

Relative Abundance and Diversity of Ciconiiforms in North-Central Oklahoma

Bryan R. Winton' and David M. Leslie, Jr.

Oklahoma Cooperative Fish and Wildlife Research Unit, Department of Zoology, Oklahoma State University, Stillwater, OK 74078-3051
 'Current address: San Pablo Bay National Wildlife Refuge, P.O. Box 2012, Mare Island, CA 94592.

We compared the relative abundance and diversity of ciconiiforms at Salt Plains National Wildlife Refuge in 1995 by using two census methods. Both methods revealed that cattle egrets were the most abundant species, with a relative abundance consistent to that observed by other investigators. Our study found that non-intrusive surveys by vehicle may be preferred over surveys by boat when relative abundance determination is the research goal. © 1999 Oklahoma Academy of Science

INTRODUCTION

We compared the relative abundance and diversity of ciconiiforms censused during vehicular trips (non-intrusive) to the relative proportion of those same species (n=7) censused in the Ralston Island heronry from a boat (intrusive) on 26 June 1995 (2). Because our primary concern was that using intrusive methods to census herons and egrets can cause significant disturbance, nest abandonment, and mortality (3, 4, 5), we wanted to determine whether a non-intrusive method (survey from vehicle) could provide comparable results to a more intrusive method (survey by boat).

METHODS

State Highway 11 runs 6 km (east/west) through the northern part of Salt Plains National Wildlife Refuge (NWR) in Alfalfa County in north-central Oklahoma. Sand Creek and two branches of the Salt Fork of the Arkansas River flow south beneath the highway, feeding the Great Salt Plains Reservoir located within Salt Plains NWR. The airspace above those tributaries served as a daily flyway for ciconiiforms and associated bird species moving between the Ralston Island heronry in the reservoir and farmfields, rangelands, and riparian areas located north of the island in 1995 (Fig. 1).

In 1995, we censused ciconiiforms during vehicle trips along State Highway 11 in Salt Plains NWR 2-4 times daily during crepuscular hours (sunrise-10:00 h/18:00 h-sunset) from 15 May to 2 July (49 d) to determine the relative abundance and species diversity of ciconiiforms in the flyway. While driving the 6-km route at 30 km/h we recorded on microcassette tapes, all ciconiiforms sighted. We compared our results to the relative abundance of a survey taken from a boat in 1995 (2) and the relative abundance of Cattle Egrets, (*Bubulcus ibis*), in 1982 reported by Talent and Hill (1).

We used Chi-square analysis to identify whether differences existed in the relative abundance of ciconiiforms, comparing surveys conducted from a vehicle to a survey conducted by boat in 1995. We used Simpson's Index (6) to measure the diversity or species dominance; a t-test of Simpson's indices to determine whether differences in species dominance existed between censuses; and Hurlbert's (7) method to determine the probability of interspecific encounter for dominant species between the surveys by vehicle (non-intrusive) and the survey from a boat (intrusive) in 1995 (2).

RESULTS and DISCUSSION

A total of 2,239 ciconiiforms was censused along State Highway 11 in 1995 (Table 1). Sightings from vehicle in order of relative abundance were Cattle Egrets, (*Bubulcus ibis*), Great Egrets (*Ardea alba*), Little Blue Herons (*Egretta caerulea*), Snowy Egrets (*Egretta thula*), White-faced Ibis (*Plegadis*

chihi), Great Blue Herons (*Ardea herodias*), and Black-crowned Night Herons (*Nycticorax nycticorax*) (Table 1). Cattle Egrets represented 81.9% of all ciconiiforms sighted during surveys by vehicle. White-faced Ibis were a newly documented nesting species on Ralston Island in 1995 (8) and represented 2.0% of our census observations (Table 1).

A total of 1,103 ciconiiforms nesting on Ralston Island was censused from a boat in 1995 (2) (Table 1). Relative abundance by species in their study was Cattle Egret, Snowy Egret, Great Egret, Little Blue Heron, Black-crowned Night Heron, and White-faced Ibis (Table 1). No Great Blue Herons were observed nesting on Ralston Island by Koenen and coworkers in 1995 (2) perhaps because they flushed upon the boat's arrival and did not return before the survey was completed (Winton, personal observation).

The frequencies of observations of all ciconiiforms were significantly different between our censuses by vehicle and the survey from a boat in 1995 (2) on Ralston Island ($X^2 = 47.84$, $df = 5$, $P < 0.001$). Differences were influenced most by variability among the least abundant species, which likely reflected differential flocking behavior and habitat preferences that rendered some species less observable during our censuses from a vehicle. A comparison of the relative abundance of Cattle Egrets to all other ciconiiforms combined did not differ between censuses from a vehicle and the survey by boat in 1995 ($X^2 = 1.17$, $df = 1$, $P > 0.5$).

Simpson's index of diversity ranges from 0-1, with 0 representing low dominance and 1 representing high dominance. Our censuses by vehicle revealed a species dominance value of 0.6797 and a probability of interspecific encounter of 0.3203, whereas the Ralston Island survey from a boat (2) revealed a slightly higher dominance of 0.7116 and a lower interspecific encounter of 0.2884. However, a *t*-test of Simpson indices revealed no significant differences between the species diversity in our study and the survey from boat ($t = 0.001$). Both studies found that Cattle Egrets were the dominant species in 1995.

Great Blue Herons were observed in the flyway during our censuses from a vehicle but not counted on the survey from a boat. Great Egrets, Snowy Egrets, Little Blue Herons, and White-faced Ibis combined made up 15% of the species composition observed on Ralston Island during the survey by boat (2) and 17.4% of the species composition observed in our study (Table 1).

Great-tailed Grackles (*Quiscalus mexicanus*) and Double-crested Cormorants (*Phalacrocorax auritus*) were observed nesting on Ralston Island in 1995, but represented less than 1% of total birds counted (2), and were not observed along State Highway 11 during censuses from a vehicle. Daily movements of grackles and cormorants differed from the north-south migration representative of ciconiiforms compared in this study. Great-tailed Grackles were seen frequently on fencelines and in farmfields located east of Ralston Island near Nescatunga on State Highway 38, and Double-crested Cormorants were observed only on the Great Salt Plains Reservoir (Winton, personal observation).

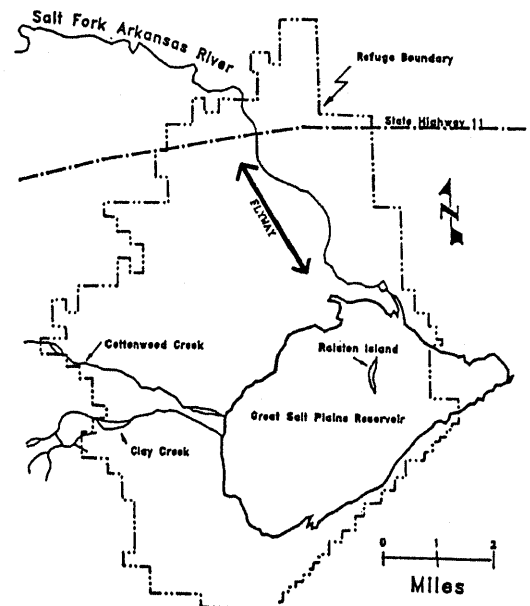


Figure 1. Daily flight path (arrow) of ciconiiforms flying from Ralston Island in the Great Salt Plains Reservoir across State Highway 11 to farm fields, rangelands, and riparian bottomlands located north of Salt Plains National Wildlife Refuge in north-central Oklahoma in 1995.

Talent and Hill (1) reported that Cattle Egrets represented 81% of the species composition of the Ralston Island heronry in 1982 which is consistent with our findings of 81.9% Cattle Egrets from our surveys from a vehicle in 1995. Cattle Egrets represented 84.0% of the nesting species observed on Ralston Island in 1995 in the survey from a boat (2). Therefore, our study reconfirmed that Cattle Egrets were the most dominant species with the highest relative abundance in the Ralston Island heronry and throughout the Salt Plains ciconiiforms flyway in 1995.

For the past 14 yr, Cattle Egrets have exhibited a fairly stable relative abundance on Ralston Island, despite significant habitat changes and a reduction in island size (9). However, the heronry has grown from ~1,240 ciconiiforms in 1982 to an estimated 22,966 birds in 1995 (2). Island stability over the next several years will most likely dictate future species composition, relative abundance, and diversity of the Ralston Island heronry.

The abundance of Cattle Egrets relative to other species recorded from censuses from a vehicle in 1995 paralleled the proportion of Cattle Egrets observed during the boat survey on Ralston Island in 1995 (2). Results of our study suggest that intrusive counts in heronries, which we assume to afford the best opportunity to enumerate all species relative to one another, are indeed necessary to completely and accurately characterize ciconiiforms- especially the least abundant species (8,10) in a particular area, i.e., Ralston Island nesting heronry. However, contrasts of the most abundant species (i.e., Cattle Egrets, in relation to all other ciconiiforms) can be accomplished with less intrusive methods. Therefore, because of the potential negative impact of entering heronries during nesting (4,5), we recommend, when research goals permit, conducting ciconiiform counts from a vehicle along flyways, if identifiable, to determine relative abundance of the most common species.

ACKNOWLEDGMENTS

Funding for this research was provided by the Oklahoma Cooperative Fish and Wildlife Research Unit (US Geological Survey's Biological Resources Division, Oklahoma Department of Wildlife Conservation, Oklahoma State University and Wildlife Management Institute, cooperating) and Salt Plains National Wildlife Refuge (NWR), Region 2 of the US Fish and Wildlife Service. We especially thank R. Krey and the staff at Salt Plains NWR for their cooperation and continued support, and D. Howell, C. McDowell, R. Tyrl, and several anonymous reviewers for reviewing earlier versions of this manuscript. J. Rupert is recognized for assisting with data analysis.

REFERENCES

1. Talent LG, Hill LA. Untitled report. Jet (OK): Salt Plains National Wildlife Refuge; 1982.

TABLE 1. Ciconiiforms and associated bird species censused in surveys from a vehicle along State Highway 11 and a survey from boat of the Ralston Island heronry (2) at Salt Plains National Wildlife Refuge in Alfalfa County, north-central Oklahoma in 1995.

Species	Ciconiiforms Censused		Percent Composition	
	Vehicle	Boat ¹	Vehicle	Boat ¹
Cattle Egret	1,833	926	81.9	84.0
Great Egret	179	50	8.0	4.5
Snowy Egret	75	61	3.3	5.5
Little Blue Heron	91	47	4.1	4.3
White-faced Ibis	44	8	2.0	0.7
Black-crowned Night Herons	1	11	–	1.0
Great Blue Heron	16	0	0.7	–
TOTAL	2,239	1,103	100.0	100.0

¹Census by boat (2).

2. Koenen MK, Winton BR, Shepperd RS, Leslie DM Jr. Species composition of a Ciconiiform rookery in northcentral Oklahoma. *Bull Okla Ornithol Soc* 1996;29:3-6.
3. Parsons KC, Burger J. Human disturbance and nestling behavior in Black-crowned Night Herons. *Condor* 1982;84:184-187.
4. Frederick PC, Collopy MW. Researcher disturbance in colonies of wading birds: effects of frequency of visit and egg-marking on reproductive parameters. *Colon Waterbirds* 1989;12:152-157.
5. Bowman TD, Thompson SP, Janik CA, Dubuc LJ. Nightlighting minimizes investigator disturbance in bird colonies. *Colon Waterbirds* 1994;17:78-82.
6. Simpson EH. Measurement of diversity. *Nature* 1949;153:688.
7. Hurlbert SH. The nonconcept of species diversity: a critique and alternative parameters. *Ecology* 1971;52:577-586.
8. Shepperd RS. White-faced ibises nest at Salt Plains National Wildlife Refuge, Oklahoma. *Bull Okla Ornithol Soc* 1996;29:1-2.
9. Koenen MK, Leslie DM Jr, Gregory M. Habitat changes and success of artificial nests on an alkaline flat. *Wilson Bull* 1996;108:292-301.
10. Feirer ST, Shepperd RS. First nesting record of the Tricolored Heron for Oklahoma. *Bull Okla Ornithol Soc* 1999;32:4-5.

Received: January 5,1999; Accepted: April 22,1999