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THE IMPORTANCE OF THE CARIBBEAN COASTAL WETLANDS OF NICARAGUA AND HONDURAS TO CENTRAL AMERICAN POPULATIONS OF WATERBIRDS AND JABIRU STORKS (*JABIRU MYCTERIA*)

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Abstract.—During the middle of the dry season (February–March), we performed low-altitude aerial strip-censuses to estimate densities of waterbirds in the Atlantic coastal wetlands of Nicaragua and Honduras (Miskito Coast and La Mosquitia, respectively), areas which are poorly known ornithologically. We found 12.9 and 5.5 waterbirds/km^2 in 294.6 and 281.5 km^2 surveyed in Nicaragua and Honduras, respectively. Great Egrets (*Ardea alba*) were most common and widespread, representing 53% (Nicaragua) and 46% (Honduras) of the sightings. Wood Storks (*Mycteria americana*) and *Egretta* herons were the next two most abundant groups. Breeding colonies of Wood Storks, Roseate Spoonbills (*Ajaia ajaja*), and Great Egrets were found in both areas, most nests containing eggs and small chicks. We document a previously unrecorded population of Jabiru Storks (*Jabiru mycteria*) breeding in both areas, with densities of 0.05 and 0.16 birds/km^2, respectively. The wetlands of both countries appear to support a large proportion of the breeding Jabirus in Central America and should be given high priority for conservation.

LA IMPORTANCIA DE LOS ANEGADOS COSTEROS DEL CARIBE DE NICARAGUA Y HONDURAS PARA LAS POBLACIONES DE CENTRO AMÉRICA DE AVES VADEADORAS Y PARA *JABIRU MYCTERIA*

Sinopsis.—Llevamos a cabo censos aéreos de banda a poca altitud para estimar las densidades de aves vadeadoras en los anegados de la costa del Atlántico de Nicaragua y de Hon-

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duras (Costa Miskito y La Mosquita, respectivamente), áreas poco conocidas ornitológicamente, a mediados de la temporada seca (febrero a marzo). Hallamos 12.9 y 5.5 aves vadeadoras/km^2 en los 294.6 km^2 y 281.5 Km^2 examinados respectivamente. Las aves más comunes y mejor distribuídas fueron *Ardea alba,* representando un 53% (Nicaragua) y un 46% (Honduras) de las observaciones. Las otras dos especies más abundantes fueron *Mycteria americana* y *Egretta thula.* Se hallaron colonias de nidos de *Mycteria americana, Ajaja ajaja* y *Egretta thula* en ambas áreas, la mayoría de los nidos con huevos y pichones. Documentamos una población previamente ignorada de *Jabiru mycteria,* con densidades de 0.05 aves/km^2 y 0.16 aves/km^2 reproduciéndose en ambas áreas. Las zonas anegadas de ambos países parecen sostener una gran proporción de los *Jabiru mycteria* anidando en la América Central, y se debería dar prioridad a su preservación.

The wetlands of the Atlantic coastal regions of Honduras (La Mosquitia) and Nicaragua (Miskito coast) are some of the most extensive in Central America, but remain poorly known ornithologically (Fig. 1). The coastal wetlands and some of the more common waterbirds are described briefly in the IWRB Directory of Neotropical Wetlands (Scott and Carbonnel 1986), and Camacho (1983) suggested the possible importance of the area for Jabiru Storks. Otherwise, the avifauna of the area is known in print from one early collection (Huber 1932), Monroe's (1968) survey of eastern Honduras, and Howell's (1971) study of eastern Nicaragua. The avifauna of the region may also be surmised from several reports from southeastern Nicaragua (Richmond 1893, Sclater and Salvin 1867, Sclater 1873, Will 1991), and Costa Rica (Stiles and Skutch 1989).

In this paper, we report on densities of large waterbirds in these wetlands during the dry season, as determined through low-altitude aerial surveys, and compare these densities to those obtained in studies of other New World tropical and subtropical wetlands. We found that these relatively unimpacted wetlands host high densities of ciconiiform birds and are of regional importance for Jabiru Storks. We believe this effort is the first quantitative survey of waterbirds in the La Mosquitia/Miskito Coast ecosystem.

METHODS

We performed low-altitude strip-censuses of waterbirds in the Atlantic coast wetlands of the Miskito Coast of Nicaragua (March 1992) and La Mosquitia in Honduras (February 1994). We counted birds systematically on both sides of a low-flying aircraft, using standard methodology for surveys of wildlife in open-country savannas (Bancroft and Sawicki 1995, Bjork and Powell 1994, Hoffman et al. 1990, Norton-Griffiths 1975). If the altitude is known, and observers on both sides of the aircraft restrict their counts to demarcated strips of ground on either side of the plane (outlined with marks on the windows and struts), then the area in which animals have been counted can be calculated (Norton-Griffiths 1975). Densities can then be extrapolated to total population counts if the habitat is uniform or if the counts can be stratified by habitat type. We chose not to do the latter, since adequate vegetation maps were not available to us.

Flying or standing birds were counted only if they occurred within these visually defined strips. Ground positions were obtained using a global po-

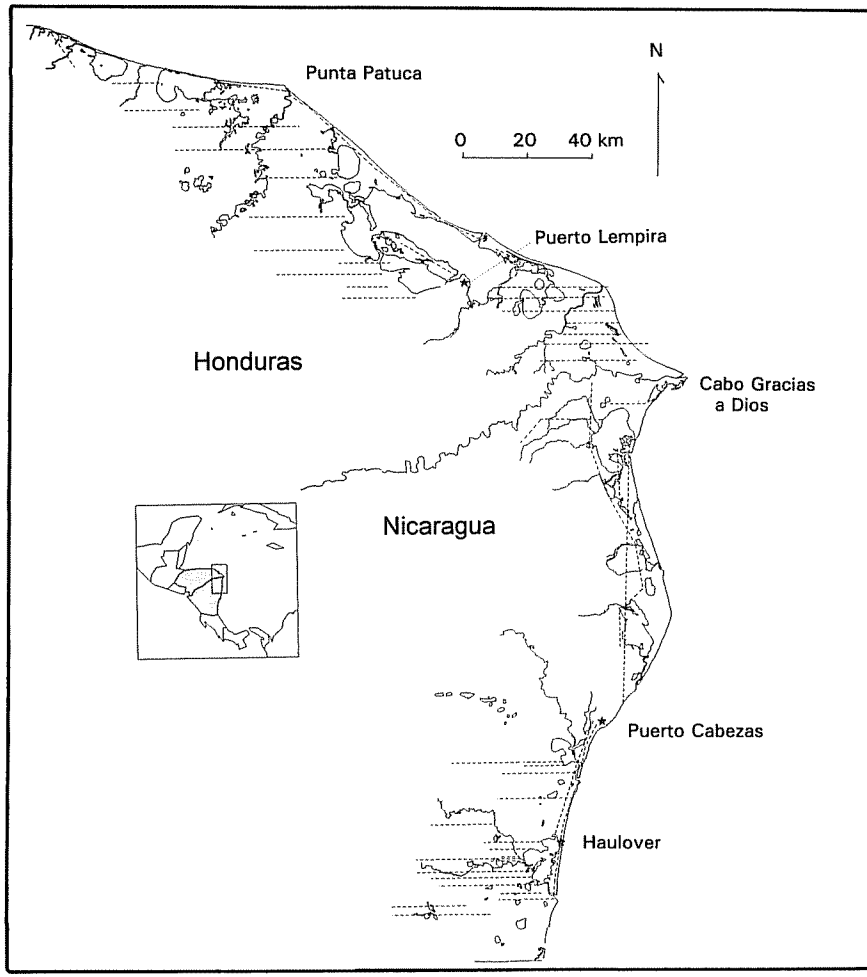

FIGURE 1. Map of coastal regions of northeastern Nicaragua and southeastern Honduras, showing large towns and locations of strip-transect aerial surveys (dashed lines).

sitioning system with an accuracy <100 m. Bird species and numbers were recorded onto paper forms by the observers, with positions called out upon demand by a third observer. All participants communicated by headset. Data were recorded separately for each straight-line transect (Fig. 1); length of each transect was calculated using the starting and ending positions of the transect.

We concentrated our surveys in areas of wetland that were not heavily forested and that had standing surface water. We did not attempt to count birds in the large open saline lagoons characteristic of the region, which are generally >1 m in depth. Our search for wetlands by definition was

biased towards sparse mangrove swamps and wet prairies, and tended to exclude hardwood forest, pine savannas, and gallery forest. While we feel our transects covered representative wetland types with surface water at the time of surveys, our study should not be construed as having sampled wetland habitat types in proportion to their availabilities. Transects were generally oriented east-west to make effects of sun glare equal on both sides of the plane. The only exception to this rule were wetlands occurring in thin strips immediately adjacent to beaches, where transects were conducted parallel to the long axis of wetlands.

Snowy Egrets (*Egretta thula*) and immature Little Blue Herons (*Egretta caerulea*) are both white-plumaged and difficult to distinguish at the altitudes we used. We therefore categorized both as "small white herons," (Bancroft and Sawicki 1995, Hoffman et al. 1990). Similarly, adult Little Blue Herons and Tricolored Herons (*Egretta tricolor*) are difficult to distinguish when viewed from above, and were both categorized as "small dark herons."

M.G.S. and P.C.F. were observers on survey flights in the Miskito Coast wetlands of Nicaragua between the Rio Coco and Wounta on 3, 4, 8, and 9 Mar. 1992. Survey flights were flown at 108 m altitude and 166 km/h groundspeed in a Cessna 206, counting birds in strips of approximately 271 m on either side of the plane.

P.C.F. and J.S.C. were observers on survey flights in Honduras between 15 and 19 Feb. 1994, between the Rio Coco on the south and Cabo Camaron in the north, in a centerline-thrust twin-engined Cessna 137 Skymaster at 61 m altitude and 166 km/h groundspeed. Transects totalled 697 km; using a calculated strip width of 206 m, we estimated that birds were counted within a total area of 282 km^2 in the Honduran wetlands.

RESULTS

Survey results.—We found 3786 waterbirds in the 295 km^2 surveyed in Nicaragua, and 1547 in the 282 km^2 surveyed in Honduras, yielding overall densities of 12.9 and 5.5 birds/km^2, respectively (Table 1). In both surveys, the most common species was the Great Egret, accounting for 53% of the total in Nicaragua, and 46% of the total in Honduras. In Nicaragua, Wood Storks were second in abundance (17% of birds seen), small dark herons comprised 10%, and small white herons 7%. In Honduras, small white herons (largely Snowy Egrets) comprised nearly 15% of the total. The numbers of small dark herons are likely to be under-estimated due to poor detectability of these dark birds. White Ibises (*Eudocimus albus*), a dominant species in southeastern United States and Venezuelan surveys, were rarely seen in Nicaragua and Honduras. Roseate Spoonbills were seen in small numbers during both surveys.

Densities in Nicaragua were almost twice those of Honduras. Our densities from the two countries were in the middle of the range of estimates for central Florida (2.3–164.0 birds/km^2, Frederick and McGehee 1994), and the central (6.6–106.89 birds/km^2, Bancroft and Sawicki 1995) and coastal (17.5–24 birds/km^2, Bjork and Powell 1993) Everglades. In all

TABLE 1. Summary of waterbird surveys in coastal Honduras and Nicaragua during the dry season.

Species	Honduras			Nicaragua		
	Number seen	Number per km^2	Proportion of total	Number seen	Number per km^2	Proportion of total
Anhinga anhinga	2	0.01	0.001	0	0	0
Anas discors	20	0.07	0	0	0	0
Cairina moschata	28	0.10	0.018	130	0.44	0.034
Dendrocygna spp.	275	0.98	0.178	69	0.23	0.018
Unidentified ducks	4	0.01	0.003	0	0	0
Small white herons	226	0.80	0.146	273	0.93	0.072
Ardea herodias	29	0.10	0.019	126	0.43	0.033
Ardea alba	712	2.53	0.460	2011	6.83	0.531
Small dark herons	62	0.22	0.040	372	1.26	0.098
Ajaia ajaja	24	0.09	0.016	47	0.16	0.012
Eudocimus albus	63	0.22	0.040	59	0.20	0.016
Jabiru mycteria	13	0.05	0.008	47	0.16	0.012
Mycteria americana	89	0.32	0.058	652	2.21	0.172
Total, all species	1547	5.50	1.00	3786	12.85	1.00

cases, these densities have been standardized for the amount of wetted marsh area surveyed (areas without standing surface water excluded).

Perhaps the most striking finding was the number of Jabiru Storks that we counted (47 in Nicaragua, 13 in Honduras), yielding estimated densities of 0.16 and 0.05/km^2, respectively. If Jabirus seen just outside the transects are included, we saw a total of 74 in 545 km of flying in Nicaragua, and 24 in 697 km of flying in Honduras. Jabirus were typically solitary and in pairs, though a single flock of four was seen.

Breeding activity.—Our surveys covered only a small fraction of the potential wetland nesting sites in each study area. In Honduras, we located two breeding aggregations of long-legged wading birds on islands within or on the edges of Laguna Kohunta and a very small lagoon northwest of Laguna Apalca. At the Laguna Kohunta colony we counted 165 Wood Stork nests with eggs or chicks, and 17–20 Roseate Spoonbill nests, probably with eggs. At the much larger Apalca Northwest colony, we counted 1520 Wood Stork nests with eggs or chicks, 155 Roseate Spoonbill nests, and approximately 150 Great Egret nests. Snowy Egrets may also have been nesting at this latter colony, but we were unable to confirm this without ground visits. Birds in these colonies appeared to be in incubation and early chick rearing activities, which would place dates of initiation in late December (Wood Storks) to mid-January (Roseate Spoonbills).

During the Nicaraguan surveys in 1992, we also found small colonies of Wood Storks (160 pairs) and Roseate Spoonbills (24 pairs). The Wood Stork nests contained small young and eggs, and the Roseate Spoonbills appeared to be incubating eggs. Timing of nesting for both these species in Honduras and Nicaragua appears quite similar to that observed in Texas, Florida, and the Yucatan (Allen 1942, Bjork and Powell 1994, Correa 1992, Lopez Ornat and Ramo 1992).

In Nicaragua, we found four Jabiru nests, two of which were inside our transects. Two additional Jabiru nests were found incidentally during 6 h of manatee survey flights, for a total of six nests found in the area. Of the six Jabiru nests we found, one had large young, three had medium sized young, one was apparently incubating, and one was standing on a complete nest platform with no eggs or young in the nest.

In Honduras, we found a total of four Jabiru Stork nests (three with chicks 1–2-mo old, one without eggs or chicks), two of which fell within our survey strips, and two of which were seen while in transit between survey transects and Puerto Lempira.

DISCUSSION

The density of waterbirds in Honduras was about half that estimated in Nicaragua (Table 1). This was true for all of the waterbird species individually, with exceptions only for whistling ducks (*Dendrocygna* spp.), Blue-winged Teal (*Anas discors*), White Ibises, and small white herons. Densities of Jabiru Storks in Honduras were less than 33% those in Nicaragua, those of Wood Storks less than 15%, and those of Muscovy Ducks (*Cairina moschata*) less than 25%.

Differences in densities were unlikely to have been due to differing methodologies, because the survey flights in both locations were performed at similar altitudes, using the same techniques for estimating strip widths, orienting flight transects, counting, recording, and analysis. One of the two observers in Honduras (PCF) was also an observer in the Nicaraguan surveys. The variety of habitat and water depths traversed, and wide geographical distribution of transects was quite similar in both survey efforts.

Nonetheless, it is not clear that the survey results in the two areas are due to inherently different carrying capacities of the two landscapes. The surveys were performed in different years with quite different weather patterns, and even at slightly different times of year (late February in Honduras, early March in Nicaragua). Interviews with residents in Nicaragua in 1992 suggested that weather and surface water conditions were normal for that time of year, with the low rainfall typical of the dry season. Similar interviews in Honduras in 1994 were just the opposite. Fishermen, local pilots, church workers, and other residents seemed to agree that the winter of 1994 had been abnormally wet, and that a typical dry season had not become established. Since waterbird densities in other large subtropical and tropical wetland regions in the Yucatan (Lopez Ornat and Ramo 1992), and the Everglades (Bancroft and Sawicki 1995, Hoffman et al. 1990) are usually much lower during wet conditions, it seems likely that weather pattern alone could explain the apparent differences between Nicaraguan and Honduran surveys.

We also saw more Blue-winged Teal in the Honduran surveys than were counted in Nicaragua. This is likely due to sampling error, because Blue-winged Teal are usually encountered in flocks and the total number seen in Honduras was relatively small (20 individuals). In Nicaragua, we in fact

did see several large flocks of teal in the lagoons, but did not count them because they did not fall within the survey strips.

This survey confirms the general species abundance pattern found in wetlands throughout Central America, with geographic and numeric dominance by Great Egrets and other herons, and much smaller numbers of Wood Storks, White Ibises, and other tactile feeders (Correa 1992, Frederick and Spalding 1992, Ogden et al. 1988). This pattern is distinct from that found in the wetlands of both the southeastern United States and the northeastern coast and interior wet plains of South America, where ibises tend to dominate the wading bird biomass (Bancroft and Sawicki 1995, Bildstein 1993, Kushlan and White 1977, Morales and Pacheco 1986, Spaans 1990).

This study confirms that Jabiru Storks breed in substantial numbers in the study area, *contra* Monroe (1968). Correa and Luthin (1988) found 0.06 Jabiru Storks/km^2 in the Usamacinta Delta wetlands of Mexico, about half the density found in Nicaragua, and nearly the same density as Honduras. Villareal (1996) found between 0.44 and 4.8 individuals/km^2 in Mata Redondo Lagoon in Costa Rica between January and April of 1993. Similarly, Brooks (1991, in Hancock et al. 1992) reported 4.38 individuals/km^2 in aggregations in the Chaco region of Paraguay. Gonzalez (1993) and Thomas (1985) found 0.028 and 2.0 nesting pairs/km^2, respectively, in the Venezuelan Llanos. The densities of adults we saw feeding on the marsh surface are suggestive of 0.03 and 0.08 pairs/km^2. Thus densities of nesting pairs in the La Mosquitia/Miskito Coast region may be similar to those in the Llanos of Venezuela.

Correa and Luthin (1988) suggested that the Jabiru Stork population of Central America may follow seasonal movements among Mexico, Belize, and Guatemala. The very high concentrations found by Ogden et al. (1988), Villareal (1996), and Correa and Luthin (1988) suggest that large seasonal influxes do occur in various parts of Central America. Hancock et al. (1992) estimated the entire Central American population of Jabirus to be no more than 250 individuals. The 98 individuals we saw in our incomplete surveys suggests that the Atlantic coast wetlands of Nicaragua and Honduras host a large portion of the Central American population.

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LITERATURE CITED

ALLEN, R. P. 1942. The Roseate Spoonbill. National Audubon Society, New York, New York.

BANCROFT, G. T., AND R. J. SAWICKI. 1995. The distribution and abundance of wading birds relative to hydrologic patterns in the Water Conservation Areas of the Everglades. Final report to the South Florida Water Management District. West Palm Beach, Florida.

BILDSTEIN, K. L. 1993. White Ibis, wetland wanderer. Smithsonian Institution Press, Washington, D.C.

BJORK, R. B., AND G. V. N. POWELL. 1994. Relationships between hydrological conditions and quality and quantity of foraging habitat for Roseate Spoonbills and other wading birds in the C-111 basin. Everglades National Park, Homestead, Florida.

CAMACHO, M. G. 1983. Notes on aquatic birds of Nicaragua, *Jabiru mycteria*. Inst. Nicarag. Rec. Nat. Ambient. 14 pp.

CORREA, J. 1992. Status of aquatic birds in the coastal wetlands of the Yucatan peninsula. M.Sc. thesis, University of Newcastle upon Tyne, England. 110 pp.

———, AND C. S. LUTHIN. 1988. Proposal for the conservation of the Jabiru Stork in Southeast Mexico. Pp. 607–615, *in* Memoria del Simposio sobre la Ecologia y Conservacion del Delta de los Rios Usamacinta y Grijalva. Instituto Nacional de Investigacion sobre Recursos Bioticos, Division Regional, Tabasco, Mexico.

GONZALEZ, J. A. 1993. Contribucion al estudio de la ecologia de las ciguenos (Fam. Ciconiidae) en los Llanos de Venezuela. PhD dissertation, Universidad Complutense de Madrid, Madrid, Spain.

FREDERICK, P. C., AND S. M. MCGEHEE. 1994. Wading bird use of wastewater wetlands in central Florida, USA. Colonial Waterbirds 17:50–59.

———, AND M. G. SPALDING. 1992. Factors affecting reproductive success of wading birds (Ciconiformes) in the Everglades ecosystem. Pp. 569–691, *in* S. Davis and J. C. Ogden, eds. Everglades: the Ecosystem and its Restoration. St. Lucie Press, Del Ray Beach, Florida.

HANCOCK, J. A., J. A. KUSHLAN, AND M. P. KAHL. 1992. Storks, Ibises, and Spoonbills of the World. Academic Press, San Diego, California.

HOFFMAN, W., G. T. BANCROFT, AND R. J. SAWICKI. 1990. Wading bird populations and distributions in the Water Conservation Areas of the Everglades: 1985–1988. South Florida Water Management District, West Palm Beach, Florida.

HOWELL, T. R. 1971. An ecological study of the birds of the lowland pine savanna and adjacent rain forest in northeastern Nicaragua. Living Bird 10:185–242.

HUBER, W. 1932. Birds collected in northeastern Nicaragua in 1922. Proc. Acad. Nat. Science of Philadelphia 84:205–249.

JELKS, H. 1991. The distribution of foraging wading birds in relation to the physical and biological characteristics of freshwater wetlands in southwestern Florida. M.Sc. thesis, University of Florida, Gainesville, Florida.

KUSHLAN, J. A., AND D. A. WHITE. 1977. Nesting wading bird populations in southern Florida. Fla. Sci. 40:65–72.

LOPEZ ORNAT A., AND C. RAMO. 1992. Colonial waterbird populations in the Sian Ka'an biosphere reserve (Quintana Roo, Mexico). Wilson Bulletin 104:501–515.

MONROE, B. L., JR. 1968. A distributional survey of the birds of Honduras. Ornithological Monographs No. 7, American Ornithologists Union, Washington, D.C.

MORALES, G., AND J. PACHECO. 1986. Effects of diking of a Venezuelan savanna on avian habitat, species diversity, energy flow, and mineral flow through wading birds. Colonial Waterbirds 9:236–242.

NORTON-GRIFFITHS, M. 1975. Counting animals. Handbook no. 1. Nairobi, Kenya: African Wildlife Leadership Foundation.

OGDEN, J. C., C. E. KNODER, AND A. SPRUNT JR. 1988. Colonial waterbird populations in the Usamacinta delta, Mexico. Pp. 565–605, *in* Ecologia de los Rios Usamacinta y Grijalva. Instituto Nacional de los Investigaciones sobre Recursos Bioticos, Tabasco, Mexico.

RICHMOND, C. W. 1893. Notes on a collection from eastern Nicaragua and the Rio Frio, Costa Rica, with a description of a supposed new Trogon. Proc. Nat. Mus. 16:479–532.

SCLATER, P. L. 1873. Additions to the list of birds of Nicaragua. Ibis 3:372–373.

———, AND O. SALVIN. 1867. List of birds collected from Blewfields River, Mosquito Coast. Proc. Zool. Soc. Lond., 278–280.

SCOTT, D. A., AND M. CARBONELL. 1986. A directory of neotropical wetlands. International Waterfowl Research Bureau, Slimbridge, United Kingdom.

SPAANS, A. L. 1990. Problems in assessing trends in breeding populations of Scarlet Ibises and other ciconiiform birds. Pp. 1–6, *in* P. C. Frederick, L. G. Morales, A. L. Spaans, and C. S. Luthin, eds. The Scarlet Ibis: Status, conservation and recent research. International Waterfowl and Wetlands Research Bureau Special Publication #11, Slimbridge, United Kingdom.

STILES, F. G., AND A. F. SKUTCH. 1989. A guide to the birds of Costa Rica. Cornell University Press, Ithaca, New York.

THOMAS, B. T. 1985. Coexistence and behavior differences amont the three western hemisphere storks. Pp. 921–931, *in* P. A. Buckley, M. S. Foster, E. S. Morton, R. S. Ridgley, and F. G. Buckley, eds. Neotropical Ornithology, Ornithological Monograph No. 36, American Ornithologists' Union, Washington, D.C.

VILLAREAL, J. 1996. Estado actual, ecologia trofica y uso de habitat del Jabiru (*Jabiru mycteria*) en tres humedales de la cuenca baja del Tempisque, Costa Rica. MS thesis, Universidad Nacional, Heredia, Costa Rica.

WILL, T. 1991. Birds of a severely hurricane-damaged Atlantic coast rain forest in Nicaragua. Biotropica 23:497–507.

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