



# Wood Stork Report

*A newsletter dedicated to sharing information about the wood stork*



Volume 2, Number 1 March 2003

## The Wood Stork Report

As with most endangered and threatened species, the wood stork has a network of people who have mutual goals, mandates, and inherent missions to promote and monitor this endangered species' recovery. This web-based newsletter is an effort to recognize the dedication of these people and their organizations' efforts in wood stork recovery. This newsletter also serves as a location to exchange information on wood stork recovery, research, monitoring, and management. It is our goal to publish this newsletter annually following the Wood Stork Research and Monitoring Working Group annual meeting. Email contact information for our recovery partners is noted in the newsletter. To submit an article or other information regarding wood stork recovery, please email [billy\\_brooks@fws.gov](mailto:billy_brooks@fws.gov).

## Federal Classification Of Wood Storks

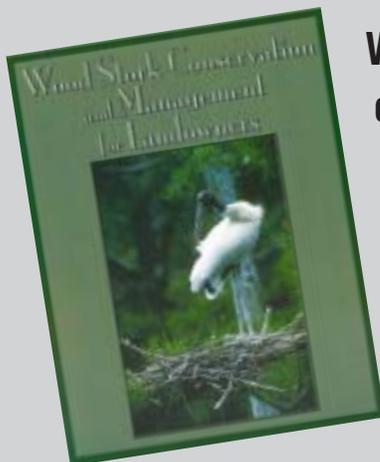
On February 28, 1984, the USFWS listed the United States breeding population of the wood stork (in Florida, Georgia, South Carolina, and Alabama) as endangered under the Endangered Species Act of 1973, as amended (ESA). A recovery plan for this species was approved in 1986 and was revised in 1997.

The ESA defines an "endangered species" as "any species which is in danger of extinction throughout all or a significant portion of its range." A "threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." A species can be listed or delisted if the Secretary of the Interior determines that the species no longer meets the endangered or threatened status based upon these five factors listed in Section 4(a)(1) of the ESA:

- (1) the present or threatened destruction, modification, or curtailment of its habitat or range;
- (2) overutilization for commercial, recreational, scientific, or educational purposes;
- (3) disease or predation;
- (4) the inadequacy of existing regulatory mechanisms; and
- (5) other natural or manmade factors affecting its continued existence.

## Recovery Partners

- US Fish and Wildlife Service (USFWS)
- Florida Fish and Wildlife Conservation Commission (FWC)
- Georgia Department of Natural Resources (GDNR)
- South Carolina Department of Natural Resources (SCDNR)
- Savannah River Ecology Laboratory (SREL)
- University of Florida (UF)
- Everglades National Park
- Big Cypress Preserve
- Palm Beach County Solid Waste Authority (SWA)
- Florida Department of Environmental Protection (FDEP) State Parks and Preserves-Pumpkin Hill Preserve and Faver Dykes State Park
- US Geological Survey (USGS)-National Wetlands Research Center
- US Department of Agriculture (USDA)-National Wildlife Research Center
- South Florida Water Management District (SFWMD)
- Southwest Florida Water Management District (SWFWMD)
- St. Johns River Water Management District (SJRWMD)
- Florida Power and Light (FPL)
- Jacksonville Zoological Gardens
- Audubon of Florida Coastal Islands Sanctuaries
- Audubon of Florida Corkscrew Swamp Sanctuary
- Audubon of Florida Duval/St. Johns/Martin County Chapters
- Avian Research and Conservation Institute (ARCI)
- Disney Animal Kingdom



## Wood Stork Private Lands Brochure Available

Through a contract with the SREL, Larry Bryan assisted the USFWS by developing a 12-page color brochure that addresses wood stork conservation and management for private landowners. To receive copies of this brochure, email your request to [billy\\_brooks@fws.gov](mailto:billy_brooks@fws.gov)

## Wood Stork Recovery Plan Available

To receive a copy of the wood stork recovery plan, email your request to [billy\\_brooks@fws.gov](mailto:billy_brooks@fws.gov).

## Wood Stork Research And Monitoring Working Group

The annual meeting of the Research and Monitoring Working Group was held at the Palm Beach County Solid Waste Authority Education Center in West Palm Beach on September 4-5, 2002. It was very well attended, and much of the information presented at the meeting is found within this newsletter. The USFWS is very appreciative of the efforts that

were made to attend the meeting and to share information regarding wood stork recovery. Many thanks to Mary Beth Mihalik, David Broten, and Todd Sandt of the Palm Beach County Solid Waste Authority for hosting the meeting at their facilities, giving us a tour of their wading bird nesting colony site, and for providing the coffee breaks.

## Synoptic Aerial Surveys

The USFWS acknowledges the limitations involved in relying on aerial surveys for developing population estimates. However, storks are a long-lived species that demonstrate considerable variation in population numbers in response to changing hydrological conditions. Over the long term, aerial surveys are the most cost-effective method for estimating population trends. Ground surveys, while providing greater individual colony accuracy, are more time-consuming and expensive on a region-wide basis. Replication of surveys and ground counts at selected index colonies will help to minimize variability and will also provide information regarding the second component of the recovery criteria, productivity (chicks per nest).

A series of aerial surveys to locate all wood stork nesting colonies was first initiated in 1957. This effort was re-initiated in 1975 by the Audubon Society and other partners. These surveys were flown by **John Ogden** ([jogden@sfwmd.gov](mailto:jogden@sfwmd.gov)) and others (see table, page 3). In 1991, the USFWS reinitiated this effort to monitor the nesting pair aspect of the wood stork recovery criteria, and partnered with the SCDNR, GDNR, The Audubon

Society, and FWC to fly surveys from 1991 to 1995 (see table, page 3). There was a synoptic aerial survey flown in 1999 when the FWC conducted surveys to update the "Florida Atlas of Breeding Sites for Herons and Their Allies." Based upon this survey and GDNR and SCDNR surveys from 1999, there were an estimated 7,495 wood stork nests in the southeastern U.S. In 2001, the USFWS reinitiated another 5-year synoptic aerial survey effort (see table, page 3). Based upon the 2002 surveys and information from monitoring individual colonies, it is estimated that there were a minimum of 8,995 nest starts by wood storks at 61 active colonies in FL, GA, and SC.

**Wood Stork Report** is published regularly to provide a forum for sharing information about the endangered wood stork. The newsletter is distributed free to anyone interested in obtaining a copy. Comments, suggestions, and article submissions should be directed to the editor. The editor and the U.S. Fish and Wildlife Service assume no responsibility for information contained herein, or for injury or damage resulting from use of such information. Information herein will be used at the reader's own discretion and risk. Views and opinions expressed herein are those of the author or source of material and do not necessarily reflect the opinions, views, or endorsements of the U.S. Fish and Wildlife Service.

## Measuring The Biological Recovery Of Wood Storks

Measuring the biological aspect of the recovery of the wood stork is outlined in the USFWS 1997 recovery plan. The plan's recovery criteria state that reclassification from endangered to threatened could be considered when there are 6,000 nesting pairs and annual regional productivity is greater than 1.5 chicks per nest/year (calculated over a 3-year average). Delisting could be considered when there are 10,000 nesting pairs calculated over a 5-year period beginning at the time of reclassification and annual regional productivity is greater than 1.5 chicks per nest/year (calculated over a 5-year average). As a subset of the 10,000 nesting pairs, a minimum of 2,500 nesting pairs must occur in the Everglades and Big Cypress systems in south Florida. The number of nesting pairs is ascertained through aerial surveys supported and flown by the USFWS, SCDNR, GDNR and FWC. The Productivity Monitoring Initiative has begun with the drafting of a scientific protocol (presented on page 9 of this newsletter) and the initiation of data collection at several regional index colonies. We hope that the number of colonies that will be monitored will increase as we develop additional partnerships.

### Wood Stork Report

Editor: Billy Brooks

Layout and Design: Dawn Zattau

### Submit articles and photographs to:

Billy Brooks

U.S. Fish and Wildlife Service  
6620 Southpoint Dr. S., Ste. 310  
Jacksonville, Florida 32216  
904-232-2580, ext. 104

Fax: 904-232-2404

E-mail: [billy\\_brooks@fws.gov](mailto:billy_brooks@fws.gov)

### Website:

<http://northflorida.fws.gov>

# Across The Southeast...

## SOUTH CAROLINA

Annual surveys have been conducted in SC since the first successful stork nesting was documented with 11 nests in 1981. This extensive database is important in quantifying the rate of recruitment to the state and to determining the status of wood stork recovery in the southeast U.S. **Tom Murphy** ([murphyt@scdnr.state.sc.us](mailto:murphyt@scdnr.state.sc.us)) with **SCDNR Division of Wildlife** reports that an early aerial survey documented 1,136 nest starts at 10 colony locations in 2002. Continuing drought conditions resulted in two colony sites that were active in 2001 not being used in 2002 because the sites were dry. In addition, three of the ten sites active in 2002 dried and were abandoned during the nesting season, resulting in no chick production from 248 nesting attempts. For the eight colonies surveyed for productivity (including the three that failed), estimated productivity was 1.80 chicks per nest, a value above the 1.5 chicks per nest outlined in the recovery criteria. However, productivity would be much lower if the nest numbers from the early aerial surveys are used as the total

nesting effort for the state. The last two active colonies had a total of 62 nests which were successful (aerial observations) but were not ground-surveyed because access to the colony was denied. Land managers have played a critical role in maintaining water levels in colony sites during the extended drought in SC, as most colony sites are in manmade ponds. For information regarding specific wood stork colonies in SC, you should contact Tom Murphy directly.

## GEORGIA

**Brad Winn** ([brad.winn@gadnr.state.ga.us](mailto:brad.winn@gadnr.state.ga.us)) of the **GDNR Non-Game Endangered Wildlife Program** reports that GA remains under drought conditions. There were 13 active colonies in GA during the 2002 breeding season with an estimated 1,227 nesting pairs of wood storks. The



Harris Neck National Wildlife Refuge

GDNR also has a long-term database on nesting pairs of wood storks in GA which dates back to 1980 and is extremely valuable in monitoring wood stork recovery. The GDNR plans to investigate and evaluate estimating productivity with aerial photography. A pilot study estimated 1.8 (+/- .61) chicks per nest (n=66) from two southwest GA colonies.

**John Robinette** of the **USFWS Harris Neck National Wildlife Refuge** ([john\\_robinette@fws.gov](mailto:john_robinette@fws.gov)), reports that there were 337 successful nests at this colony in 2002. He also intensively monitored 57 individual nests (every 3-7 days) from a twenty-four-foot-high observation tower located outside the colony. From these observations he estimated that 1.37 chicks fledged per nest start and 1.95 per successful nest. John noted that GA continues under serious drought conditions and that the record nesting effort at the Harris Neck NWR colony is due to the refuge staff's ability to keep water in the impounded pond (many of the traditional nesting sites located nearby were dry). A significant storm event in mid-May (3.4 inches of rain and temperatures dropped to 46°F) had a major impact on chick survival. Prior to the storm, the 57 nests that

Total Wood Stork Nests and Colonies from aerial synoptic survey data of SC, GA, FL.										
Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Total Nests	5110	5275	2520	4984	4827	4146	3990	6075	6040	5215
#of Colonies	17	24	16	23	23	23	22	26	29	26
Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total Nests	5835					4073		6729	5523	7853
#of Colonies	36					37		43	47	56
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total Nests				7427*		5131	8985*			
#of Colonies				61		44	56			

(\* ) These numbers reflect the lower number of a range of nesting pair estimates from aerial surveys. It should also be noted that many of the wood stork colonies, such as the Everglades and Corkscrew Swamp in FL, Birdsville in GA and many of the colonies in SC, have been continuously monitored since the early 1980s or even earlier.

## Across The Southeast...

...Continued from Page 3

were being monitored had an average of 2.42 chicks per nest and post-storm it was 1.5. John estimated that 38% of the chicks were lost, and 26% of the monitored nests were lost. Based upon the intensive monitoring effort John was able to estimate that the average age of the chicks that died were 25 days old and that 80% of the total chick mortality was of chicks between 19 and 26 days old.

**Larry Bryan** ([bryan@srel.edu](mailto:bryan@srel.edu)) of the **SREL** reports that the Birdsville Colony site was dry and thus no nesting activity occurred in 2002. The Chew Mill Pond Colony had an estimated 170 nests; however there was considerable nest failure. Over 40% of 72 observation nests produced no young to fledging age. An average of 1.15 (+1.06 SD) chicks fledged from the 72 observation nests. This low productivity was presumably the result of GA's extensive drought and the resultant reduction in the storks' wetland foraging habitat.

For information regarding other wood stork colonies in GA, you should contact **Brad Winn** of the **GDNR** at: [brad.winn@gadnr.state.ga.us](mailto:brad.winn@gadnr.state.ga.us).

### FLORIDA

**Billy Brooks** ([billy\\_brooks@fws.gov](mailto:billy_brooks@fws.gov)) of the **USFWS Endangered Species Recovery Program**, contracted with **Ken Meyer** ([meyer@arcinst.org](mailto:meyer@arcinst.org)) of **ARCI** to fly most of Florida's wood stork colonies known to be active during the past decade. The Everglades National Park, Everglades Water Conservation Areas 2 and 3, Big Cypress Preserve and Corkscrew Sanctuary were not covered under this contract,

because they are monitored by others (results are described later in this newsletter). From mid-April through May 2002, **ARCI** conducted 9 survey flights and flew 65 locations and documented that 2002 was a very active year for wood stork nesting. These totals combined with data compiled by others from south FL colonies show that there were a total of 47 active colonies in FL, with an estimated range of 6,622-7,732 nest starts during 2002. Additional information regarding many of the FL colonies can be found below.



Jacksonville Zoological Gardens' wood stork colony

### North and Central Florida Colonies

**Donna Bear-Hull** ([donna.bear-hull@jaxzoo.com](mailto:donna.bear-hull@jaxzoo.com)), from the **Jacksonville Zoological Gardens** reports that this 4<sup>th</sup> year colony has doubled in size again. There were 40 nesting pairs of wood storks at the Jacksonville Zoo colony which successfully fledged approximately 111 chicks in 2002. In a partnership with the USFWS and the local Duval Audubon Chapter, this colony will be monitored in 2003 as part of the Productivity Monitoring Initiative.

**Amanda Whitiker**, the bird and mammal curator at the **St. Augustine Alligator Farm Zoological Park**, reports that again more than a half dozen pairs of wood storks attempted to nest at the

Alligator Farm's multi-species wading bird colony. Several of the pairs abandoned the site, but at least one pair successfully fledged chicks.

**Paul Elliot** ([paul.elliott@swfwmd.state.fl.us](mailto:paul.elliott@swfwmd.state.fl.us)) of the **SWFWMD** reports that wood storks did not nest in 2002 at the Green Swamp Colony in Pasco County.

**Rich and Ann Paul** ([rpaul@audubon.org](mailto:rpaul@audubon.org) and [apaul@audubon.org](mailto:apaul@audubon.org)) of **Audubon of Florida's Florida Coastal Islands Sanctuaries Program** have been monitoring several wading bird colonies around the Tampa Bay region and documented 150 breeding pairs at the

Cypress Creek Colony with a 2.32 average brood size. Eleven pairs with a 1.73 average brood size were reported at the East Lake Colony in Hillsborough County. The Alafia Corridor Colony initiated but abandoned. There were 240 breeding pairs with a 2.47 average brood size at the Dot Dash Dit Colony in the Braden River in Manatee County. There were 42 pairs with a 2.14 average brood size at the Blackburn Bay Colony in Sarasota

County. They also documented 6 wood stork nests at the Weeki Wachi River in Hernando County, 27 nesting pairs with a 1.70 average brood size at the Greenbrooke Colony, and 39 pairs at the Seven Springs Colony in Pasco County.

Refuge Biologist **Mark Graham** ([mark\\_graham@fws.gov](mailto:mark_graham@fws.gov)) of the **USFWS Pelican Island National Wildlife Refuge** reports that 176 nesting pairs of wood storks nested at the Pelican Island colony during the 2002 breeding season and successfully fledged an estimated 238 chicks.

Continued on Page 5...

# Across The Southeast...

...Continued from Page 4

For information regarding other wood stork colonies in North and Central FL, you should contact **Jim Rodgers** of the **FWC** at [jim.rodgers@fwc.state.fl.us](mailto:jim.rodgers@fwc.state.fl.us) or **Billy Brooks** of the **USFWS** at [billy\\_brooks@fws.gov](mailto:billy_brooks@fws.gov). As part of the Productivity Monitoring Initiative, the USFWS has contracted with Jim Rodgers to monitor several North and Central FL colonies over the next several years.

## South Florida Colonies

The South Florida Wading Bird Report, which is edited by

### Dale E. Gawlik

([dale.gawlik@sfwmd.gov](mailto:dale.gawlik@sfwmd.gov)) of the **SFWMD**, is a great resource regarding wading bird ecology in south FL. The 2002 Report ([http://glacier.sfwmd.gov/org/wrp/wrp\\_evg/projects/wading01/SFWadingBirdReport02.pdf](http://glacier.sfwmd.gov/org/wrp/wrp_evg/projects/wading01/SFWadingBirdReport02.pdf)) is the seventh compilation of this report with the first being published in 1997. These earlier reports can be found at the same website. The following reports on wood stork colonies in south FL are excerpts from the November 2002 South Florida Wading Bird Report, ed. D.E. Gawlik.

**Jason Lauritson** of **Audubon's Corkscrew Swamp Sanctuary** ([jlauritsen@audubon.org](mailto:jlauritsen@audubon.org)) reports that wood storks did nest in large numbers at the Corkscrew Swamp Colony during the 2002. Aerial surveys were conducted in a fixed wing aircraft with complete coverage of the area. Slide photos were taken of the entire colony on each survey date from approximately 1800 feet, circling the colony until full slide coverage was attained. Visual estimations were made counting each nest when the colony size was small, and estimating as the colony approached its maximum density. Photos of each sub-colony were taken from 300-500

feet during a single pass to assist in productivity estimates and stage of development. Eighteen flights occurred between November 21, 2001 and June 7, 2002 (54 person-hours). Photos of each aerial survey were projected on a grid, and individual nests were then counted. Once the flights revealed that fledging was occurring (April 23) productivity was determined from the previous flight date (April 17). Chicks from a subset of 156 nests (all nests clearly visible from photos taken at 300 ft) were counted. This number was used to determine colony productivity. The wood stork colony nesting at Corkscrew Swamp Sanctuary



Photo from *The South Florida Wading Bird Report*

produced an estimated 3,160 chicks from 1,240 nests. Nest productivity averaged 2.55 chicks per nest. The first nests were occupied the week of December 12, 2001. Heavy rainfall caused these early nesters to abandon and re-nest. Wood storks began leaving the nests around April 23. Nearly all nests had fledged by June 7.

**Deborah Jansen** of the **Big Cypress National Preserve** ([deborah\\_jansen@nps.org](mailto:deborah_jansen@nps.org)) reports that they assessed wading bird nesting activity using 2 methods in 2002: random observations during wildlife-associated aerial fixed-wing and helicopter flights, and aerial helicopter surveys of a sample of previous years' colonies. The fixed-wing flights averaged 10 hours per week and occurred throughout the year,

whereas, the helicopter surveys occurred on February 5, March 12, April 11, and April 26. Total flight time was approximately 6 hrs. One ground check of the only known wood stork colony occurred on April 25. Twenty of 53 sites previously documented with wood stork and/or great egret nests were sampled at least once in 2002. One wood stork and 4 great egret colonies were documented. The stork colony had an estimated 25 nests, and the great egret colonies ranged from 12 to 80 nests. All colonies were within the Preserve boundaries with the exception of a great egret colony approximately 1 mile north of the

Preserve on private land in the Okaloacoochee Slough. Staff have developed a proposal to conduct systematic nesting surveys of the Big Cypress National Preserve and are looking to the USFWS and others for potential funding.

**Peter Frederick** from the **UF's Department of Wildlife Ecology and Conservation** ([pcf@mail.ifas.ufl.edu](mailto:pcf@mail.ifas.ufl.edu)) monitors wading bird colonies in Water Conservation Areas 2 and 3, and at the Loxahatchee National Wildlife

Refuge. He reports that there were wood storks in 550 nests at the Jetport colony and 76 at the Crossover colony. Also see Becky Hylton and Peter Frederick's report "Nesting Success and Productivity of South Florida Wood Storks in 2002," on page 12 of this newsletter for a productivity summary from the Jetport and Crossover colonies. This was the first year in many in which wood storks at the Crossover site were largely successful.

**Patrick Lynch** ([plynch@sfwmd.gov](mailto:plynch@sfwmd.gov)) of the **SFWMD** reports that the North Fork St. Lucie River Colony is situated

Continued on Page 6...

# Across The Southeast...

...Continued from Page 4

near the boundary of the St. Lucie River State Buffer Preserve. It has been active since at least 1998, although it was only surveyed formally in 2000. This year, casual observations were made from a kayak during a recreational outing. The colony was observed at the time young wood storks were hatching. There were 50 wood storks on nests, 5 great egrets, several anhingas with young, and numerous cattle egrets.

**Mary Beth Mihalik** of the **Solid Waste Authority of Palm Beach County** ([mmihalik@swa-pbc.org](mailto:mmihalik@swa-pbc.org)) reports a 20% decrease of wood stork nests from the previous year. From February through July 2002, Breeding Bird Censuses (BBCs) were conducted in the SWA roost by two observers every 8 weeks, representing approximately 12 man-hours. During the BBC, all islands from three abandoned shell pits were systematically surveyed from a small boat, and the identified bird species and nest numbers were recorded. Surveys were conducted during the morning hours so as to minimize any burden caused by the presence of observers.

The SWA roost is located on spoil islands in abandoned shell pits that were mined in the early 1960s in Palm Beach County, FL (Lat. 26°46'41"N; Long. 80°08'32"W NAD27). The spoil islands consist of overburden material and range from 5 to 367 m in length, with an average width of 5 m. Islands are separated by 5-6.5 m with vegetation touching among close islands. The borrow pits are flooded with fresh water to a depth of 3 m. Dominant vegetation is Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casurina spp.*), and melaleuca (*Melaleuca quinquenervia*), all non-native species. Local features influencing the roost include: (1) the North County Resource Recovery Facility and landfill; and (2) the City of West Palm Beach's Loxahatchee Watershed Preserve

(=Water Catchment Area), a 44 km<sup>2</sup> remnant of the Loxahatchee Slough.

This report presents preliminary data for the 2002 breeding season. Typically nesting activities have been observed at this colony through September, and these surveys being reported are only through the end of July. Nest surveys were conducted on February 20, April 3, May 17, and July 12, 2002. Only the peak nest numbers are being reported for each of the bird species.

The estimated peak number of wading bird nests for the SWA colony is 2,851 which represents a 14.8% increase from the 2001 season. The number of white ibis, great egret, tricolor heron, little blue heron, and anhinga nests are higher during this year than the 2001 season. Cattle egret, wood stork, snowy egret, and great blue heron nest numbers appeared to be less than observed in 2001. There is a 20% decrease of wood stork nests from last year. However, from personal observation (no data) it seems that the number of wood stork young per nest has increased, averaging 3-4 fledglings per nest.

The colony will be monitored again during the 2003 breeding season as part of the Productivity Monitoring Initiative to look at wood stork recovery.

**Lori Oberhofer** ([lori.oberhofer@nps.gov](mailto:lori.oberhofer@nps.gov)) and **Sonny Bass** ([sonny.bass@nps.gov](mailto:sonny.bass@nps.gov)) from the **Everglades National Park** report that staff flew several colony surveys during the 2002 nesting season. They report that nesting began in January and increased through April. The numbers of wading birds nesting in ENP was a slight increase over the all time low in 2001. Species nesting in the highest numbers were the great egret with 1,045 nests and the wood stork with 835 nests. Wood storks nested in four colonies with the largest colony, Tamiami West, containing 450 nests. Wood storks again nested at the traditional Cuthbert Lake colony (60 nests). The Paurotis Pond colony (200 nests) and the Rodgers

River colony (125 nests) also appeared to have successfully fledged young. Cuthbert Lake initiated nesting much later than the other colonies with incubation still being observed in April and others with only very small young. The Paurotis Pond, Rodgers River Bay, and Tamiami West colonies were observed with large fledglings that were seen flapping on branches in May and June. (Also see Becky Hylton and Peter Frederick's report "Nesting Success and Productivity of South Florida Wood Storks in 2002," on page 12 of this newsletter for a productivity monitoring at the Tamiami West colony.) Wood storks had generally high nest success at Tamiami West, where they saw over 92% of their marked nests survive between hatching and fledging. In addition, it looks as though many of the young birds were successful in fledging and dispersing from south FL, see Becky Hylton and Peter Frederick's "Survival and Movements of Juvenile Wood Storks From South Florida" study on page 13 of this newsletter.



Copyright Wayne Lasch

# Mississippi/Louisiana Wood Stork Tracking Project

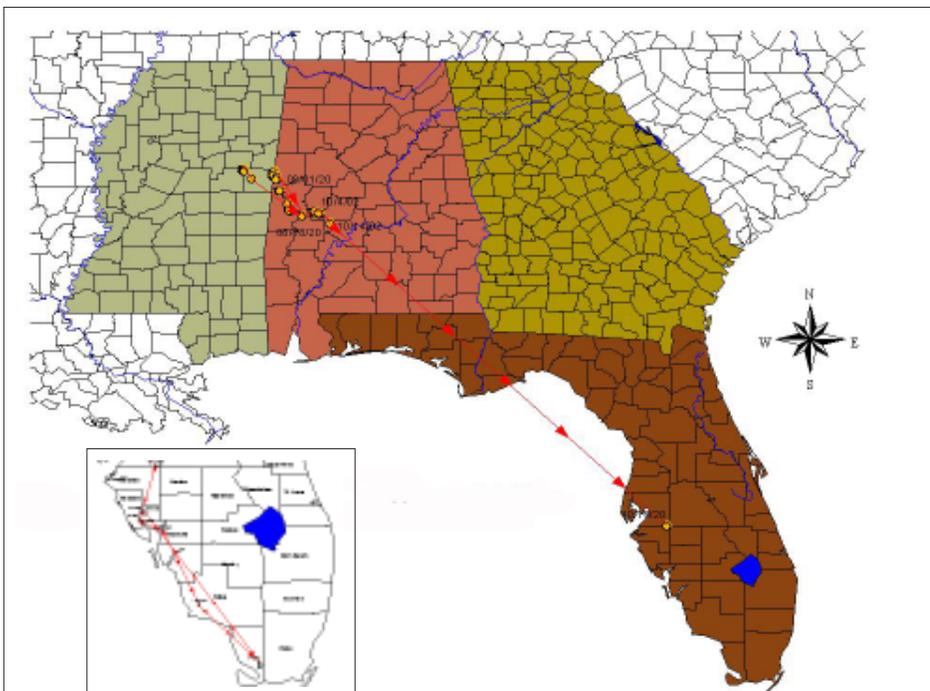
Larry Bryan, SREL ([bryan@srel.edu](mailto:bryan@srel.edu))

In the summer of 2002, there was an increased interest in determining the origins of wood storks observed in MS and other Gulf Coast states due to increased visitation of aquaculture facilities in those states by this species. At present, it is not known if these birds originate from the endangered population in the southeastern U.S., or come from populations dispersing out of Mexico. There is also the possibility that the two populations are mixing in the Gulf states.

In an initial effort by SREL, USFWS, and USDA-National Wildlife Research Center to determine regions of origin, seven wood storks were captured by rocket nets and padded leg-hold traps in MS during late summer of 2002. The first stork, captured at the Noxubee National Wildlife Refuge (NWR) in northeastern MS, was tagged with a satellite transmitter prior to its release. This stork remained on the refuge for several days and then headed east into AL. It remained in AL for several

weeks, weathering two tropical storms, before it traveled to FL. By late October, it was residing just north of Fort Myers, FL and since November has been utilizing the south Everglades area. The remaining 6 storks were captured at the Noxubee NWR and St. Catherine's NWR. All captured storks had blood samples removed for genetic comparison to samples from southeastern U.S. and Brazilian populations. Feathers also were collected to determine if the stable isotope signatures of the storks captured in MS differ from the signatures of the southeast U.S. breeding population. All released storks were banded with USGS aluminum bands over a light blue band with black numbers on the right leg and a tall plain yellow band on the left leg.

SREL, USFWS, and USDA and USGS-National Wetlands Research Center-Layfayette plan to deploy 10 satellite transmitters in MS, LA, and possibly TX or AR in the summer of 2003.



Stork location of banded bird from Noxubee National Wildlife Refuge from June until October 19, 2002. Inset shows recent movements.

## Wood Storks At Noxubee NWR

Dave Richardson, USFWS  
([dave\\_richardson@fws.gov](mailto:dave_richardson@fws.gov))

Noxubee National Wildlife Refuge is located in east-central MS. The refuge is largely forested with the exception of 2 man-made lakes (600 and 1200 acres) in addition to 200 acres of moist-soil units managed for wintering waterfowl. In the mid-1960s the first reports of wood storks on the refuge were recorded. This coincided with the shallow flooding of the newly-constructed Loakfoma Lake. Other shallow water systems were virtually absent in the eastern portion of the state. However, stork numbers have progressively increased through the years at the refuge with as many as 475 storks being seen during June through early September. The storks on the refuge are a mix of both juvenile birds (hatch-year), sub-adult and adults. The number of storks seen during any given year is primarily dependent on whether the water levels in Loakfoma Lake and/or Bluff Lake is lowered. This tends to congregate the storks for 1-2 months.

The original federal listing of the wood stork as endangered did not include storks in MS which were believed to be birds from Mexico. However, there is some evidence that at least storks in the eastern portion of the state are part of the protected eastern population. Anecdotal data include: (1) a record of a stork that John Ogden color-tagged as a nestling in the Lane River Rookery in Everglades National Park was later sighted at Noxubee NWR; (2) a report of wood storks banded from the Georgia Colony Banding Project (see related story on page 8); (3) a documented nesting attempt in MS in 1997; (4) a wood stork captured at Noxubee NWR and released with a satellite transmitter backpack returned to south FL; and (5) satellite-transmitted fledgling wood storks from a south FL nesting colony migrated up into AL and into MS, which included a stop at Noxubee NWR.

Continued on Page 8...

## Aquaculture And Wood Storks In Mississippi

Catfish aquaculture has expanded rapidly across the southeastern U.S. over the past 3 decades and now exceeds 240,000 acres of water surface area. Historically, wood storks have not been a perceived threat to aquaculture production, though little is known regarding their use of these commercial facilities. As wood stork populations in the southeast have increased in response to recovery efforts and catfish prices have decreased, producers and scientists are interested in the activities of wood storks observed on catfish facilities during post-breeding dispersal. **Jimmy Taylor** (*Jimmy.D.Taylor@aphis.usda.gov*), a research wildlife biologist at the **USDA National Wildlife Research Centers Mississippi Field Station**, is currently conducting a study with captive, wild-caught wood storks to determine: (1) if wood storks can catch, handle and process various sizes of healthy channel catfish; (2) if wood stork foraging efficiency in catfish ponds is affected by water depth and stocking density; and (3) if wood storks show a foraging preference for sick vs. healthy channel catfish. Jimmy also is working with the SREL and the USFWS to monitor post-breeding movement of wood storks captured in MS, LA, and hopefully TX and AR using satellite telemetry. The USDA Wildlife Services aspect of this study will determine if wood stork movement is associated with abundance, size, or complexity of aquaculture facilities and attempt to answer questions about the potential range overlap of wood storks moving from southeast U.S. and South American breeding grounds. The USDA MS Field Station personnel and Wildlife Services operations staff also plan to monitor wood stork use of randomly selected catfish facilities from June through September to better understand the association between wood storks and catfish aquaculture.

## Banding Project At Selected Georgia Colonies Continues

**Larry Bryan** of SREL has continued a leg-banding project that began back in the 1980s at the Birdsville Colony in GA. Over the past several years Larry and **John Robinette** of the USFWS have banded between 70 and 90 chicks at the Woody Pond Colony at the Harris Neck NWR. Larry and other SREL staffers have also banded between 25-45 chicks at Chew Mill Pond Colony and at Birdsville Colony when active. Close to 1,000 wood stork chicks have been banded at GA colonies since 1995. Sightings from the GA colonies typically come from coastal GA and SC. There have also been sightings of these birds in MS, AL, and down into FL. This year's banded stork sightings came from AL, GA, and both north and south FL. Two storks banded as nestlings in Birdsville in 1991 (thus making them 11+ years old) were observed in 2002 at the Chew Mill colony (east-central GA) and St. Petersburg, FL.

The wood storks are banded with a USGS band on the left leg and a colored numbered band on the right leg. Yellow bands with black lettering are from the Birdsville Colony; orange bands with black lettering are from the Chew Mill Pond Colony; and red bands with white lettering are from the Woody Pond Colony at Harris Neck NWR.



Wood stork banding at Harris Neck NWR

## Wood Storks At Noxubee NWR

...Continued from Page 7

The increase in storks at the refuge and throughout the eastern edge of MS has also coincided with the development of the Tennessee-Tombigbee waterway which impounded both the Tennessee and the Tombigbee Rivers. Storks numbering a few hundred are seen annually along the waterway, especially in managed impoundments. As food resources are depleted, the birds move to new shallow water areas.



Banded/tagged stork prior to release at Noxubee NWR

# Draft Protocol For Monitoring The Reproductive Success Of Wood Storks In The Southeast United States

Jim Rodgers, FWC ([jim\\_rodgers@fwc.state.fl.us](mailto:jim_rodgers@fwc.state.fl.us))

## INTRODUCTION

The ultimate goal of good experimental design in science is the collection of data with minimal error, or the sources of error are known and controlled. Inaccurate estimates do not provide conservation agencies with reliable population trend analysis for a species. Even though the wood stork is a relatively large, predominately white-plumaged species that tends to nest on top or high in the forested canopy, the variability of aerial estimates from fixed-wing aircraft of the number of nests is large (Rodgers *et al.* 1995). This problem is especially acute with larger colony sizes and when storks breed with other white-plumaged species. Thus, ground-based monitoring studies are the only reliable technique to accurately determine both colony size and reproductive success. In addition, since nesting success often exhibits a significant negative trend with hatching date (Rodgers and Schwikert 1997), the entire nesting season must be sampled to avoid biasing reproductive success data based on few visits or monitoring nesting only early in the season. The most important component in determining an accurate estimate of colony productivity is to base calculations on the number of fledglings in individually marked nests from the time the nest is started (i.e., egg-laying or early incubation) to the final outcome of the breeding attempt. This will allow the calculation of mean, standard deviation, and confidence intervals for individual colonies and regional populations of storks.

## GENERAL GUIDELINES

The following are some general guidelines and recommendations for monitoring wood stork productivity. To reduce disturbance and negative impacts on both storks and other waterbirds in the colony, conduct all field work during the cooler morning or late afternoon

hours to avoid thermal stress to both the eggs and/or nestlings. Be wary when entering a colony while corvids (either fish crows [*Corvus ossifragus*] or american crows [*C. brachyrhynchos*]) are present, as these species can cause depredation of eggs and young nestlings in unattended nests. Allow yourself to be visible as you move through the colony site to allow parent birds to slowly move/flush from the nest and avoid panic flushing that may cause the nest, eggs, and/or nestlings to be lost. Move through the colony in a steady, orderly manner to allow parent birds to return to their nests as soon as possible. Keep track of your current location and course to avoid repeated flushing of individual birds by moving through the colony in a planned path that results in disturbing birds only once. Finally, avoid monitoring regions of a colony that contain a large number/high density of other nesting species (e.g., cattle egrets [*Bubulcus ibis*] and white ibis [*Eudocimus albus*]). Especially later in the nesting season when there are large nestlings (i.e., branchers), there is the potential to cause pre fledging of these species. If in doubt, do not monitor these regions of a colony. Another problem species is the Anhinga (*Anhinga anhinga*); while adults will fly away, the older nestlings often jump from their nests and are impossible to capture as they swim away. These regions of a colony are best monitored from a distance that does not cause the flushing of parent birds.

## FREQUENCY OF NEST MONITORING

The following are some recommendations regarding the study design for the collection of wood stork productivity data. An ideal study would involve marking and monitoring nests on a daily basis. However, this probably would cause excessive disturbance to the nesting birds and would be prohibitively time-consuming for researchers monitoring more than one

colony or a large number of nests in a single colony. Based on previous work with storks, I suggest that biweekly visits (once every 14 days) are adequate to mark and monitor the status of stork nests, especially since the nesting season of storks is relatively long in duration, and an individual nest is active for 12+ weeks (see below). While there is the possibility that a previously-marked nest was abandoned or failed and either the nest was taken over by another pair or a new nest was constructed in the same location as the previous nest, the loss of information on nest starts/failures with a biweekly visitation is only about 3-5% compared to weekly visits. The maintenance of a status chart (see below) for the chronology of individual nests often will allow the detection of nest failure and re-nesting events.

## DURATION OF NEST MONITORING

As indicated above, stork productivity often varies during the breeding season thus necessitating the monitoring of a sample of nests during the entire breeding season from early egg-laying to fledging of the last nestlings of the year. An individual nesting effort by a pair of storks generally lasts about 80-91 days (about 7 days to build the nest, 5-7 days to complete the clutch, 26-28 days of incubation, and 42-49 days to fledge the nestlings). As with other waterbirds, nesting by all storks within a colony is relatively unsynchronized (egg laying or hatching is distributed over time). Based on my previous studies, hatching can occur over a period of 80 to 100 days in north and central FL. While an individual nest may require 84 days (4 weeks of incubation plus 8 additional weeks for the nestlings to attain fledging age for a total of 12 weeks or 84 days), the monitoring schedule for an

*Continued on Page 10...*

# Draft Protocol...

...Continued from Page 9

individual colony for the entire nesting season will require about 180 days, from the early arrivals and egg laying to fledging of the last nestlings from the last arriving storks.

In general, there is a delay in the onset of stork nesting with both latitude and longitude in FL. That is, nesting commences (and finishes up) earlier in south FL compared with north FL, and colonies along the east coast start earlier compared to west coast and panhandle sites. In south FL, nesting can begin as early as December but generally initiates in the January–February period. In central FL, nesting commences during early March–April period, and in north FL during early April. Preliminary visits to the stork colony will allow for determination of the onset of the nesting cycle. While storks may use a colony site for roosting and leave during the day when not breeding, a slow but steady number of storks will begin pairing and nest building in the spring. Pairs of storks standing side-by-side or carrying nest material into the site are good indications that nesting behavior has begun.

## SAMPLE SIZE OF MARKED NESTS

Aside from the minimal sample size to satisfy normal theory and the requirements of various statistical tests, there is no easy answer for the determination of an adequate number of nests to monitor in a colony of wood storks. I would recommend monitoring a minimum of 20–30 nests per colony. Based on my previous experience, it is not too difficult and time-consuming to monitor all nests in colonies with less than 100 nests when done over the entire breeding season. On a daily basis, only about 30–40 nests would be checked each visit because of the unsynchronized nesting by storks. I would recommend that a sample of nests be monitored for colonies with >200 stork nests based on ease of movement through the colony and ability to see the nests and its contents. When monitoring a sample of nests, be sure to mark a random selection of nests throughout the colony to avoid potential biases of edge versus interior differences in nesting success (e.g., nest collapse due to storm events and different nesting vegetation or effects of predators).

## GENERAL FIELD TECHNIQUE

My usual method of monitoring a wood stork colony varies slightly from colony to colony and during the nesting season of an individual colony. I use my first visits to a colony early in the nesting cycle to locate access and exit points to the site. This usually involves a preliminary survey of storks and their nests from around the



Two-week-old nestlings



Four-week-old nestlings



Six-week-old nestlings



Fledglings

Continued on Page 11...

## Draft Protocol...

...Continued from Page 10

perimeter of the colony/swamp. Once I have begun to mark and monitor nests, I usually establish a standard course through the colony to check on previously-marked nests. However, I also occasionally make forays outside the standard course and perimeter of the colony to locate any new nesting regions or sub-colonies that initiate later in the season.

I generally traverse a serpentine or zig-zag path through the colony, checking previously-marked nests and marking new nests as they appear during the nesting season. New nests can be marked along the main course or in short excursions off to the side of the general course. It also is a good idea to just look around and size up the distribution of nests to plan your course through the colony. Keep an eye out for anhinga nests and other hazards (e.g., hornet nests). A word of caution: avoid looking up with your mouth open when directly beneath a nest, as both adults and especially large nestlings will defecate over the nest edge. Nestlings also will regurgitate partially digested fish and prey items. Both of these behaviors probably function as anti-predator defense but a hat and sunglasses are all the protection you will need to defend yourself.

I prefer to mark nests using 2-inch-wide, red-colored plastic flagging tape that is available from most office supply stores or survey catalogs. I have found that red tape is relatively visible to the researcher and will hold its color throughout the entire field season but is not too visible to attract the attention of the public. I designate each individual nest with a **large-sized** number on the tape using a black **permanent** felt-tipped marker pen (e.g., large-tipped laundry markers). I tie the 2-inch tape flat around a nest tree such that I can easily see the number when approaching. This is especially important later when the nestlings are large and viewing the nest and its contents from a distance with binoculars will prevent pre-fledging the storks. Another technique I use with trees with

multiple nests is to tie the number so it is on the side of the tree limb corresponding to the marked nest. With trees with multiple nests, it is sometimes possible to tie the flagging material in a straight-line below individual nests on lower limbs. Practice will make the marking of nests routine.

The above technique generally works well for wood storks nesting in smaller cypress and gum trees that are widely spaced apart in the colony. Other colony sites with different nesting habitat may require individual marking/monitoring methods. As the breeding season progresses, storks breeding in dense, closely-spaced subcolonies may be monitored by either drawing diagrams and numbering the nests or taking pictures and numbering the nests for individual identification. Storks nesting in tall, large cypress trees (e.g., Corkscrew Swamp, Croom, River Styx) can be monitored by first mapping the nest arrangement during the initial approach to individual trees, making sure to designate stork nests from similar appearance and sized nests of other waterbirds (e.g., great blue herons [*Ardea herodias*] and great egrets [*A. alba*]), then moving off to one or more side locations and viewing the nests with binoculars. One strategy is to mark a tree with a number (and GPS-generated location) and the individual nests with letters. Often the storks nesting in these tall trees will tolerate visits to the base of their nest trees without flushing and just peer down as you approach. Storks nesting in dense stands of mangrove (both black mangrove [*Avicennia germinans*] and red mangrove [*Rhizophora mangle*]) and Brazilian pepperbush (*Schinus terebinthifolius*) often present special monitoring problems because the closed, dense canopy obstructs viewing storks from below and does not allow observation of distant nests, and nestlings of all waterbirds will attempt to escape by crawling over the vegetation. I have found the best method with these colony-types is to use a selective series of entrances/exits into the colony to mark/check nests, withdraw

to the perimeter, and re-enter the colony at another region.

### DATA COLLECTION

It is important to keep track of individually marked wood stork nests on a regular basis. Depending on the colony, I use a combination of aerial photographs, drawn maps, and a tabular list of marked nests from previous visits. I use a series of codes to designate the status of each nest based on the previous visit and update the status of each nest prior to the next visit: A=nest with one or more adults; IA=nest with an incubating adult laying in the prone position (this is a good indicator of the presence of eggs or young nestlings); 0A=nest intact but no adult/nestlings observed in attendance; 0C=original nest structure absent/collapsed; Y=nest with calling/visible young but exact number is uncertain; XN@XW=number of nestlings at number of weeks of age (e.g., 2N@4W is a nest with 2 nestlings approximately 4 weeks of age); and XF=number of large nestlings of fledging age. More about nestling age follows below. Knowledge of the current status will alert you to the possibility that large, near-fledged young are in a nest and you should exercise caution when revisiting this site.

### DETERMINATION OF NESTLING AGE

The ability to visually estimate the age of wood stork nestlings can assist with determining when young attain fledging age and a nest does not require further monitoring. I use the 7–8 week age as indicative of fledging because the young are fully feathered and capable of flight albeit they are still present in the colony. Because these large nestlings also are capable of moving away from their nest in response to your approach, it is important to observe the status of a nest in advance in order to count the number of young. I recommend using binoculars and viewing the number of nestlings from as far away as possible.

Continued on Page 12...

## Draft Protocol...

...Continued from Page 11

I have included photographs of stork nestlings from 2 to 8 weeks of age at 2-week intervals (see page 10). Because their eggs hatch at 1–2 day intervals, a nest that originally contained 3 eggs (modal clutch size is 3, range is 1–5) can have 3 nestlings whose age span a week. This unsynchronized hatching is responsible for later brood reduction, especially during a year when the amount of forage is low, as a 1-week-old nestling cannot compete with the stronger and more aggressive 2-week-old sibling that is twice the size of the younger bird. Two-week-old nestlings are about the size of a chicken, are covered with down, and generally sit upright in the nest. An adult is always in attendance. Four-week-old nestlings have a combination of both down (especially the head and neck regions) and contour body feathers contributing to an “unkept” appearance, the legs appear disproportionately large, and the bill looks disproportionately small compared to the body, there is evidence of the black wing feathers, very short tail, and they generally stand in the nest. An adult may or may not be in attendance at this age. Six-week-old nestlings have most of the body covered with contour feathers but down is still visible in the crest, the wings are large and the black feathers are visible, the tail is distinctive, and overall they appear similar in size to an adult. At this age, nestlings are often referred to as “yellow-bills,” as the bill is nearly the size of adults but is yellow-colored compared to the black of an adult. Eight-week-old nestlings appear similar in size and plumage as an adult but have a fully-feathered dark-colored head and upper neck. These nestlings are capable of flying from the nest.

### REFERENCES

Rodgers, J.A., S.B. Linda, and S.A. Nesbitt. 1995. Comparing aerial estimates with ground counts of nests of wood stork colonies.

## Nesting Success And Productivity Of South Florida Wood Storks In 2002

Becky Hylton, UF ([becky\\_hylton@hotmail.com](mailto:becky_hylton@hotmail.com))

Peter Frederick, UF ([pcf@mail.ifas.ufl.edu](mailto:pcf@mail.ifas.ufl.edu))

We systematically surveyed for wood stork colonies from February to June 2002 throughout the Water Conservation Areas 1, 2, and 3 using fixed-wing aircraft. In addition, we also regularly monitored the Tamiami West colony located within Everglades National Park from the ground and air. Each wood stork colony was surveyed to determine layout of the colony, nesting stage, and numbers of nests to develop in our study area. Of the three major wood stork colonies (Tamiami West, Crossover, and Jetport), we chose to follow nesting success in Tamiami West (N25°45.31, W80°31.90), as this colony was easily accessible from FL State Road 441, was centrally located in the Everglades ecosystem, hosted a large number of nesting wood storks (>400 pairs), and had stork nests easily reachable by ladder. Although storks nesting in nearby Paurotis Pond (N25°16.89, W80°48.18) were also easily reachable by ladder, accessibility to this colony within Everglades National Park was limited due to visibility to the public. Paurotis Pond colony was thus monitored by Everglades National Park employees. Both Crossover (N25°55.51, W80°50.10) and Jetport (N25°52.11, W80°50.61) colonies located within Water Conservation Area 3A were in tall,

inaccessible cypress (*Taxodium distichum*) ranging from 25 to 80+ meters in height. Ground visits to the Tamiami West colony were made from March (after the majority of storks were well into incubation) through July 2003.

### CROSSOVER AND JETPORT COLONIES

Both Crossover and Jetport colonies occur within Water Conservation Area 3A. The number of storks nesting within the Water Conservation Areas were 2.9 times the average of the past five years, and 3.7 times the average of the previous ten years. This was the first year in many in which birds at the Crossover site were largely successful. Fifty-six of the 76 wood stork nests initiated in Crossover successfully produced young in 2002. Although approximately 150 pairs of wood storks began nesting in Jetport colony in February, this number eventually grew to 550 nesting pairs by March. Approximately three nestlings hatched per nest (range 1–4 nestlings) in each colony; however only two young were estimated to have fledged per nest.

### TAMIAMI WEST COLONY

Approximately 400 wood stork nests were initiated in Tamiami West in 2002. Nests were selected for inclusion in this study along two roughly north-south transects on either side of an agricultural canal, both transects extending from the northern edge south through the center of the colony. Only nests within roughly 5 meters of our transect were marked for study to avoid focusing our efforts in one area. Although nests were not randomly

Journal of Wildlife Management  
59:656–666.

Rodgers, J.A., and S.T. Schwikert.  
1997. Breeding success and  
chronology of wood storks *Mycteria  
americana* in northern and central  
Florida, U.S.A. Ibis 139:76–91.

Continued on Page 13...

# Survival And Movements Of Juvenile Wood Storks From South Florida

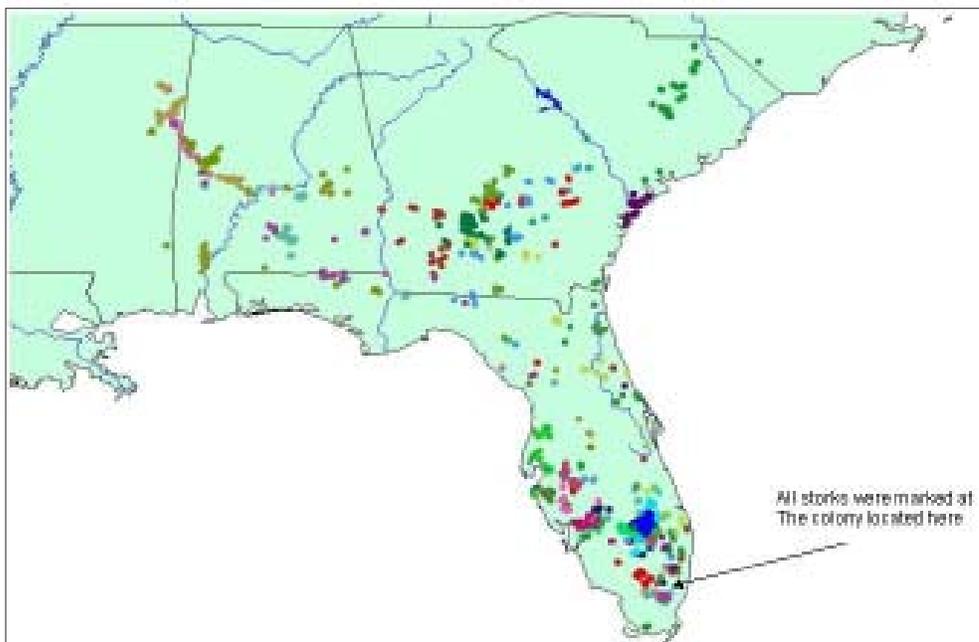
Becky Hylton, UF ([becky\\_hylton@hotmail.com](mailto:becky_hylton@hotmail.com))  
Peter Frederick, UF ([pcf@mail.ifas.ufl.edu](mailto:pcf@mail.ifas.ufl.edu))

This was the initial year of study examining factors that may affect the survival of juvenile wood storks. Storks are of special interest with regard to the restoration of the South FL Ecosystem, both because wetlands of south FL are considered prime habitat for this federally endangered species and because the storks' demographic responses are thought to be indicators of several aspects of normal ecosystem function. As the first few months of birds' lives are often the period of time when they may experience their highest mortality, we examined nestling health and body condition of wood stork nestlings prior to fledging. Storks nesting in south FL are actually a fluid subset of the larger southeastern U.S. population, yet the movements of these birds, and the specific habitats they use remain poorly understood. This study of the movement-dependent survival of individual storks may therefore lead to the identification of specific wetland areas used most heavily, and those that are most valuable.

We chose to work in the Tamiami West colony in Everglades National Park (N25°45.31, W80°31.90) for this study, as this colony was easily accessible from FL State Road 441, was centrally located in the Everglades ecosystem, hosted a large number of nesting wood storks (>400 pairs), and had stork nests easily reachable by ladder. The colony was visited on the ground from March through July 2002 after the majority of storks were well into incubation, thus avoiding the more sensitive courtship and egg-laying periods.

After nestlings reached 4-5 weeks of age, first-hatched nestlings from 33 nests were randomly selected for inclusion in our health and telemetry studies. After a juvenile stork was captured on the nest, we performed a health exam on each individual. Skeletal measurements (culmen and tarsus) and mass were recorded which will be used to develop an index of body condition. Each health exam included a physical examination for ectoparasites, palpation for Eustrongylides

*Continued on Page 14...*



All good quality locations of 33 satellite-tagged juvenile Everglades wood storks from May-August 2002. Each unique color represents an individual.

# Nesting Success...

*...Continued from Page 12*

selected, we attempted to mark a good cross-section of the nesting population by including nests from the edge of the colony as well as centrally-located nests. A total of 120 nests were marked with numbered surveyors flagging. The majority of storks (>75%) nested on the eastern side of the canal where we marked 86 nests, and we also marked 34 nests on the western side of the canal.

We followed the nesting success of each of 115 nests approximately every 3 days throughout the nesting season. This schedule was modified when necessary to reduce the level of disturbance during critical nest-building and egg-laying stages of wood storks and other wading bird species. Colony visits were also restricted to one hour in length to limit disturbance. Despite these limitations, we were able to at least partially follow 115 nests in this colony to determine rates of survival during incubation and nestling stages. In cases where marked nests became unidentifiable for various reasons (limbs blown down, flagging ripped by birds, illegible ink, etc.), we truncated the nesting information for Mayfield analysis on the last date that nest ID was known.

Nests in the Tamiami West colony were almost entirely built in the canopy of pond apple (*Annona glabra*), although a few nests were in willow (*Salix caroliniana*). As nests were typically located between two and three meters above the ground, we used three-meter-long extension poles with attached mirrors to view nest contents and determine numbers of eggs and young. Storks were considered to be at least 4 weeks of age when they had visible white contour feathers on the back and coverts and primaries 5-8cm in length, and were considered fledged by day 55. In cases where a full clutch had yet to be laid completely, or a chick in a nest was hatching on the nest check date, we pro-rated nest initiation dates using the

*Continued on Page 15...*

# Survival And Movements...

...Continued from Page 13

nematodes, and collection of up to 2 mL of blood. Blood was used for sexing, hematocrit, white blood cell counts, and blood smears which will later be examined for the presence of blood parasites. In addition, 4–6 growing scapular feathers were collected from each bird to determine level of mercury contamination. This information will be used to construct an estimation of the health, parasite load, and body condition of each bird.

Following the health exam, each bird was fitted with a backpack harness that combined a 10g VHF radio transmitter and a 35g solar-powered ARGOS-certified platform transmitter terminals (PTT) for satellite tracking. The total weight of the Teflon harness, VHF transmitter, and PTT did not exceed 3% of the wood stork's fledging mass (2–2.8 kg).

Signals from the PTTs are recorded by polar-orbiting environmental satellites and then processed by Argos Satellite Location and Data Collection System, Landover, MD. PTTs work on a 10-hour-on/24-hour-off cycle. Argos assigns each location an accuracy rating, and only locations with estimated accuracies of <1000m are being used in this study. These data are being used to follow the storks' post-fledging survival and to examine their movement patterns and habitat use.

Between 26 April and 13 June 2002, we placed a total of 33 transmitter harnesses on juvenile wood storks between 4 and 6 weeks of age. Pre-fledged storks were visually monitored on subsequent visits to ensure that harness fit was not hampering movements or agility of the birds. Many individuals with transmitters were observed flying away unimpeded when disturbed from their nest or roost. In three cases the VHF transmitters became detached from the PTT after the carcass had been scavenged by vultures, and these PTTs were not recovered. We were unable to relocate PTTs separated from the VHF transmitters since PTTs are not equipped with a mortality sensor, and resolution

power from satellite data is never less than 350 m. As of 10 March 2003, we have relocated a total of six PTTs and eight VHF transmitters. Three sets of transmitters were refitted with new harnesses and placed on additional birds this season, increasing our initial sample size from 30 to 33. Currently, we have recovered 3 PTTs and 4 VHF transmitters that will be reused in spring 2003.

We receive good quality location information on each bird approximately 4.44 times per week (range 1.71–5.74). In general, we received fewer good fixes early in the season while birds were still attached to the colony, presumably due to poorer transmitting and battery recharging conditions beneath the tree canopy.

## FLEDGLING SURVIVAL

Of the 33 birds tagged with satellite transmitters, satellite data suggests that 26 have died as of 10 March 2003 (21.21% survival). Of those 26 mortalities, 5 occurred within the borders of the colony. One fledgling mortality occurred approximately 100m north of the colony along a levee road. Cause of death was uncertain for this bird; however we note that power lines occur along this road and vehicle traffic is not uncommon. Of the 27 birds that successfully left the colony in a permanent fashion, 21 have died (22.22% survival) as of 10 March 2003. We retrieved one juvenile carcass directly under large power lines in orange groves due east of Lake Okeechobee. Of the 22 mortalities that occurred outside the colony, 22 were within Florida, 2 were in Georgia, 1 was in Alabama, and 1 was in South Carolina along the Georgia border. These mortalities have occurred throughout the year, averaging 2.5 stork mortalities per month (range 1–4).

## MOVEMENT PATTERNS

In south Florida, birds monitored by radio telemetry were seen foraging individually as well as in large mixed groups containing both adults and other juveniles.

In the past 6 months however, we have very few indications that any of the tagged fledged storks have been traveling together. This is quite interesting considering many young were tagged from adjacent nests in the same colony and therefore had plenty of chance to develop social groupings based on natal colony. Many of these birds have also frequently visited the same areas throughout the southeastern United States, although not simultaneously.

After tagged storks left the colony in a permanent way, in general they moved north through the Water Conservation Areas and Big Cypress National Preserve. After this initial local movement, the majority (16 of 27) of storks continued moving north, spreading across the coastal plains of Florida, Georgia, South Carolina, Alabama, and Mississippi. The birds that left Florida did so in a roughly simultaneous way during the second week of June, and tagged birds were found in Alabama, Georgia, and South Carolina. Of 16 birds to leave Florida, 11 moved through Georgia, 8 through Alabama, 3 through South Carolina, and 1 briefly crossed the border into North Carolina. A total of five birds moved through Alabama into Mississippi, with the first bird arriving the last week of June. Fifteen of these 16 birds set up primary summer "home ranges" outside of Florida: 2 in South Carolina, 7 in Georgia, and 6 in Alabama/Mississippi. The simultaneous departure of three birds from Mississippi into Alabama and Florida and one Alabama bird into Florida during the last week of September coincided with the arrival of tropical storm Isidore that made landfall directly over New Orleans, LA. The rains and strong winds from this storm may have been an impetus for withdrawal from these areas.

We identified multiple northern movement pathways for these juvenile birds. Three birds left south Florida and flew north through the western-central

Continued on Page 15...

## Survival And Movements...

...Continued from Page 14

portion of peninsular Florida, turning northwest into Alabama once they reached the Florida panhandle. Two other birds also arrived at the same destination, but followed a coastal path through Florida along the Gulf of Mexico before making their way into Alabama. All five birds remained in Alabama or moved into northeast Mississippi for the remainder of the summer. These birds were most frequently located along the Tennessee-Tombigbee Waterway in Alabama and Mississippi.

There were an additional six birds that spent the majority of their summer (June–September) in Georgia. Of these, two traveled north along the Gulf Coast of Florida, two along the Atlantic Coast, and two directly through the center of peninsular Florida after leaving the colony located just west of Miami.

A large portion of tagged birds, 11 of 26, remained in Florida after fledging from the colony. Most of these birds summered around the edges of Lake Okeechobee or headed further west along the Gulf Coast. These western birds tended to be localized between Tampa and Fort Myers. In this area, the

C.M. Webb Wildlife Management Area, just southwest of Port Charlotte, was frequented most often. By the beginning of November, all northern birds located outside of Florida moved back south into central and south Florida. So far, the areas around Lake Okeechobee and along the Gulf Coast appear to be important wintering areas for many of these young birds.

### WEBSITE

An educational website detailing the ecological requirements and environmental concerns relating to wood storks was developed as a result of this project (<http://www.wec.ufl.edu/faculty/FrederickP/stork/index.htm>). This website focuses on the biology of wading birds and the dynamic movements of the study group of juvenile storks. In an effort to make the movement information available to the public and other professionals, the satellite telemetry project is emphasized on this site and includes maps and descriptions of the birds' movements, which are updated bi-weekly. In addition, this site references many other telemetry projects around the world.

## Nesting Success...

...Continued from Page 13

Mayfield method. Despite occasional long periods between nest checks, we felt the Mayfield method was appropriate since nests were monitored most often during incubation and early nestling stages when the majority of nest abandonment and mortalities occurred, and less often during the later nestling period when survival was high.

At the initial time of marking, 57% of these 115 nests had hatched young. The average clutch size of marked nests located during incubation was 3.09 (SE=0.075, n=46). Average brood size for nests monitored during the period when nestlings were 8-14 days old was 2.81 (SE=0.093, n=26) (note that many nests not monitored during this period were not included in this analysis). Analysis of the nesting success for this colony reveals varying results, depending on the stage of nesting. Overall traditional nesting success (number of nests fledging young / number of nests studied) for this colony was 77.39% (89/115 nests). Of the 26 nests that failed during this study, 57.69% of these failures occurred early in the nesting season, during March. We also used Mayfield's method of analyzing nesting success, which pro-rates survival on a daily basis (Mayfield 1961). During the incubation stage, Mayfield survival was 49.66% (SE= 1.02). During the nestling stage, survival dramatically increased to 89.29% (SE=1.63). The overall, combined Mayfield nesting success for these two periods was 44.34% (SE=0.624).

In general, 1,800 wood stork nests were initiated in these three colonies in 2001 as compared to 1,000 wood stork nests in 2002. Although productivity in 2002 was much lower in the Tamiami West colony as compared to 2001 when 1,400 nests were initiated there, nesting was generally considered successful. Many large groups of juvenile storks were seen throughout early summer foraging in the Water Conservation Areas, Big Cypress National Preserve, and the agricultural areas surrounding Lake Okeechobee.



Copyright Wayne Lasch