes roosting in Wisconsin and Jasper-Pulaski FWA often roosted in areas surrounded by trees. Lewis (1976) and Melvin (1978) stated that cranes would roost on land when flooded areas were not available. They reasoned that visibility was a greater factor than water. Tradition also seemed to be a factor in choosing roosting sites. Lewis (1976) noted many types of roost sites have been used since the late 1800's. According to Lovvorn and Kirkpatrick (1981), the main requirements for roost sites were, water less than 20 cm deep, and areas free of human disturbance.

Sandhill Cranes are usually considered grain eaters. In Nebraska during spring, corn comprised 97% of the diet (Reinenecke and Krapu 1986). The bulk of the energy in the diet was undoubtedly corn, but corn lacks calcium, iron, ascorbic acid and essential amino acids (U.S.

Dep. Agric. 1978). These components were apparently supplied by earthworms (2%), snails (0.5%), and insects (0.5%). In a study from Texas, wolfberry fruit (*Lycium virginiana*), and acorns (Quercus spp.) were the primary foods consumed by cranes (Hunt and Slack 1989). However, Ballard and Thompson (2000) studied Sandhill Cranes in coastal Texas and found that rice (*Oryza sativa*) and nutsedge (*Cyperus* spp.) made up about 78% of the diet. The proportion of nutsedge in the diet increased as the amount of agricultural grains became less available. Reports from birders and biologists indicated that the cranes in Louisiana were feeding in pastures and corn fields around Cheneyville and in pastures and rice fields near Holmwood.

The Louisiana wintering Sandhill Cranes may utilize different habitat characteristics than the neighboring coastal Texas flocks. Availability of habitat may be attracting new migrants, but we do not know the characteristics of the habitat being used in Louisiana. The flocks have increased slightly over the years, but in the last four years the two flocks have increased at a higher rate. We would like to know the subspecies composition of the two flocks, to estimate the migration patterns and breeding areas. The habitat assessment is also important for management purposes. The two Louisiana flocks winter near two federal refuges, but have never been seen on the refuges. This study may provide information on how to manage refuge habitats to attract the wintering flocks of Sandhill Cranes.

METHODS AND MATERIALS

One flock of cranes is located close to Grand Cote National Wildlife Refuge (NWR) near Cheneyville, Louisiana and another near Cameron Prairie NWR south of Holmwood, Louisiana. Cheneyville, LA is located in Rapides parish in central Louisiana, approximately 32 kilometers southeast of Alexandria. Cheneyville is surrounded by agricultural fields with few pastures. Holmwood is located in the southwestern part of Louisiana in Calcasieu parish approximately 11 km southeast of Lake Charles. It is surrounded mostly by pasture land and rice fields. The Sandhill Cranes have been seen in these two areas since at least 1966 and 1980 in Cheneyville and Holmwood, respectively.

Sandhill Cranes were counted at the feeding sites and roost sites from mid-December until early March. Observations were conducted before sunrise to get a good count on the birds when they left the roost and again at dusk when the birds would return to the roost. When the birds were located in the fields used for feeding, the number of birds and type of field and location were noted. Once the feeding fields were located, each field was checked each sampling day to count the number of birds. The fields that were used for feeding were compared to the available fields in the Parish using a Chi-square Goodness of Fit test. The feeding fields and roost sites were located using visual and auditory senses, local birder reports, and radio telemetery.

Sandhill Cranes were captured and fitted with transmitters in February, 2002. We attempted to capture eight cranes at each site using Ramaka's (1978) suggestions for capturing cranes. A 17.5 x 9.2 m rocket net with 32 mm square mesh size was used to capture the birds. About 11 kg of corn was tossed on the ground to attract birds to the net site. After the birds were captured, measurements of culmen, culmen post nare, tarsus, and middle toe were taken using a

300mm caliper. The wing chord (not flattened) was measured using a one-meter wing board. The tarsus was measured by folding the foot down and measuring above the middle toe to the end of the bone conspicuous on the side of the joint. The toe was measured from the tip of the toe to the beginning of the foot. Measurement data for the same traits was published by Walkinshaw (1973) and Tacha et al. (1985). We compared our measurements with the measurements of the male Lesser subspecies because males are larger than females. The captured Cranes' morphometric results were used to separate the two sub-species in the study areas. Information from Lewis (1979) about differences between juveniles and adults was also used.

Captured birds (n=5) were then fitted with a Model (2) 16M Sandhill Crane transmitter made by Advanced Telemetry System, Isanti, Mn. The transmitters contained Lithium batteries with 10-inch antennas and mortality signals. The transmitters had a life of greater than 400 days. Birds were also banded with size eight Fish and Wildlife Service leg bands. Three inch long white colored leg bands made by Haggie Engraving, Crumpton, Md were also used. We put the radio transmitter on the right leg of the bird and the colored leg band was attached above the tibiotarsal joint with the FWS band above the toes on the left leg.

Three other methods were tried in attempts to capture Sandhill Cranes. We tried a snare method (S. Herford, pers. commun.) in which a set of snares was set out in hopes to catch the toes of the birds. Night lighting was tried on the Cheneyville flock according to Drewien and Clegg (1992), and in 2003, plans were made to use Alpha-Chloralose on corn according to Bishop (1987). I was unsuccessful in capturing any birds using these three methods.

Measurements were taken on middle toe imprints left in the mud at roost sites and feeding sites in 2003. These measurements were made with the hope of distinguishing size

differences between the Cheneyville and Holmwood flocks. Using a wooden meter stick the measurement started from the tip of the imprinted toe to the middle of the foot. Measurements were taken in December and February at Holmwood and in January at Cheneyville. A two sample t test was used to determine any significant middle toe size difference between the months sampled and an F test was used to determine a difference in the variance of the means.

Once the roost sites were located, times when birds arrived and departed from roost sites were recorded. Departure and arrival times were recorded about once a week form mid-Dec. to early Mar. Water depth measurements were taken when the birds were away from the roost. We took measurements only once at each site during each season, because water levels did not seem to change throughout the winter. Water depth measurements were taken on 12/30/01, 1/4/02, 1/8/02, 2/14/02, 12/16/02, 12/21/02, and 2/14/03. Vegetation height and water depth were sampled in 20 locations within the roost site. Feces' were located at the roost site and water depth measurements were taken close to the fecal piles. Feces' were also collected at the roost sites and in the feeding fields.

Cores (10 cm diameter X 10 cm deep) were taken at randomly selected locations in fields used by Sandhill Cranes. Cores were taken on 3/8/02, 3/9/02, 2/28/03, 3/1/03, and 3/7/03. Not all of the fields used for feeding were sampled because some landowners could not be contacted. The core material (soil sample) from the fields that were sampled was stored in 3.8 liter plastic bags until it could be analyzed in the lab. Each soil sample was washed through a number 10 sieve, which would prevent rice from passing through. The material that did not pass through the sieve was sorted by potential food items and other organic materials. Potential food items were rice, corn, nutsedge tubers, eleocharis (*Eleocharis* spp.) tubers, onions (*Allium* spp.), snails, and cotton (*Gossypium* spp.) seeds. Most of the "rice" was actually rice hulls, but counted as

rice. Other organic materials included roots, corncobs, corn stalks, or any above ground biomass. The core material was separated and dried at 40° C. Once the material from the soil sample reached a constant weight it was recorded to the nearest 0.01 gram.

Feces gathered in the field were analyzed to reveal the species of plants and animals in the diet. Feces were collected throughout the 102 days of the study and separated into month/year collected. Samples were frozen and stored until further analysis. Korschgen (1948) used dried crops of quail in the same manner, to analyze food selection. Hunt and Slack (1989) used 0.5 g randomly chosen from each fecal sample to identify vegetation and prey species. In this study, the fecal sample was thawed and put on a Micro concavity slide (7.62 x 2.54 x 6 mm thick with a straight wall concavity of 16 mm diameter x 3 mm deep) with water and a 3 x 6 grid system (1.5 mm x 2 mm rectangles). A 35 power Nikon SMZ-1B dissecting scope was used to identify plant materials under the intersecting points of the grid. Each fecal sample was scanned until 30 points where plant species could be identified were encountered. The species composition of the fecal material was listed by frequency of occurrence. Known vegetation samples were colleted, during 2002 and 2003, for verification of plant species found in the fecal samples.

RESULTS

The highest count of Sandhill Cranes in 2002 was 795 individuals (Jan. 18) at Holmwood (Fig. 1) and 686 individuals (Feb. 8) at Cheneyville (Fig. 2). In 2003, the highest number was 721 (Feb. 13) in Holmwood (Fig. 3) and 775 (Mar. 6) in Cheneyville (Fig. 4). Because these flocks were mixing, our best estimate was a total of about 1,300 individuals on any given day in these flocks. Total counts in Louisiana from 2002, show Sandhill Crane numbers in the following parishes: Acadia (16 individuals), Avoyelles (200-250), Calcasieu (Holmwood flock) (795), Natchitoches (300-400), Rapides (Cheneyville flock) (560), and West Carroll (200-300) (Fig. 5). Statewide counts total approximately 2,200 wintering individuals. Arrival dates were around the first week of November and departure dates were the first and second weeks in March.

On Feb. 16, 2002, five Sandhill Cranes were banded in Cheneyville and on the 19 Feb. two dead cranes were found in Holmwood. One bird also was found dead and almost fully decomposed in Cheneyville on Feb. 21, 2002. These cranes were used to determine the subspecies of the two flocks. The culmen length of all eight birds was longer than the greatest length given for the male Lesser subspecies. This indicates that the birds are the Greater subspecies according to Walkinshaw (1973) and Tacha et. al. (1992) (Table 1). However, seven of the eight tarsus measurements fell within range of the male lesser subspecies, but all measurements were above the mean. Three of the seven (unable to measure bird found dead in Cheneyville) wing chord measurements were longer than the maximum length of the male Lesser subspecies and the other four measurements were above the mean of the male Lesser subspecies. Using these three morphometric measurements on the eight cranes, I believe both flocks are composed of the Greater Sandhill Crane subspecies.

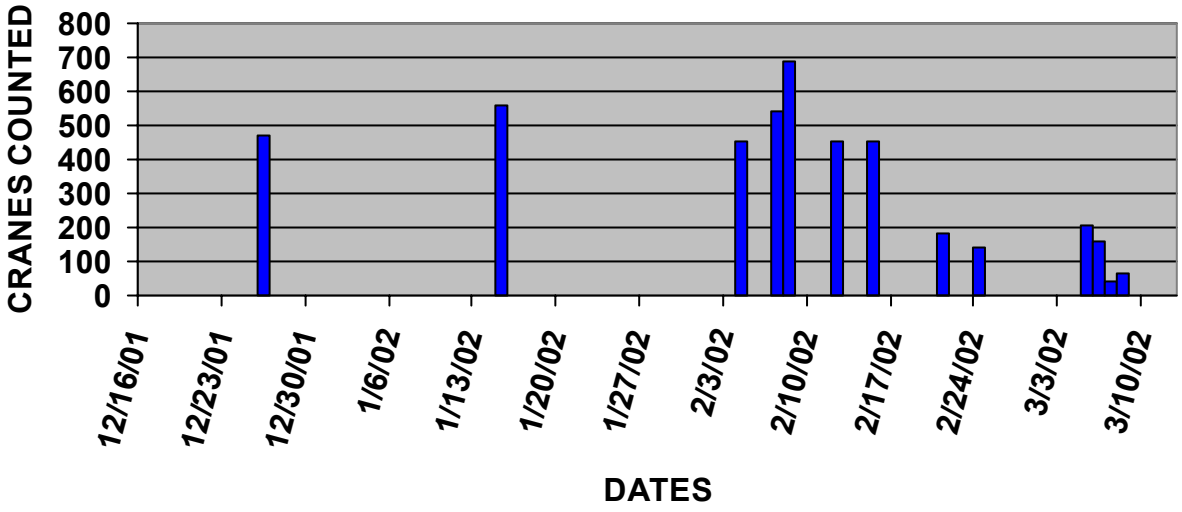

FIGURE 1: The number and date of Sandhill Cranes counted at Cheneyville in the winter of 2002.

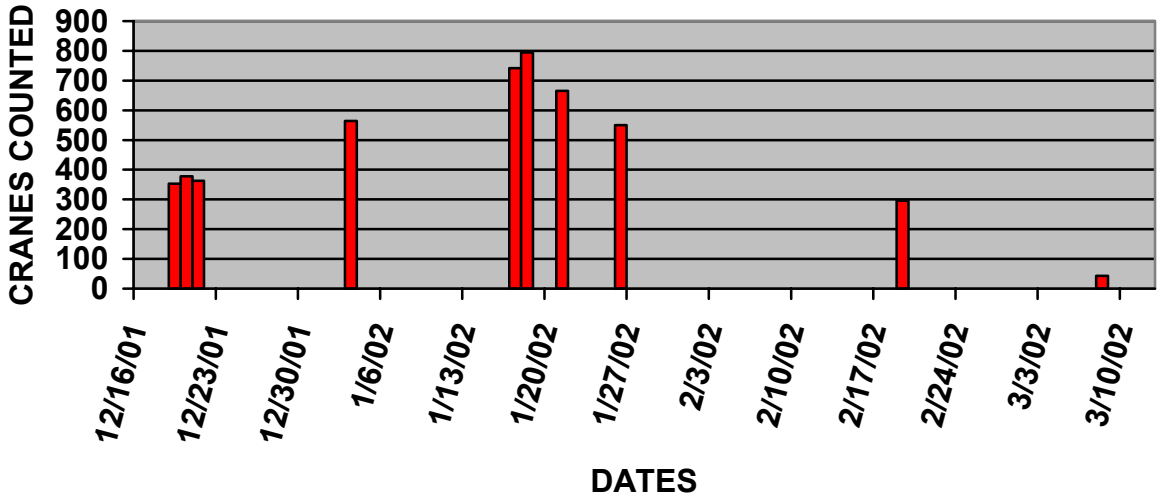

FIGURE 2: The number and date of Sandhill Cranes counted at Holmwood in the winter of 2002.

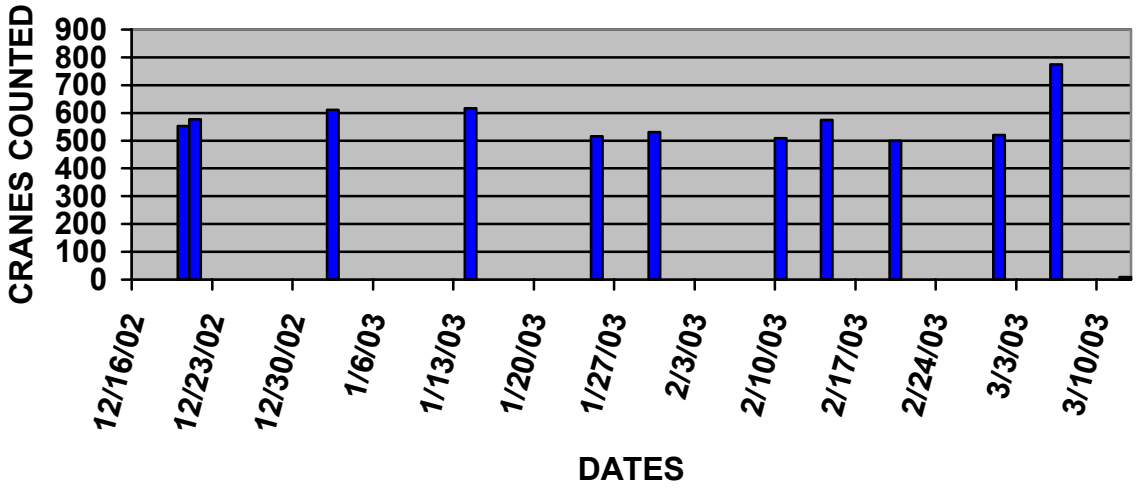

FIGURE 3: The number and date of Sandhill Cranes counted at Cheneyville in the winter of 2003.

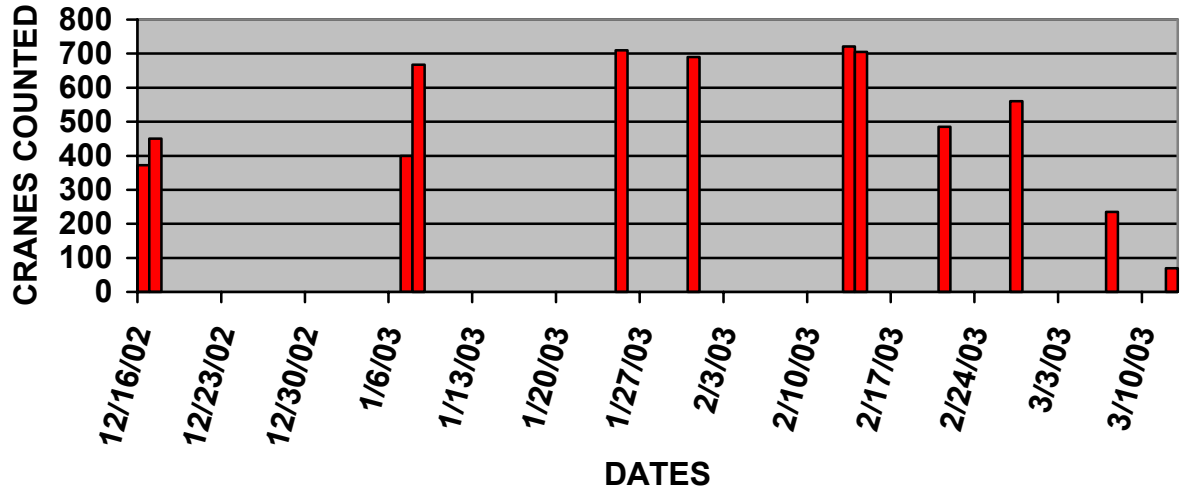

FIGURE 4: The number and date of Sandhill Cranes counted at Holmwood in the winter of 2003.

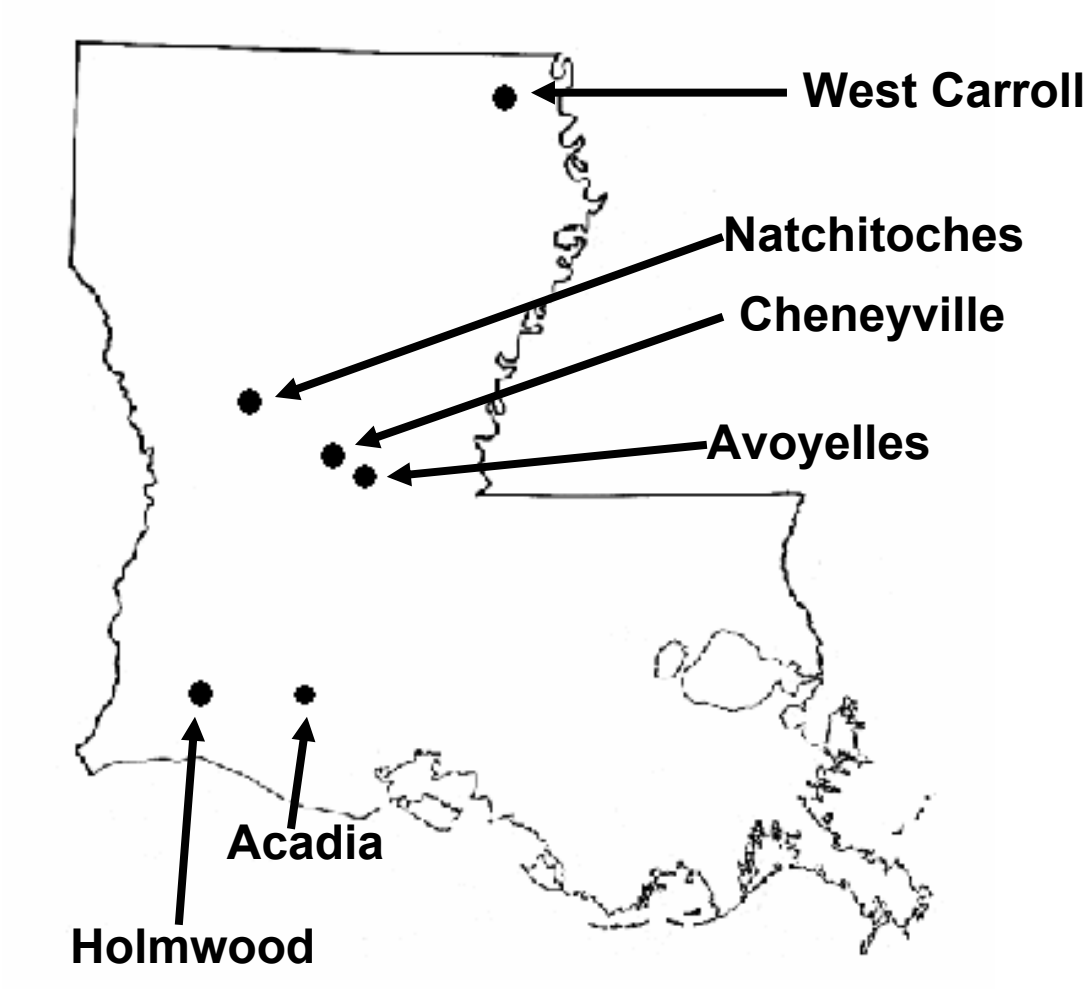

FIGURE 5: Map of Louisiana showing where Sandhill Cranes were found in 2002.

TABLE 1: Morphometric measurements (mm) of Sandhill Cranes from Louisiana compared to measurements from known Lesser Sandhill Cranes in the literature.

Flock	Age*	Sex	Bird	Tarsus	Wing chord	Culmen length	Culmen post-nare	Middle toe
Cheneyville	Juv.		E01	240.75	528.0	136.4	96.8	70.04
Cheneyville	Adult		E02	217.5	530.5	130.9	96.2	78.7
Cheneyville	Juv.		E03	221.9	490.0	123.5	88.7	75.1
Cheneyville	Adult		E04	207.7	540.0	124.6	92.5	75.5
Cheneyville	Adult		E05	193.6	490.5	112.9	80.3	71.9
Cheneyville	**	**	D	193.2	**	123.3	88.7	76.8
Holmwood	Adult	F	1	199.0	505.0	111.4	83.5	74.3
Holmwood	Adult	F	2	200.2	493.0	119.1	89.0	81.1
Lesser Sandhills								
Walkinshaw	Adult	M		189.3 (156-228)	469 (418-510)	92.6 (69-110)		
Walkinshaw	Adult	F		181.8 (162-212)	447.6 (420-500)	91.8 (80-103)		
Tacha et. al.	Adult	M		187.5±14.4		97.3±3.9		75.4±3.2
Tacha et. al.	Adult	F		179.2±10.8		92.0±5.2		73.4±4.8

* Unsure of the ages on the adult birds, adults could have been juveniles of the year.
**Unable to take measurements because of the deterioration.

The middle toe imprint measurements taken in Holmwood on 16 Dec. had a mean of 74.5 mm, n=54 (se=0.69), while the measurements taken on 14 Feb. had a mean of 77.9 mm, n=17 (se=1.32). Middle toe measurements on the 15 Jan. in Cheneyville had a mean of 80.2 mm, n=50 (se=0.68). The differences in middle toe imprint measurements between the Feb. 14 Holmwood flock and the Jan. 15 Cheneyville flock were within what would be expected by chance ($t=1.60$, $p=0.11$). However, the Dec. 16 Holmwood middle toe measurements were significantly smaller than the Jan. 15 (Cheneyville) ($t=5.82$, $p<0.01$) and Feb. 14 (Holmwood) ($t=2.39$, $p<0.02$) middle toe measurements. There was no significant difference in the variances between the 16 Dec. (Holmwood) measurements and the 15 Jan. (Cheneyville) ($F=1.12$, $p=0.690$) and 14 Feb. (Holmwood) ($F=1.13$, $p=0.71$) middle toe measurements.

Table 2 shows the percentages of middle toe imprint measurements equal to or less than 70 mm, 71-79 mm, and greater than or equal to 80 mm. At Holmwood, there were more

measurements less than 80 mm in December. However, when the measurements were taken again in February there were more measurements equal to or greater than 80 mm in the Holmwood flock. The measurements taken from Cheneyville in January also have a higher percentage of middle toe imprints equal to or greater than 80 mm.

TABLE 2: Percentages of middle toe imprint measurements from Sandhill Cranes wintering in Louisiana in 2003.

Length (mm)	Holmwood (December) n=54	Cheneyville (January) n=50	Holmwood (February) n=17
$\leq$ 70	30%	4%	18%
71-79	48%	24%	24%
$\geq$80	22%	72%	59%

In 2002, the radio-marked birds were located periodically until they left for the spring migration in late February and March. On Feb. 17, 2002, four of the five radio marked birds, excluding E04, were at the roost site (ChyRo 1) (Appendix A). On February 20, radio marked bird E05 was located at Chy 5 and bird E03 was last located close to ChyRo 2. On 24 February 2002, bird E05 was last heard close to ChyRo 1 and E02 was found dead, probably due to capture myopathy. The only bird left was E01, which continued feeding in Chy 7 and close to Chy 1, until last seen on Mar. 8, 2002. However, a local birder reported seeing two Sandhills with the same banding scheme used in this study at Chy 4 on Mar. 15, 2002.

The following winter on the 20 of December, bird E04 was located in a rice field at Cheneyville. The next day E04 was feeding with 576 individuals in a corn field (Chy 8). E04 was never located in Cheneyville again, but on January 24, 2003 E04 was located in Holmwood (Hom 8) (Appendix B). E04 was not found for about two weeks and was then located near Holmwood on the 13 of February and periodically through March 7, 2003. In Cheneyville, on 15 January, 2003 bird E05 was located in a corn field (Chy 8) with 376 other Sandhill Cranes.

That same day there was a location on E03 in West Carroll parish about five miles southwest of Lake Providence, Louisiana (T. Michot, pers. commun.). E03 was never located again and E05 was not located after January 30, 2003.

Two banded birds were observed in Cheneyville that had distinct color bands. On February 12, 2002, a banded bird from Briggsville, Wisconsin was spotted in Chy 5. This bird was a male banded in 1997 as a chick with a green 3" leg band # 178 above the tibiotarsal joint on the left leg and one inch colored strips "white, green, red" from top to bottom on the right leg.

In the winter of 2003, on the 30 of January another banded bird was spotted feeding in Chy 8. The numbers were not readable on the 3" yellow non-flanged band, nor was the color coordination identified. However, we believe (J. Barzen and M. Hayes, pers. commun.) this was also a Wisconsin bird. The International Crane Foundation banded both birds and neither bird was seen after the initial sighting.

Three roost sites were located in Cheneyville and three in Holmwood during the study. All roost sites were in harvested rice fields. The cranes roosted more than 10 m from the rice levees. All of the roost sites in Cheneyville had rice stubble and one roost site in Holmwood contained stubble. The other two roost sites in Holmwood contained short vegetation ($\leq$ 5 cm) or bare ground. The two most frequently used roost sites ChyRo 1 and HomRo 2 both were located within 350 m of duck blinds and ChyRo1 had a power line running through the rice field. The mean roost site water depth in 2002 at Cheneyville (ChyRo 1) was 19.91 cm (se=0.84) and 8.96 cm (se=0.20) for ChyRo 2. In 2003, mean roost site water depth was 11.42 cm (se=0.41) at ChyRo 1. The third roost site (ChyRo 3) was located north of Bunkie, La in a rice field. The 2002 mean roost site water depth for Holmwood was 5.46 cm (se=0.48) and 5.86 cm (se=0.48)

for HomRo 1 and HomRo 2, respectively. In 2003, 2.4 cm (se=0.26) and 0.81 cm (se=0.20) were the mean roost site water depths at HomRo 3 and HomRo 2, respectively.

Sandhill Cranes in Cheneyville would fly to feeding areas up to 17 km away from the roost site, but mostly fed within 8.5 km of the roost site. Most of the time there was a main flock in one field and small flocks (10-150 individuals) feeding in other fields. Out of 28 observation days in 2002, 46% of the time the main flock fed in rice fields, corn fields at 25% of the time, pastures at 11%, cotton fields at 11%, and soybean fields at 7%. With 18 observation days in 2003, Sandhill Cranes used corn fields 61% of the time, soybeans (33%), and rice (6%). Sandhill Cranes feeding in Cheneyville fed mostly in harvested rice fields in Dec. and switched to harvested corn fields in Jan. and Feb.

The Holmwood flock fed mostly in rice fields in Dec. and early Jan. then switched to pasture lands that contained rice levees. The Holmwood flock fed as far as 12.1 km from the roost site, but usually fed within 4.8 km of the roost site. In 2002, 29 days of observations showed the main flock of cranes feeding 69% of time in pasture lands and 31% of the time in rice fields. In 2003, 17 observation days revealed 59% of the time was in pasture land and 41% was in rice fields. There were usually small flocks from 10-150 individuals feeding in fields separate from where the main flock was feeding.

Rapides Parish consists of approximately 46,601 hectares of agricultural land (crop land and pasture) (Table 3). In 2001, the greatest acreage (excluding pastures) in Rapides Parish was cotton at 23%, and only 3% was planted in corn. In 2002, however cotton made up only 15% of the crop land, while the corn crop doubled to 6%. Most of the other crops changed only by a small amount between the two years. In Holmwood, the biggest crop production (excluding pastures) was rice in 2001 and 2002 (Table 4). The other crops made up less than 6% of all

agricultural fields. In each Parish, the largest percentage of agriculture fields was pastures at 18,060 ha in Rapides and 62,346 ha for Calcasieu (data taken from the USDA census of 1997).

TABLE 3: Hectares of agricultural land in Rapides Parish, La.

Crop land type	2001	2002
Pasture *	18060	18060
Cotton	10825	6939
Soybeans	6273	7192
Sugar cane	5757	5718
Rice	2367	2957
Sorghum	2047	2339
Corn	1255	2736
Wheat	342	660

*The "Pasture" data came from the USDA census of 1997.

TABLE 4: Hectares of crop land in Calcasieu Parish, La.

Crop land type	2001	2002
Pasture *	62346	62346
Cotton	0	0
Soybeans	936	809
Sugar cane	2249	2226
Rice	8658	7362
Sorghum	202	160
Corn	0	0
Wheat	420	304

* "Pasture" data was taken from the USDA census in 1997.

Table 5 shows the percentage of fields used for feeding versus the percentage of fields within the parish. Both flocks of birds selected rice fields in which to feed ($p < 0.01$). The Cheneyville flock fed more in corn fields than what would be expected by chance. The Holmwood flock only fed in rice fields or pastures and was not seen feeding in any other types of agriculture fields.

Soil samples taken in Cheneyville contained mostly nutsedge tubers (excluding the "organic matter" which was roots, above ground biomass, etc.) (Table 6). Cranes feeding in Chy 7, a cotton field, were noticed feeding primarily along a ditch that ran through the field. When

the soil samples were taken along the ditch, they contained nutsedge tubers. The soil samples taken randomly throughout the cotton field, however, did not contain any nutsedge tubers. Holmwood soil samples also had mostly nutsedge tubers (excluding "organic matter"), but one field contained mostly Eleocharis spp. tubers (Table 7).

TABLE 5: Percent usage in each type of agricultural field by Sandhill Cranes compared to the percentage of each type of field within Rapides and Calcasieu Parishes.

	CHENEYVILLE Rapides Parish		HOLMWOOD Calcasieu Parish	
CROP LAND	% USED	% AVALIBALE	% USED	% AVALIBALE
2002				
PASTURE	11	38	69	83
RICE	46	5	31	12
CORN	25	3	0	0
SOYBEANS	7	13	0	1
COTTON	11	23	0	0
WHEAT	0	1	0	1
SORHGUM	0	4	0	0.27
SUGAR CANE	0	12	0	3
2003				
PASTURE	0	39	59	85
RICE	6	6	41	10
CORN	61	6	0	0
SOYBEANS	33	15	0	1
COTTON	0	15	0	0
WHEAT	0	1	0	0.41
SORHGUM	0	5	0	0.22
SUGAR CANE	0	12	0	3

Table 8 and 9 contain the frequency of occurrence of foods found in fecal material from Cheneyville and Holmwood, respectively. Nutsedge and corn were the primary foods found in the fecal remains at Cheneyville, but rice seemed to be an important food source early in the winter. Corn and nutsedge were both important food sources through the winter, but later in the winter the cranes would switch to nutsedge tubers. Identifiable fragments in feces from Holmwood were mostly nutsedge and rice. Like the Cheneyville flock, rice was an important

food source early in the year, but in late winter the birds started consuming more nutsedge and Eleocharis tubers.

TABLE 6: Potential Sandhill Crane food items identified in soil samples from selected fields used for feeding in Cheneyville, La. Results given in kg/ha with standard error in parentheses.

Location	Nutsedge	Rice	Snails	Cotton seed	Organic matter
Chy 5 '02	71.91 (24.19)	0 (0)	0 (0)	0 (0)	6675.45 (1233.94)
Chy 7 '02	0 (0)	0 (0)	0 (0)	201.09 (80.18)	1494.18 (361.49)
Chy 7* '02	2565.82 (1214.57)	0 (0)	0 (0)	0 (0)	2929.82 (1268.59)
Chy 1 '02	0 (0)	117.73 (22.90)	10.82 (7.80)	0 (0)	3753.91 (609.63)
Chy 2 '02	5288.18 (811.67)	0 (0)	0 (0)	0 (0)	2931.09 (600.34)
Chy 3 '02	112.00 (49.69)	28.00 (5.96)	1.91 (1.04)	0 (0)	1872.18 (379.97)
Chy 5 '03	3.82 (3.82)	0 (0)	0 (0)	0 (0)	3001.47 (710.87)
Chy 1 '03	0.64 (0.64)	0 (0)	0 (0)	0 (0)	403.45 (140.23)
Chy 8 '03	134.91 (57.86)	0 (0)	0 (0)	44.55 (28.33)	4252.18 (881.02)

* A sub sample of Chy 7 that contained only soil samples taken from a ditch where the Sandhills were concentrating.

TABLE 7: Potential Sandhill Crane food items identified in soil samples from selected fields used for feeding in Holmwood, La. Results given in kg/ha with standard error in parentheses.

Location	Nutsedge	Rice	Onions	Snails	Eleocharis	Organic matter
Hom 6 '02	635.94 (127.01)	0 (0)	62.79 (22.65)	1.27 (1.27)	0 (0)	9013.88 (801.47)
Hom 1 '02	0.64 (0.64)	148.91 (26.00)	0 (0)	19.09 (4.08)	0 (0)	9366.64 (935.82)
Hom 8 '03	112.00 (47.52)	0 (0)	1.91 (1.39)	0 (0)	0 (0)	3920.00 (529.72)
Hom 9 '03	86.55 (40.67)	0 (0)	19.73 (9.07)	0 (0)	442.91 (83.31)	10315.45 (611.88)

TABLE 8: Frequency of occurrence of materials found in the fecal material from Sandhill Cranes in Cheneyville, La.

Date	Nutsedge	Corn	Rice	Sagittaria	Insect	Unknown	N
Jan '02	29.67	45.67	14.33	5.33	0.0	5.0	10
Feb '02	52.67	46.33	0.0	0.0	Trace	Trace	10
Dec '02	55.06	33.08	10.74	Trace	0.0	Trace	27
Jan '03	47.89	43.33	2.29	Trace	Trace	5.79	19
Feb '03	88.50	10.67	0.0	0.0	0.0	Trace	20

TABLE 9: Frequency of occurrence of material found in fecal material from Sandhill Cranes in Holmwood, La.

Date	Nutsedge	Rice	Sagittaria	Onion	Unknown	N
Jan '02	72.33	9.67	15.00	1.67	1.33	10
Dec '02	2.50	86.11	9.17	1.67	Trace	24
Jan '03	76.33*	18.50	0.0	1.67	3.50	20
Feb '03	93.33*	1.03	Trace	2.19	2.44	26

* Due to the inability to distinguish between nutsedge tuber remains and Eleocharis tuber remains the "NUTSEDGE" column contains both Eleocharis and Nutsedge

DISCUSSION

Estimating the number of cranes in the state at any one time requires the assumption that relatively little movement is occurring among the flocks. It was difficult to get good counts on the same day at the two sites, therefore good counts within five days of each other were used as my best estimates of the number of cranes in the state. Movement of two of my four radio-marked cranes between flocks in 2002-03 raise questions about the assumption of limited movement. Even more intriguing is that neither of these birds nor the one radio-marked bird found in East Carroll Parish were found more than a few times in spite of trips at weekly or more frequent intervals to the major sites. The Wisconsin banded bird seen in February of 2002 was only seen once. During January of 2003, another bird with a similar banding pattern was seen, but could not be identified. These birds were only seen once and probably spent part of the winter elsewhere. The paucity of these sightings raises the issue of whether more flocks of Sandhill Cranes are wintering in Louisiana or in surrounding states, or if birds from the Louisiana flocks are mixing with flocks from other states. The data collected in this study are not adequate to answer these questions.

The presence of banded birds from the Wisconsin flock clearly demonstrates that some of these birds were from that area. However, M. Hayes and J. Barzen (pers. commun.) were not able to locate the birds with Louisiana attached radios during the spring and summer of 2002. This clearly shows that not all of the birds are being produced in the area being studied in Wisconsin.

The middle toe imprint measurements were taken in hopes that I could possibly distinguish the two flocks. The significantly smaller middle toe lengths in December than in February at Holmwood, were not expected. J. Barzen (pers. commun.) indicated that the

likelihood of measurable growth of young Sandhill Cranes after December is unlikely. One possible explanation is that some Lesser Sandhill Cranes were in the Holmwood flock in December, but had left by January. The data collected are only suggestive, but lead to the hypothesis that individual birds or groups of birds are shifting among the flocks on the wintering grounds.

Roost sites were all flooded rice fields. The Cheneyville flock roosted in deeper water than the Holmwood flock, but the water depth for both areas was < 20 cm, similar to what Norling et. al. (1992) and Lovvorn and Kirkpatrick (1981) found. All of the roost sites were several hundred meters away from roads and fairly isolated. However, the cranes would feed in fields usually no closer than 200 m from the road. The majority of these fields were surrounded by a row of trees along a fence, which did not seem to bother the birds. The presence of duck blinds actively hunted close to the roost site did not seem to bother the birds either.

The food items found in the fecal material were probably over represented due to the digestibility of some foods. For example, nutsedge hairs were counted as nutsedge. These hairs are numerous and probably indigestible which would lead to over representation. However, I believe most of the food items that comprised the bulk of the calories were identified. Nutsedge tubers seemed to be the most important food for both flocks. Guthery (1975) found similar results in Texas from Sandhill Crane gizzards (87 % frequency of nutsedge). Corn was second in importance for the Cheneyville flock while the Holmwood flock used rice. There was a shift in the feeding habits of both flocks, which relied more on rice early in the winter; then later switched to nutsedge tubers. The agriculture seeds either deteriorated or, were depleted later in the winter. In Cheneyville, during Feb. 2002, more corn was consumed versus Feb. 2003. This

is probably because the growing season of 2002 and winter of 2003 were much wetter causing more rapid deterioration of agricultural waste grain than in the drought of 2001-2002.

In Holmwood, the cranes feed in pastures most of the time. These pastures were old rice fields in rotation that still contained rice levees. These pastures were probably shallowly flooded at some time of the year, which is good habitat for nutsedge tuber production (Kelly 1990). In Cheneyville, the Sandhill Cranes feeding in corn fields were consuming nutsedge tubers in addition to the corn. In several observations, within these corn fields, I noticed areas (approximately 3x3 meters) of bare soil dug up. Many nutsedge tubers were found in the dug up areas. The cranes were probing these areas where there were high concentrations of tubers in the corn fields. The cores or soil samples that were taken in these corn fields were probably not representative of the whole corn field. There seemed to be patches of high concentrations of tubers within these fields. The cranes appeared to actively seek out these patches compared to my random sample method, which apparently missed these patches of high concentrations of tubers.

CONCLUSIONS

The Sandhill Cranes in Louisiana appear to be Greater Sandhill Cranes and should be considered as one flock. The Holmwood and Cheneyville areas winter the majority of the birds, but West Carroll and Natchitoches Parishes also winter sizable flocks. The cranes seem to rely heavily on rice and corn fields. Pastures are also important when corn fields are not available. Natural occurring foods, especially nutsedge and Eleocharis tubers were the most important foods followed by agriculture foods. Refuges located near these flocks could possibly attract wintering cranes by planting corn or managing for nutsedge production as long as human disturbance was minimal. In the two years of this study, the Cheneyville and Holmwood flock did not appear to grow in numbers, but it is possible that the other flocks located around LA could be spillovers from Cheneyville and Holmwood. If that was the case then the smaller flocks around LA should be watched closely to determine if they are growing.

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APPENDIX A
GPS COORDINATES CHENEYVILLE

GPS coordinates (Lat/Lon hddd°mm'ss.s") of roost sites and feeding areas of Sandhill Cranes wintering in Cheneyville, Louisiana.

FEEDING AREAS

CHY 1	N31 05 18.5 W92 20 17.6
CHY 2	N31 04 43.4 W92 20 07.0
CHY 3	N31 04 33.3 W92 19 26.3
CHY 4	N31 09 22.7 W92 25 48.4
CHY 5	N31 09 58.0 W92 18 33.1
CHY 6	N31 13 32.6 W92 25 10.1
CHY 8	N31 04 12.7 W92 23 44.7
CHY7	N31 06 08.7 W92 23 43.8

ROOST SITES

CHYRO 1	N31 05 14.9 W92 20 52.8
CHYRO 2	N31 04 30.4 W92 18 58.3

APPENDIX B
GPS COORDINATES HOLMWOOD

GPS coordinates (Lat/Lon hddd°mm'ss.s") of roost sites and feeding areas of Sandhill Cranes wintering in Holmwood, Louisiana.

FEEDING AREAS

H0M 1 N30 07 55.1 W93 07 10.0

H0M 2 N30 08 47.8 W93 06 33.1

H0M 3 N30 08 52.9 W93 05 25.2

H0M 4 N30 12 14.3 W93 04 49.1

H0M 5 N30 03 58.8 W93 11 46.4

H0M 6 N30 06 01.6 W93 09 02.3

H0M 7 N30 04 02.3 W93 07 28.0

H0M 8 N30 07 01.2 W93 07 30.1

H0M 9 N30 05 24.2 W93 04 48.4

ROOST SITES

HOMRO 1 N30 07 24.2 W93 06 37.7

HOMRO 2 N30 07 52.7 W93 06 36.5

HOMRO 3 N30 05 40.3 W93 04 10.5

VITA

Joseph McGowan was born in Shreveport, Louisiana, on September 16, 1979. He was introduced to the world of wildlife by his father Mike McGowan and grandfathers Charles Liberto and Edward McGowan. He graduated from Northwood High school in May 1997 and continued his education at Northwestern State University until he graduated with a Bachelor of Science degree in biology in 2001. He worked as an intern at Cameron Prairie National Wildlife Refuge in the summer of 1999. In the summer of 2001, he worked at Rockefeller Refuge in Cameron Parish. He went on to pursue a master's degree in wildlife under Dr. Vernon Wright. He was hired by the Fish and Wildlife Service as a SCEP (Student Career Experience Program) student in 2002. He is currently working at Reelfoot National Wildlife Refuge outside of Union City, Tennessee. He expects to receive a Master of Science degree in wildlife in December 2003.