SOUTH FLORIDA WADING BIRD REPORT

Volume 7 Dale E. Gawlik, Editor October 2001

SYSTEM-WIDE SUMMARY

This nesting year encompassed what has been widely characterized as the worst known drought in South Florida. What might be surprising to some is that water levels in the Everglades were not below those of other recent droughts (1989 and 1990).

The estimated number of wading bird nests (excluding Cattle Egrets, which are not dependent on wetlands) in south Florida in 2001 was 38,647. This number is down only 5% from last year, which was one of the best years in a decade. The large nesting effort in 2000 was due to increases in nesting by White Ibises, Wood Storks, and Snowy Egrets, the 3 species that have declined most since the 1930s. In 2001, the number of Wood Stork and White Ibis nests decreased slightly from 2000, and the number of Snowy Egrets increased. All were above average for the last decade.

Nesting effort differed strongly among regions, but the pattern was not the same as last year's. In 2001, LNWR supported the largest number of nests (51% of nests in Everglades proper in 2001 vs. 7% in 2000), whereas WCA 3 had fewer nests than usual (38% of nests in 2001 vs. 81% in 2000). ENP and Florida Bay collectively continue to support only about 10% of the Everglades' wading bird nests, a trend that must be reversed as part of the ecosystem restoration.

Unfortunately, 2001 was noteworthy in that there was some nest failure, particularly in ENP and WCA 3. Nest failure seemed to be primarily the result of drought conditions, and to a lessor extent, a Spring rainfall event that caused water levels to increase quickly. Given the nest failure in ENP and WCA 3, the number of nests in 2001 may be a liberal measure of productivity. The relationship between nest numbers and productivity was more direct in 2000 when high nest numbers were also accompanied by good nesting success.

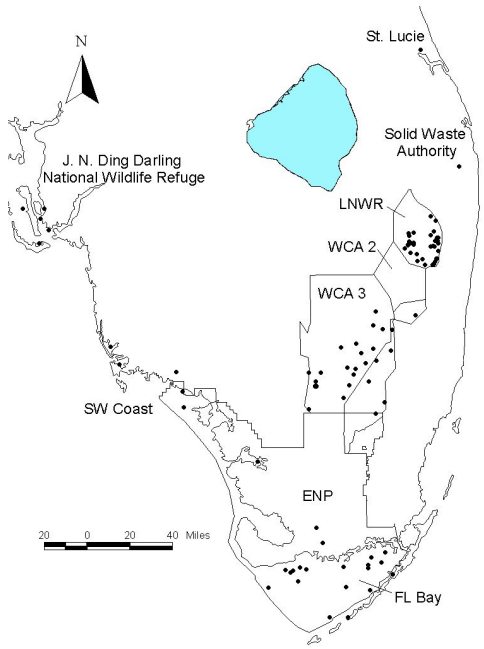
The switch in nesting effort between WCA 3 and LNWR in the last 2 years is almost certainly due to differences in hydrologic patterns. Nesting effort was greatest where water levels were high at the start of the dry season and thereafter decreased substantially, but not so much as to dry out all surface water. Poorer nesting occurred where water levels at the start of the dry season were low or where too much water precluded a strong recession.

Aerial wading bird distribution surveys (SRFs) indicated that *bird abundance* was even higher in 2001 than 2000, which was 129% higher than in 1999, a year which was roughly 3 times that of 1998. This year continues a trend of more birds being in the Everglades at the start of the dry season than have done so in the past.

Three of 4 species met the target proposed by the South Florida Ecosystem Restoration Task Force for nest numbers, and there was some improvement for Wood Stork nest initiation date. However, all species fell far short of the target of increased nesting in the coastal Everglades.

System-wide patterns this year added to the mountain of evidence that wading birds are extremely sensitive to changing hydrologic conditions. Nest success differences in Roseate Spoonbills in Florida Bay and switches in nesting effort and foraging locations among regions of the Everglades are reminders that wading bird

Locations of wading bird colonies in S Florida 2001. Colonies with more than 10 nests are depicted in LNWR and Florida Bay. Colonies with more than 39 nests are depicted in WCA 2 and 3.



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monitoring is a powerful tool for assessing the state of the ecosystem, and therefore the success of restoration efforts. What is becoming evident from past volumes of this report is that the tremendous differences in rainfall among years (some of the driest and wettest on record) produce very different responses in individual wading bird species. No single year has been ideal for all species and perhaps we should neither expect nor want it to be so given the diversity of wading bird foraging tactics. The information in these reports may be laying the foundation for the view that hydrologic extremes, which so define the Everglades, are also necessary to sustain the full complement of species in North America's most diverse wading bird community.

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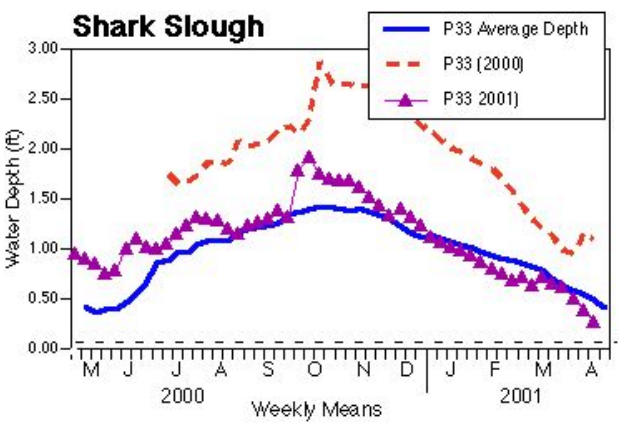
ABBREVIATIONS

Species: Great Egret (GREG), Snowy Egret (SNEG), Reddish Egret (REEG), Cattle Egret (CAEG), Great Blue Heron (GBHE), Great White Heron (GWHE), Little Blue Heron (LBHE), Tricolored Heron (TRHE), Green Heron (GRHE), Black-crowned Night-Heron (BCNH), Yellow-crowned Night-Heron (YCNH), Roseate Spoonbill (ROSP), Wood Stork (WOST), White Ibis (WHIB), Glossy Ibis (GLIB), Anhinga (ANHI), Double-crested Cormorant (DCCO), Brown Pelican (BRPE), Osprey (OSPR), Bald Eagle (BAEA), small dark herons (SMDH), and small light herons (SMLH).

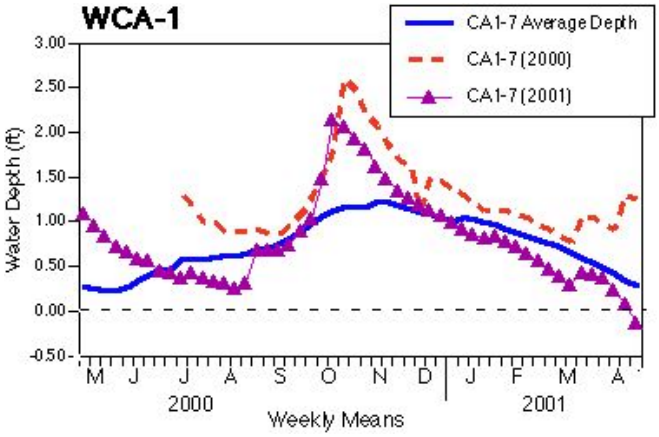
Regions, Agencies, and Miscellaneous: Water Conservation Area (WCA), Everglades National Park (ENP), Wildlife Management Area (WMA), A.R.M. Loxahatchee National Wildlife Refuge (LNWR), Lake Worth Drainage District (LWDD), Solid Waste Authority (SWA), South Florida Water Management District (SFWMD), U.S. Army Corp of Engineers (USACOE), and Systematic Reconnaissance Flights (SRF).

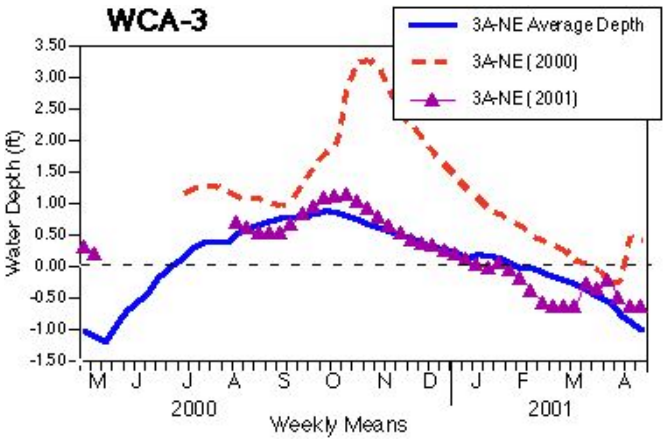


HYDROLOGY 2001

Everglades Protection Area

Much attention was given, this past year, to the lowest recorded Lake Okeechobee water levels in the history of Florida. Low lake levels led to water supply restrictions for urban and agricultural regions. However, the trends in the Everglades Protection Area were not as dramatic as in Lake Okeechobee, partly because the previous year had above average water levels due to Hurricane Irene and partly because this year's rainfall pattern *in the Everglades* was only slightly lower than the 31-year historic average. Despite a general reduction in rainfall in the WCAs of 23% and an average reduction of structure inflows to the WCAs of 45%, compared to the 31-year historic average, average annual water depths in the WCAs and ENP in 2001 were actually slightly above (+0.13 ft) the 31-year average. This apparent disconnect between water levels and "drought" appears to be due to water conservation and active management to hold water in the WCAs. It may also be due to the lag time between rainfall and its expression as low water levels in the Everglades. Taking this one step further, the full impact of the 2001 drought may not be felt until the 2002 dry season. (see the 2001 Everglades Consolidated Report by the SFWMD). The recent hydrologic trends, summarized in the table and figures below, compare the 2000-2001 water-year, 1999-2000 water year, and the 31-year average. A water-year is defined as beginning 1 May (beginning of the wet season) and ending 30 Apr (end of the dry season).





Water depth in LNWR in 2001 was again (as it was last year) above average whereas in WCA 2A, it was below average. This was a significant departure from last year when WCA 2A was above average. Like last year, the average water depth in the northern sector of WCA 3A (gage 3A-NE) was higher than the 31-year average. This may explain the lack of peat fires in this area in 2001. Data from ENP, showed a similar trend. Despite the drought, depths in Shark Slough were 0.13 ft above average. Last year they were 0.83 ft above average.

Average weekly water depths (ft) for water-year 2001 in comparison to the 31-year average weekly water depth.

Area (gage)	Average (1970 – 2001)	Average 2001	Average 2000
LNWR (1A-7)	0.75	0.80	1.3
WCA-2 (2A-17)	1.34	0.78	1.7
WCA-3 (3A-NE)	0.15	0.22	1.2
ENP (P33)	0.97	1.10	1.8

Hydroperiod trend in LNWR during the summer of 2001 was lower than average and lower than that observed during the summer of 2000 (see Figure). This appears to be due to the lag effects of the Lake Okeechobee draw-down in the spring of 2000 and the relatively low summer rainfall. The usual trend for LNWR, both observed and estimated by the Natural (hydrologic) System Model (NSM), is to reach minimum low water in mid-May followed by increasing water levels until Oct or Nov. Instead, water levels in 2001 continued to drop past mid-May and then increased rapidly towards the end of the wet season (Oct) due to intensive precipitation and high structure inflows from the Everglades Agricultural Area. After the Oct 2000 deluge, rain and structure inflows showed very little activity. As a result, water levels dropped precipitously and eventually went below average in Apr 2001, similar to the trend observed in WCA 3 in 2000 (see Figure). This rapid recession was quite different from 2000 when dry season depths were constant at 1 ft.

The 2001 water depth trend in WCA 2A was similar to the LNWR. Both areas experienced a 2.5-ft rise in water depth over a 2-month period and both saw a rapid decline in water depth from Nov to Apr. The difference was that the rate of depth change in WCA 2A was more dramatic than in LNWR. In 2000, water depths in WCA 2A were generally unchanging during Jun, Jul, and Aug but quickly exceeded the historic averages in Oct. This increase appears to be related to rainfall and a big pulse of structure inflows, to prevent urban and agriculture flooding in Oct. The decline during the dry season produced dry soil by Mar 2001, 2 months before the typical May dry-down. This trend would have continued if it had not been for a "fortuitous" 6-in rainfall in Mar. This rain was enough to re-hydrate the soils for an additional month before WCA-2A went dry again.

Despite a lack of data in the Fall of 2000 due to gage repair, the 2001 water depth in northern WCA 3A was very similar to the average historic water levels (see Figure). However, major water depth deviations occurred during the 2001 dry season when water levels hit zero (ground level) in Feb and never recovered. Historically, this site did not go dry until Mar and according to the NSM, water depths during pre-drainage conditions did not go dry until Apr. The reason for the lack of any early indication of drought can be found in the wet-season rainfall and inflow patterns. Unlike the other WCAs, WCA 3A saw typical wet-season rainfall patterns and typical volumes of structure inflows. The early dry-down in WCA 3A appears to be related to the early onset of the dry season, a lack of structure inflows from Nov to Apr, and below average dry-season rainfall. The average weekly 2001 structure inflows to WCA 3A decreased by 40% and the average weekly rainfall decreased by 30%. It is important to note that last year, a year marked by high nesting success in WCA 3, had a very different hydroperiod trend. Water depths at the end of the 1999 wet season were over 2 ft deeper than they were at the end of the 2000 wet season. Deep water, at the end of a wet season, may be the key to creating the steep recession rates, in the dry season, needed for good foraging habitat for wading birds.

The ENP, as represented by the P33 station in Shark Slough, showed a significantly different hydroperiod trend (see Figure) than LNWR and WCA 2A, and a similar hydroperiod to WCA 3. Water levels during the wet season in ENP were slightly higher than the historical average but significantly less than last year. The 2001 trend can be attributed to low area-specific rainfall and structure inflows, as in WCA 3. What was significant about ENP water depth in 2001, was its similarity to last year's seasonal pattern and the historic water depths. It seems that last year in ENP, the dry season did not get dry enough for optimum wading bird foraging while this year, the wet season did not get wet enough.

Southwest Coast Hydrology:
Ted Below, at Rookery Bay Sanctuary, compared a 36-year inland water level record at Corkscrew Swamp Sanctuary with a 19-year coastal pond water level record at Rookery Bay to help understand current nesting. Over the years he has found that water levels in Rookery Bay generally fluctuate in unison with the inland ponds at Corkscrew Swamp (36 km. N). This year the dry-down was earlier and quite strong but didn't last as long. Rainfall for the 8-month period (Oct-May) this year was down 73%, from the 19-year mean whereas for 2000 it was down 21%. Ponds in Rookery Bay were full by the end of Jul. Thus, the ponds were dry for 2 months in 2001 compared to 3 months last year. As of Jul, rainfall for 2001 was 1 in above the mean for the first 7 months.

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REGIONAL NESTING REPORTS

WATER CONSERVATION AREAS 2 AND 3

Methods
This year we performed monthly systematic aerial surveys and comprehensive ground surveys of the entire area of WCAs 2 and 3, and occasional overflights of eastern ENP and LNWR. We also followed the fates of nests in the Tamiami West colony in ENP and documented nest success and juvenile survival of White Ibises in LNWR, WCA 2B, and WCA 3A.

This was of course a year with substantial drying. Alley North colony to the north of Alligator Alley was dry (total lack of surface water) by the end of February. We couldn't get above Holiday Trail in WCA 3A by airboat by the beginning of Mar. WCA 3B was dry by end of Feb, at least around the launches (there was water in the central portion). WCA 2B was largely dry except in the southern portion for most of the season, and even that eventually dried up. The surface water surrounding the Tamiami Trail colony in ENP was gone by late Mar. Once the water rose again in May and Jun, the top layer of soil ended up floating much of the time (+2 in thick). Nonetheless, there was still some surface water in southern WCA 3A as far N as L-67 colony by the beginning of the rainy season. This puts the surface water conditions as slightly wetter than 1988, similar to 1985, and considerably wetter than 1989–1991.

Results
Excluding Tamiami West, and excluding Cattle Egrets and Anhingas, we documented a total of 13,144 nesting attempts by wading birds in WCAs 2 and 3 this year. This total is 8% higher than the average of the last 5 years and 30% higher than the average of the last 10 years for the same area. The pattern of abundance by species, however, was quite different from many past years. In general, we saw increases in numbers of nesting attempts in species that are highly social foragers, and whose foraging strategies are adapted for shallow water foraging. For example, Wood Stork nests increased by 2 times the 5-year average, Snowy Egrets by 2.25 times, and Glossy Ibises by 10 times. The only exception to this rule was White Ibises, which were 23% less than the 5-year average. However, this is probably an artifact of not including system-wide counts here. The majority of the ibises in the system chose to nest in LNWR this year rather than in WCA 2 or 3, and system-wide it seemed that there were many more ibises than usual.

Interestingly, we saw decreases in nesting by Great Blue Herons (35% fewer than the 5-year average), a species which forages solitarily in deep water. Great Egrets, which also forage in deeper water, increased 30% over the 5-year average in number of nest starts but their nest success was poor. These trends may suggest that, as we have suspected, there are tradeoffs in foraging strategies depending on foraging conditions, and that extreme environmental conditions tend to favor species with one set of foraging habits, while others may be at a disadvantage.

The large number of nest starts this year was very much at odds with the very poor nesting success that ensued. We saw repeated abandonments of entire colonies of Great Egrets and of White Ibises, and large reductions in nests at colonies that continued. Of the 4,168 Great Egret nests that were initiated, we estimate that 80% were abandoned or failed during the early nesting season. We saw a complete abandonment of the Crossover colony by Wood Storks, of the Big Pond and Tamiami West colonies by White Ibises, and near-complete (>90%) abandonment of Pocket and L-67 colonies by ibises. Wood Storks held on at the Tamiami West colony and produced young, but we estimated that of 1,400 nest starts, only about 450 survived to produce young. Nonetheless, we estimated that at least 900 young storks fledged from the Tamiami West colony.

There may have been multiple causes for the poor success rates we observed in WCA 2 and 3. The most obvious cause was the strong drying trend, which literally dried out a number of the colony sites. For example, WCA 3B was without surface water from mid-May onward, resulting in abandonment of the majority of nests of Great Egrets at the 3B Mud Canal East colony, and the Heron Alley colony simply never formed. We believe that many of the early abandonments by Great Egrets were in response to drying conditions. In addition, a large storm event occurred in Mar, causing water levels to increase dramatically in some areas. After this event, we found over 90% of Great Egrets abandoned the Alley North colony, and we found considerable wind damage to Great Egret and small heron nests in this colony. Rising water has produced large-scale abandonment in many years during the past, presumably because food becomes temporarily unavailable due to the rising water. Following this rainfall event, the few Great Egret nests that survived seemed to be persistent, and most made it to fledging. Among White Ibises we also saw a repeated pattern of large colony initiations followed within 2 weeks by complete abandonment (Tamiami West, Alley North, Big Pond, Pocket). These were not always in conjunction with periods of rising water, and it was unclear what caused the birds to leave. It is tempting to associate the abandonments with colony drying but we saw examples (Cypress City) where ibises had apparently good nest success despite there being little surface water under nests or near the colony for much of the nesting period.

As a result of this pattern, we had many cases in which it was difficult to know how to count nest starts in a colony. For example, we counted several hundred ibises in the Alley North colony in early Mar this year, engaged in courtship. Yet the site was abandoned prior to the laying of eggs or full construction of nests. We therefore attributed no ibises to that colony. Similarly, we counted

Numbers of wading bird nest starts found in WCAs 2 and 3 from January through June 2001

Lat.	Long.	Colony	GREG	GBHE	WOST	BCNH	LBHE	SNEG	TRHE	WHIB	GLIB	ROSP	CAEG	ANHI	Colony Total*
N26 10.77	W80 31.72	Alley North	1,400			100	50	750				4			2,304
N25 58.50	W80 31.63	Pocket								2,265					2,265
N26 09.78	W80 20.74	2B Melaleuca	650	5	50	25	53	150	40	800	50	10		35	1,833
N25 46.36	W80 50.24	Hidden	200					600	800					67	1,600
N26 07.32	W80 32.50	Cypress City	200				20		25	800	30		200		1,075
N25 57.88	W80 34.48	L67	180	2			2		50	600	20			9	854
N25 55.51	W80 50.10	Crossover	55		400										455
N25 52.00	W80 48.20	Big Pond	5				40	100	65	55				20	265
N26 01.48	W80 32.36	Donut	150	1			20		15	20	6			50	212
N25 52.14	W80 48.39						140	10	5						155
N25 48.08	W80 29.40	3B Mud East	150												150
N26 00.97	W80 27.61	Mud Canal	150												150
N25 55.07	W80 37.93		100	5										35	105
N25 52.44	W80 39.00		75	5										40	80
N26 01.83	W80 41.29		110										24		110
N25 56.41	W80 37.25	Starter Mel	70	10										25	80
N25 49.18	W80 40.66		65	1										20	66
N25 53.27	W80 33.67		80												80
N25 56.70	W80 39.55							80							80
N25 52.26	W80 48.12						30	45	4						79
N26 06.11	W80 27.27	Holiday Park	75												75
N25 55.48	W80 46.80						50		4						54
N25 52.04	W80 48.10						35	10	7						52
N26 02.75	W80 37.10	Big Mel	50												50
N26 06.37	W80 29.89		50												50
N25 52.22	W80 48.39							45							45
N26 00.43	W80 35.70		45												45
N25 53.34	W80 48.26						22	15	3						40
Colonies with < 40 pairs			308	177		17	122	79	32					381	735
Total Nesting Pairs			**4,168**	**206**	**450**	**142**	**584**	**1,884**	**1,050**	**4,540**	**106**	**14**	**224**	**682**	**13,144**

* Totals do not include Anhingas or Cattle Egrets

several thousand ibises in the Tamiami West colony in early Mar, and saw courtship and nest building. In the end, the site was abandoned by ibises after only about 100 nests with clutches were completed.

The emerging picture was one of large numbers of ibises repeatedly failing at nesting, and moving around the ecosystem trying to find a place to nest. The timing of abandonments and initiations suggests that the large numbers of birds attempting to nest at Tamiami West, Alley North, and those in roosts on the W side of WCA 3A must have moved to the large colonies in Loxahatchee. Similarly, later in the season the abandonments of Big Pond and L-67 colonies by ibises were closely followed by the formation of the Pocket colony, suggesting the Pocket was a renesting attempt by these birds. As a result of renesting, there could have been many fewer nesting pairs than nesting attempts.

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A.R.M. LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Methods

Wading bird nesting surveys were conducted using both ground (airboat) and aerial (fixed-wing) techniques. Seven ground surveys were conducted between 3 Apr and 20 Apr. Refuge staff initiated ground surveys earlier than normal (15 Apr) because of the continued decline of interior water levels as the result of the drought. Systematic transects, both N-S and E-W approximately 0.5 mi apart, were run by airboat where conditions and vegetation allowed. Generally, areas N of 26°33.00N and W of 80°24.00W were not covered in the airboat survey because of dense vegetation. Low water levels as the result of the drought also limited access by airboat into areas of LNWR which were surveyed in previous years. Deviations from the transects were made if a colony was suspected or known to be off the transect line. This method covered approximately 40% of the refuge as estimated by examining area surveyed.

One fixed-wing aerial survey was conducted on 17 Apr and provided complete coverage of LNWR lands including the Cypress Swamp and Strazzulla Marsh. The fixed-wing survey started at the north end of the refuge and the aircraft was flown in a progressive southward pattern. These systematic transects were flown E to W 1 mi apart. Total survey time was approximately 3 hrs. Recorders documented all colonies on and off the transect line when identified and recorders directed the pilot to circle the colony to document nesting species. Four fixed-wing surveys were conducted by refuge staff for the 2000 nesting season but refuge staff felt that aerial surveys conducted either too early (Mar) or too late (Jun) in the nesting season contributed little useful information to the wading bird nest survey so it was decided to conduct 1 survey during 2001 during the peak of the nesting season (late Apr).

Results

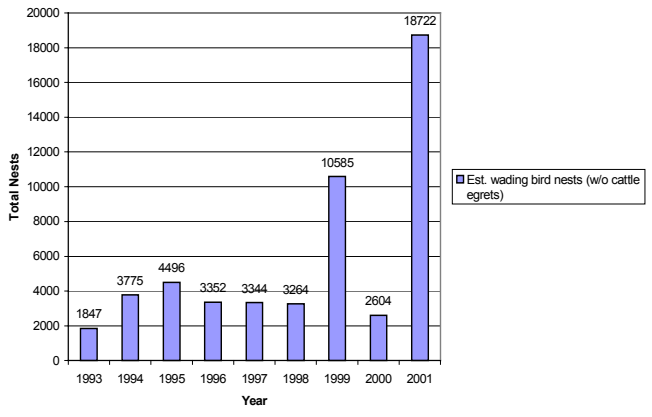
Approximately 42 colonies and 152 individual Great Blue Heron nests were located during combined survey efforts. A record 19,882 wading bird nests, including Cattle Egrets, were tallied for the 2001 nesting season (see Table and Fig. 1.). Nesting effort was approximately 5 times that recorded for 2000 (3,338 nests). Three colonies contained over 3,000 birds of which White Ibis were the most prevalent species. White Ibis accounted for 63% of the wading bird nests at LNWR. It appears that the refuge supported the majority of the White Ibis nesting effort for the Everglades ecosystem. Colonies varied in size but species diversity within colonies was similar to past years. Nineteen colonies of >99 birds were recorded, which was similar to the previous record year of 1999 (11,416 nests). Only 5 colonies composed of >100 birds were discovered during 2000.

Eight colonies were located during the only fixed-wing survey conducted on 17 Apr, 2001. The colonies identified by air were either Great Egret or White Ibis. Only 1 new colony was identified by air and this colony was located in a large willow head in the southwestern portion of LNWR and contained an estimated 300 Great Egret nests and 3000 White Ibis nests.

The primary purpose of aerial surveys was to locate new colonies separate from those found during ground survey efforts. Data collected during ground survey efforts were used for the other 7 colonies identified by air because ground surveys are more accurate for species diversity, composition, and species total numbers. Dark-colored waders are easily tallied by airboat and easily flushed due to the proximity of the airboat to the colony. Generally, the dark wader colonies are difficult to discern from the air and resulted in lower identification levels. More colonies containing white birds could have been identified had aerial transects been closer together (<1 mile) but this would have increased survey costs and probably would not have resulted in the discovery of any additional colonies which had not been documented during ground survey efforts. Refuge staff supplemented their findings with surveys being conducted by the SFWMD on the impacts of the drought to the wading bird nesting effort throughout south Florida.

The timing of the 2001 nesting season was similar to past nesting seasons. Great Blue Herons and Great Egrets began nesting in Jan, Feb, and Mar respectively, and Great Blue Heron nesting continued throughout Apr. Great Blue Heron and Great Egret chicks were in the nestling and branching stages when ground surveys were initiated in response to rapidly declining water levels in early April. Smaller waders, such as Little Blue Herons, Tricolored Herons, and Snowy Egrets initiated nest building in late-Mar and early Apr whereas some species were incubating, or had nestlings as of the first or second week of Apr. White Ibis were nest building and were incubating as of 3 Apr. Cattle Egrets were still tending active nests as of early Aug. Additional recruitment of White Ibis and Cattle Egrets probably occurred after refuge staff had completed

Figure 1. Wading Bird Nest Estimates for A.R.M. Loxahatchee NWR, 1993-2001.



Numbers of wading bird nests found in LNWR from March to June 2001

COLONY NUMBER	LAT.	LONG.	GBHE	LBHE	TRHE	BCNH	GREG	SNEG	CAEG	WHIB	GLIB	YCNH	WOST	Total
01001	26 30.140N	80 22.510W				12								12
01002	26 29.520N	80 22.360W		55	20	1				3	6			85
01003	26 30.270N	80 21.260W		125	30									155
01006	26 34.280N	80 16.500W		25										25
01012	26 33.170N	80 15.120W	2				15							17
01018	26 24.877N	80 20.358W		85	15									100
01019	26 25.304N	80 22.016W					11							11
01027	26 27.088N	80 22.800W	1				25							26
01028	26 27.260N	80 22.830W	2		1		12							15
01029	26 27.475N	80 22.419W		12	3			1						16
01030	26 27.502N	80 22.409W		55	5					450				510
01032	26 27.700N	80 21.212W	1	225	60		35	30		10	30			391
01033	26 27.339N	80 21.275W		200	15									215
01036	26 28.099N	80 22.368W	1		15	40	45	90		500				691
01037	26 27.862N	80 22.242W			2	5	35			100				142
01038	26 27.747N	80 22.356W		35	12									47
01042	26 23.183N	80 20.114W		25	5									30
01046	26 23.728N	80 18.754W	1	28										29
01048	26 22.279N	80 18.156W		65	35		8							108
01056	26 28.118N	80 14.484W		125	12			35	200	10	15			397
01058	26 27.519N	80 14.392W	1	4		2	65							72
01064	26 24.541N	80 14.812W	1	6	3									10
01066	26 23.870N	80 15.019W		4		3	10				3			20
01067	26 23.829N	80 14.829W		90	5		5	20	75					195
01068	26 22.582N	80 15.586W	4	150	25		15	28	385	25	12			644
01069	26 22.414N	80 15.594W	4	5	75		6	20	100	2	22	7		241
01070	26 22.300N	80 15.963W	1	43	50		10		275	5	25			409
01072	26 22.980N	80 15.326W		50	5				50		4			109
01076	26 26.770N	80 15.453W				2	12				1			15
01080	26 28.180N	80 15.190W		25										25
01081	26 28.906N	80 14.737W		25	25			1		15	6			72
01082	26 28.898N	80 14.464W		85	20			20	75	2	50			252
01083	26 30.500N	80 15.620W		100	700	300	150	1100		5000			16	7366
01084	26 25.690N	80 14.430W			20	100	20	20		3500				3660
01085	26 26.290N	80 23.550W					300			3000				3300
01098	26 26.847N	80 16.492W	1	90										91
01101	26 29.589N	80 16.472W		75			2							77
01107	26 27.008N	80 15.797W		110	1		5	30						146
Colonies < 9 nests			132	15	2	7	0	0	0	0	0	0	0	156
Total			**152**	**1937**	**1161**	**472**	**786**	**1395**	**1160**	**12622**	**174**	**7**	**16**	**19882**

their only ground survey. It is believed that the majority of White Ibis nesting was documented by refuge staff during the initial survey effort.

All but 1 species that usually nest in the refuge showed a significant increase in nesting activity when compared to the 'poor' nesting observed in 2000. Little Blue Heron (248%), Tricolored Heron (690%), Great Egret (47%), Snowy Egret (2,305%), and White Ibis (1,372%) showed significant increases in nest attempts compared to the 2000 season. However, Great Blue Heron nesting efforts declined by 13%.

The majority of colonies were located in the southern half of LNWR (below 26°N 32.00) and within the central slough which is the last portion of the interior to completely dry out. Staff also recorded increases in numbers of nests for the Glossy Ibis (174), Cattle Egret (1160), Black-Crowned Night-Heron (472), and Yellow-Crowned Night-Heron (7).

For only the second time in LNWR history, Wood Storks nested on the refuge. As of 7 Jun, 16 active Wood Stork nests were located in a colony (labeled 01083 in 2000 and 00111 in 2001) adjacent to the western most loop of the canoe trail. Young storks appeared to be about 2 weeks from fledging (D. Gawlik, SFWMD, pers. comm.). Over 7,000 nests of 7 species nested in this colony which was comprised of 15 to 25 bayhead tree islands of various sizes. Due to low water levels, ground surveys were not conducted within this colony. However, a University of Florida graduate student conducting research on juvenile White Ibis provided staff with estimated numbers of species present and nesting activity within the colony. Staff used these data along with data collected or forwarded by SFWMD staff conducting aerial surveys to develop a template of nesting efforts for this colony. The only other documented

Wood Stork nesting occurred in 1990 when 7 Wood Stork nests produced 15 fledglings (M. Maffei and H. Jelks, 1991).

Despite the prolonged drought, the 2001 nesting season at LNWR was extremely successful and exceeded the previous high nesting year (since accurate records were kept) of 1999. Wading bird nesting efforts, excluding Cattle Egrets, increased by 496% over the 2000 season. While other regions of the Everglades had minimal or no nesting, the overall feeling of LNWR staff is that the majority of wading birds utilizing the refuge experienced minimal drought-related nesting impacts and the majority of nesting birds did fledge young. Fledged young, especially White Ibis, were often observed feeding in wet prairies and sloughs within a short distance of a nearby colony. It is unknown how many of these young actually survived after they fledged. Refuge staff visited only a few colonies when drought conditions were at their worst but Univ. of Florida graduate students reported a minimal amount of nestling mortality. They documented White Ibis nestling mortality in the 2 colonies in which they were conducting research (J.D. Semones, Univ. of Florida and M. Bailey, USFWS, pers. comm.) It is not clear whether nestling mortality was drought-related or the result of noise/human impacts from multiple weekly visits to the colonies via airboat.

The intensive ground transect effort undertaken by Refuge staff continues to supply reliable and accurate estimates of wading bird nesting on the refuge. The fixed-winged survey continues to be useful in locating colonies in obscure locations or within areas inaccessible by airboat.

Univ. of Florida graduate student J.D. Semones, placed radio transmitters on White Ibis chicks and assisted refuge staff by providing information on nesting species and nest success for 2 colonies. D. Gawlik and G. Crozier (SFWMD) also provided refuge staff with valuable information on nest success and nesting effort throughout the drought.

Special thanks to LNWR staff whose assistance made gathering the data for this year's report possible. A very special thanks to biological volunteer Laura Allishaw for her field dedication and assistance with data base compilation, query, and design.

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SOLID WASTE AUTHORITY OF PALM BEACH COUNTY COLONY

Methods

From Mar – Jul 2001, Breeding Bird Censuses (BBCs) were conducted in the SWA Roost by 2 observers every 8 weeks, representing approximately 9 man-hrs. During the BBC, all islands from 3 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 disturbance.

Location & Study Area

The SWA roost is located on spoil islands in abandoned shell pits that were mined in the early 1960's in Palm Beach County, Florida (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 (i.e., Water Catchment Area), a 44 km² remnant of the Loxahatchee Slough.

Results

This report presents preliminary data for the 2001 breeding season. Typically nesting activities have been observed at this colony through Sep, and these surveys being reported are only through the end of Jul. The estimated peak number of wading bird nests for the SWA Colony is 2427 which represents a 6% decrease from the 2000 season. The number of White Ibis, Great Egret, Cattle Egret, Snowy Egret, Tricolor Heron, and Great Blue Heron nests are higher during this year than the 2000 season. However, Anhinga and Little Blue Heron nest numbers seemed to decrease. There is over a 36% increase of Wood Stork nests from last year. It should be mentioned that Glossy Ibis nests and young have been observed again this year in the SWA Rookery. However, these nests were not easily identified during the nest surveys and are not included in the reports.

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Peak number of wading bird nests in the SWA Colony from March to July 2001

Survey Date	GREG	SNEG	CAEG	GBHE	LBHE	WOST	WHIB	ANHI	TRHE	Unidentified nests	Total nests
9-Mar-01	96	24	80	8	24	267	622	94	47	136	1398
11-May-01	22	18	553	2	49	60	988	180	90	465	2427
3-Jul-01	2	0	706	0	25	0	392	51	14	307	1497
Max Count	**96**	**24**	**706**	**8**	**49**	**267**	**988**	**180**	**90**	**465**	

EVERGLADES NATIONAL PARK

Methods

Park biologist flew three colony surveys during the 2001-nesting season. Both traditional colony sites as well as new colonies discovered during SRFs were surveyed. Flights were conducted using a Cessna 182 fixed-wing aircraft. Nesting began in late Jan and increased through early Mar. As a result of a drier than normal wet season, water levels in ENP began receding in late Nov and continued to decline rapidly through the nesting season. This rapid decline in surface water caused nest abandonment in most of the colonies by Apr.

Results

There was an estimated 2605 wading bird nests in 4 mainland colonies during the 2001 season. This number represents a decrease over last year's effort with 7 fewer colonies. The number of wading birds nesting in ENP continues to remain at an all time low. Species nesting in ENP included the Great Egret, Wood Stork, Little Blue Heron, Snowy Egret, Tricolored Heron, and White Ibis. Species nesting in the highest numbers were the Great Egret with 510 nests and the Wood Stork with 1585 nests. For the first time in decades Wood Stork nesting effort exceeded that of all other wading bird species in the mainland colonies. Wood Storks nested in 4 colonies with the largest colony, Tamiami West, containing 1000-1400 nests. For the first time since 1992, Wood Storks nested at the traditional Cuthbert Lake colony. Unfortunately, the rapid dry down caused abandonment by Wood Storks at the Cuthbert, Paurotis Pond, and Rodgers River colonies by early Apr with few young successfully fledged. However, Wood Storks nesting at Tamiami West did successfully fledge young. As noted in the table below, many small herons and egrets were observed nesting in many of the colonies but estimates could not be made from the air.

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Number of wading bird nests in Everglades National Park, February-April 2001

Colony Name and Location	GREG	WOST	LBHE	TRHE	SNEG	WHIB	BCNH	CAEG	Status
Cuthbert Lake 25'13.10 /80'46.50	100	20							
Paurotis Pond 25'16.89/80'48.18	150	125							
Tamiami West* 25'45.48/80'30.47	200	1400			350	100	60		
Rodgers River Bay 25'33.40/81'04.19	60	40	+	+	+				
East River Rookery 25'16.08/80'52.03									Inactive
NE Shark Slough 25'42.29/80'35.90									Inactive
Grossman Ridge 25'37.68/80'38.74									Inactive
West of Obsv. Tower 25'39.48/80'47.96									Inactive
Lane River Rookery 25'18.02/80'53.18									Inactive
Loop Road 25'43.07/80'45.70									Inactive
25'31.31/80'48.70									Inactive
25'33.14/80'50.62									Inactive
Total	**510**	**1585**	**+**	**+**	**350**	**100**	**60**	**0**	

* Data collected by Frederick et al.
+ Indicates species present but unable to determine numbers

FLORIDA BAY

Methods

The aerial census of water birds in Florida Bay continued this past year, however the record was abbreviated because the U.S. Coast Guard cancelled flights due to budget constraints. Flights were cancelled in Jul 2000, May 2001, and Jun 2001. The lack of flights in May and Jun 2001, was especially unfortunate, as this was the latter part of what had been the longest and most severe drought since the Florida Bay aerial water bird census began in Apr 1995.

Results

During the period Aug 2000 - Apr 2001, the Great White Heron, Great Egret, Great Blue Heron, Roseate Spoonbill, and Snowy Egret were observed nesting in Florida Bay. Nesting by the White Ibis and Tricolored Heron was not observed, possibly because of lack of flights in May and Jun. It has not been possible to distinguish nesting by Reddish Egrets on the census flights. Little Blue Herons have not been observed nesting in Florida Bay on any census flight, although large numbers of this species, including many young, are seen in the Bay.

Nesting by Great White Heron was observed in all months except the period Aug 2000 - Apr 2001. The table on page 11 provides an estimate of annual nesting activity, based on the maximum number of nests per colony in any month. The maximum number of Great White Heron nests was observed in Dec. Based on the maximum number of active nests counted on each island in any month, we estimate 410 active Great White Heron nests and 820 individual birds. Nesting by this species occurred in Aug and Nov - Mar.

The highest number of Great Blue Heron nests was observed in Feb. We estimate 39 active nests and 78 individual birds.

Nesting by Great Egrets was observed in Nov and Jan - Apr. The maximum number of nests (233) was observed in Feb. We estimate 466 individual birds were nesting.

Nesting by Roseate Spoonbills was only observed in Jan. In that month, there were 70 nests observed, suggesting 140 nesting birds. Past comparisons with the Audubon ground surveys (see Lorenz, 1999 and 2001 South Florida Wading bird Reports) indicate that our aerial census greatly underestimates nesting activity of spoonbills. According to Lorenz (pers. comm.), Roseate Spoonbill nesting at Tern Key was aborted in Mar, and the birds did not re-nest.

Nesting by Snowy Egrets was observed at Frank Key in Apr. There were an estimated 50 nests (100 individual birds). No active nesting by White Ibis and Tricolored Herons was observed during this past year, possibly because we had no flights in Jul 2000 and May and Jun 2001. In previous year, the latter 2 species were seen nesting in the Bay during surveys. The last observations of nesting by these species were 100 active Tricolored Heron nests in Jun 2000 and 500 White Ibis nests in Apr 2000.

The 2000-2001 season was neither exceptionally high nor exceptionally low, either in terms of number of active nests sighted within the months covered or monthly total sightings of birds (see Figures). This was the case for all wading bird species.

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BIG CYPRESS NATIONAL PRESERVE

No wading bird nesting activity was documented in Big Cypress National Preserve in 2001. Formal surveys were not flown by Big Cypress staff, however, they did search for nesting activity during routine flights S of I-75 for other wildlife (about 8 hrs/week). The last time water levels were this low was in 1989.

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HOLEY LAND AND ROTENBERGER WMAs

There was no wading birds nesting observed on Holey Land and Rotenberger Wildlife Management Areas during the 2001 nesting season. The areas were unusually dry because of the drought.

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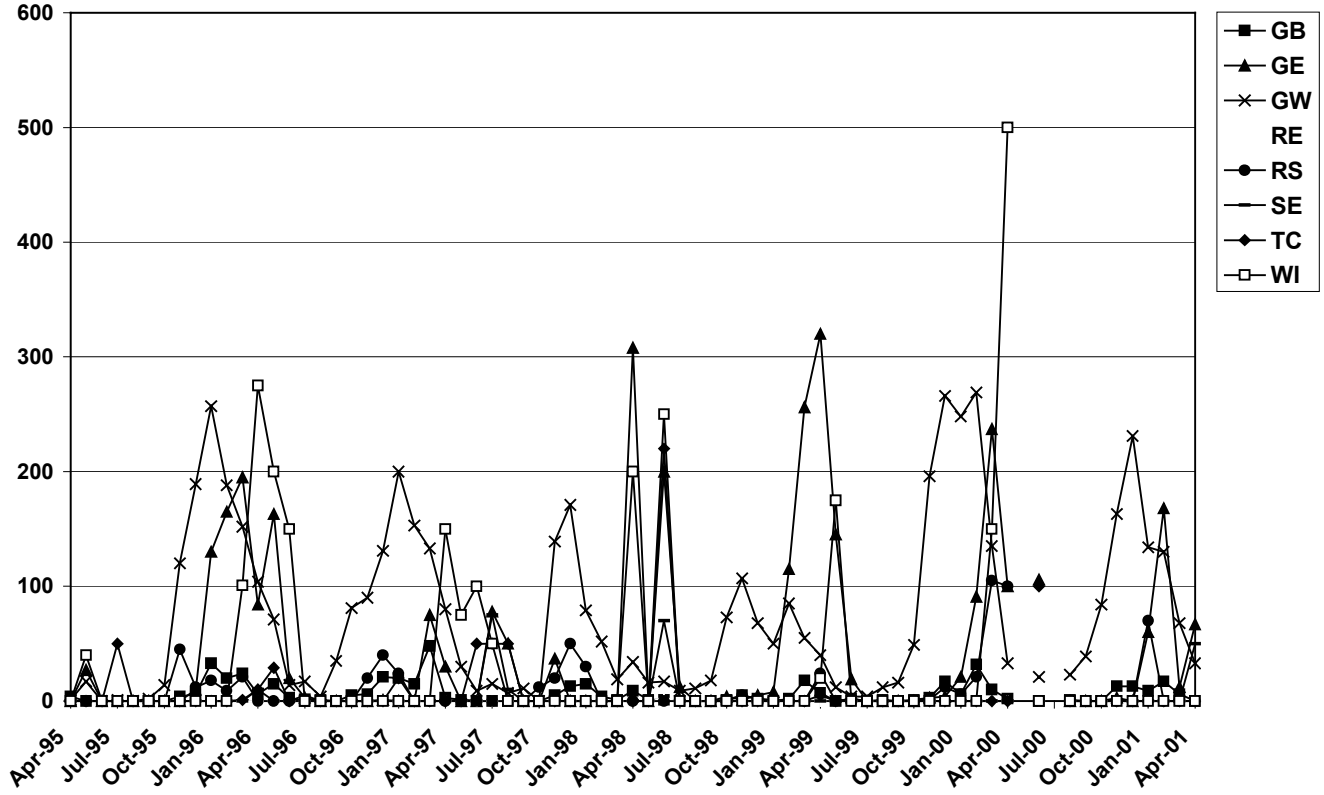
Maximum number of active nests per colony (island) in Florida Bay, by species, from Aug 2000 - Apr 2001.

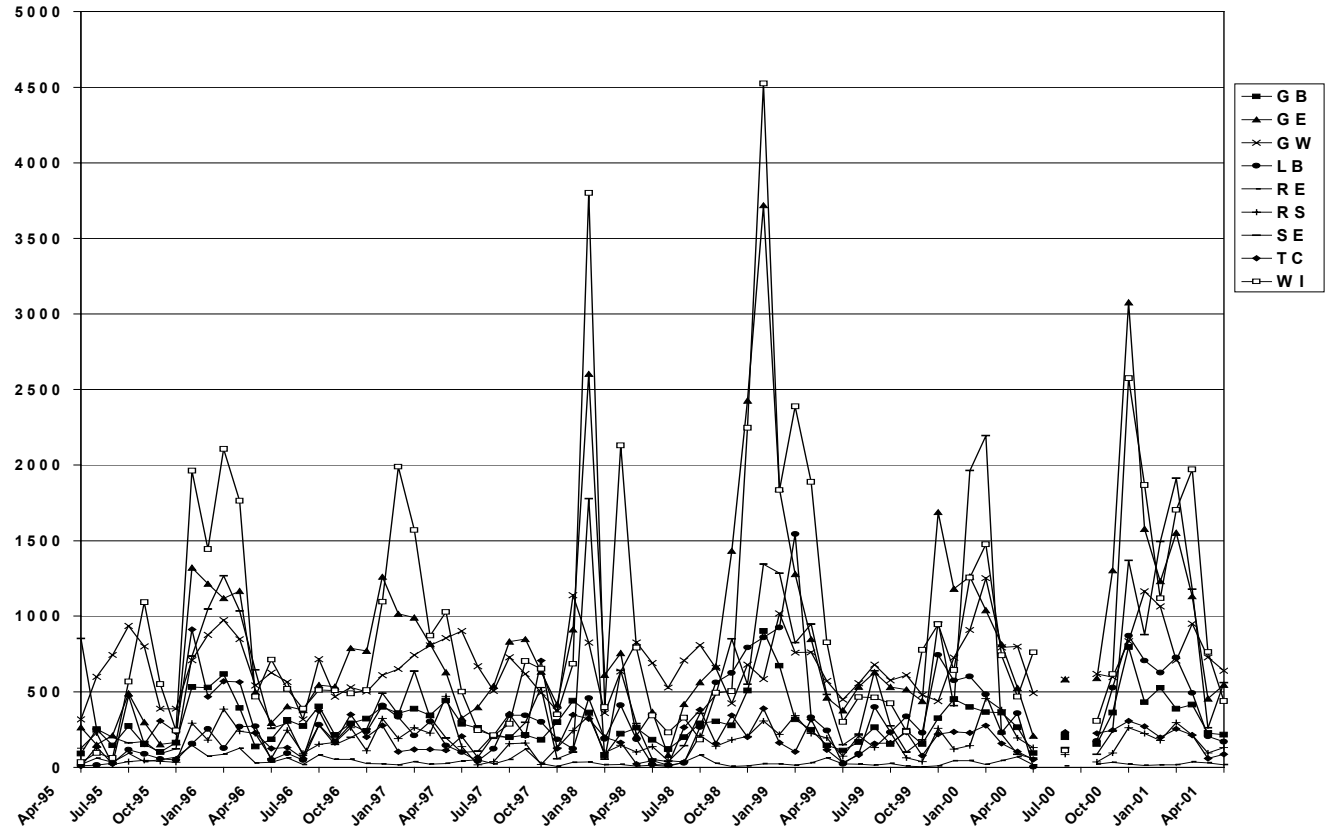
Colony	GWHE	GBHE	GREG	ROSP	SNEG	Total
ARSENICKER UPPER	4	1	2			7
BARNES E	2					2
BLACK BETSY	4					4
BOB ALLEN E	5					5
BOB ALLEN M	2					2
BOTTLE	4	1				5
BOTTLE OUT	1		2			3
BRUSH	2		1			3
BUCHANAN	10					10
BUCHANAN E	4		3			7
BUOY	8					8
BUOY LITTLE	2					2
BUTTERNUT E	3					3
CALUSA	3					3
CALUSA BOOM	2		1			3
CALUSA ROUND	1		2			3
CALUSA ROUND BIG	4					4
CALUSA W	4					4
CATFISH	8	3	1			12
CLIVE	5	4				9
CLUETT	6	2				8
CORMORANT	15	12	11			38
COWPEN	9					9
COWPEN S	15		1			16
CRAB	4		3			7
CRANE	3					3
CRANE E	6		1			7
CRANE W	4					4
CURLEW	2					2
DILDO	15	3				18
FRANK	24	1	120		50	195
HORSESHOE	12					12
JIMMIE N	4					4
JIMMIE N BIG	9					9
JIMMIE S BIG	6					6
JIMMIE S LITTLE	2					2
LIGNUM VITAE	2					2
LOW	4		1			5
MAN O' WAR	1	2				3
MURRAY	19	1				20
NEST S	3					3
OYSTER	3					3
OYSTER KEY	2					2
OYSTER W	2					2
PALM	16	5	7			28
PARK S	5		1			6
PELICAN		2				2
PETERSON	4					4
PETERSON E	11		1			12
PETERSON M	2					2
PETERSON W	2					2
PIGEON	4					4
POLLOCK	6					6
POLLOCK W	7		1			8
RABBIT	10					10
RABBIT N	3					3
RANKIN LITTLE	7					7
ROSCOE	3		1			4
SANDY	17		20	50		87
SHELL	2					2
SID	2		2			4
SUNSET COVE NE PELICAN	25		20			45
TERN W	4	2	20	20		46
TRIPLET	10		3			13
TWIN S	4		1			5
UMBRELLA	1		3			4
OTHER (1 active nest/location)	15	0	4	0	0	19
TOTAL	**410**	**39**	**233**	**70**	**50**	**802**

Note: Nesting sites with only 1 active nest were Butternut Key, Calusa Round Little, Captain, Carl Ross, Cotton Out, Dead Terrapin, Deer, Duck, Jim Foote, Jimme Channel, Otter, Park North, Rankin, Rebrook, Shell Swash, Stake, Tiny Key West of Black Betsy, Topsy, and Trout Cove.

Monthly Number of Active Nests Sighted in Florida Bay



Monthly Number of Birds Sighted in Florida Bay



ROSEATE SPOONBILLS IN FLORIDA BAY

Methods

Thirty-two of Florida Bay's keys have been used by Roseate Spoonbills as nesting colonies (see Table). These colonies have been divided into 5 distinct nesting sub-regions (see Table) based on each colony's primary foraging location. During the 2000-2001 nesting cycle (Nov-May), complete nest counts were performed in 3 of the 5 sub-regions: the NW, NE and Central sub-regions (see Table). Nest counts were performed by entering the active colony and thoroughly searching for nests. Nesting success was estimated for 4 of the sub-regions through mark and re-visit surveys of the largest colony within the sub-region. These surveys entail marking between 15 and 50 nests shortly after full clutches had been laid and re-visiting the nests on an approximate 2-week cycle to monitor chick development. Prey fish availability was estimated at 4 sites (TR, JB, HC, and BS) in the coastal wetlands of NE Florida Bay (see Lorenz et al. 1997 for location coordinates) known to be spoonbill foraging locations for the NE and Central sub-regions. Prey abundance was also estimated at a site located in southern Bear Lake (BL) on Cape Sable where large numbers of spoonbills that nest in the NW sub-region regularly feed. Prey fish were collected monthly from Nov - Apr with a $9m^2$ drop trap using the techniques of Lorenz et al. 1997. Prey availability data have not been fully analyzed and the qualitative information presented should be considered preliminary.

Results

NW Sub-Region: Sandy Key

Nesting surveys were conducted at Sandy Key on 8 and 22 Dec, 9 and 23 Jan, and 26 Mar. We estimated that date of first egg-laying was 23 Nov, date of mean egg-laying was 10 Dec, and date of mean hatch was 31 Dec. On 9 Jan, the colony appeared healthy but it collapsed by 23 Jan. As many as 75 dead chicks were found floating along the shoreline; certainly, many more had already decomposed or were eaten. Out of 130 initial nests, only 10 living chicks were observed. Our preliminary conclusion was that the combination of drought conditions and inclement weather probably caused the colony's collapse. Unprecedented low water levels on the Cape Sable foraging grounds resulted in unexpectedly low prey fish abundance at the BL sampling site: 2 orders of magnitude lower compared to the nesting periods of previous years. A possible explanation for the depauperate prey base may be that shorter hydroperiods on the ephemeral wetlands south of the lake resulted in lower fish production. Furthermore, unusually low water levels during the dry season caused the shallows surrounding Bear Lake to become completely dry (an unprecedented event in the 10 yrs of data collection), thereby forcing the prey into deeper water habitats. Nesting spoonbills dependant on this normally reliable food source would have found it difficult to meet the high energetic demands of their chicks. Furthermore, the strong winds and cool whether that occurred throughout Jan would have made it physically difficult for adults to make the foraging flight from Sandy Key to Cape Sable. A final survey performed on 10 Mar confirmed the extremely low success rate (only 10 juvenile birds) and that no second nesting occurred (only 10 adults).

NE Sub-region: Tern Key

Spoonbill nesting surveys were conducted at Tern Key on 9 and 25 Nov, 15 Dec, 4 and 29 Jan, 14 Feb, and 1, 14, and 26 Mar. As has been the norm for the last several decades, there were 2 distinct nesting periods. We estimated the first egg was laid on 8 Dec, the mean laying-date was 11 Dec, and the last clutch was started 19 Dec. The estimated mean hatch date was 1 Jan and the mean fledging date was 11 Feb. As has been the trend in recent years, the first nesting effort was alarmingly small: only 65 nests compared to almost 200 nests 10 years ago and over 500 nests 25 years ago. This nesting was moderately successful with an average of 0.77 chicks/nest attempt. The standard definition of successful nesting (≥1 chick/nest attempt) suggests a failed nesting. However, more than half of the nests succeeded in fledging young with an average of 1.76 chicks/nest. These results indicate that at least half of the nesting parents were successful in finding food in sufficient quantities to fledge young.

Peak prey availability was temporally staggered among the sites: HC peaked in Nov, BS and TR peaked in both Dec and Jan, and JB peaked in Feb. Previous studies indicate that staggering of peak availability is important for nesting wading birds because it provides a consistent prey source somewhere in their foraging range throughout nesting. A possible reason for prey being available in the NE but not at the NW foraging sites is the open hydrologic connection between Florida Bay and the NE foraging grounds. There is a well-developed coastal ridge at the NW foraging grounds which blocks any direct hydrological connection between the wetlands of Cape Sable and the marine environment. In the NE, the wetlands grade into Florida Bay and are heavily influenced by the marine environment. This marine influence likely ameliorated the effect of the drought on the wetlands through high marine water levels and wind-driven tides. As a result, hydroperiods were longer resulting in greater fish abundance. Furthermore, the draw downs were more protracted, thereby explaining the temporal and spatial staggering of peak fish availability.

As in the previous few years, the second nesting attempt was much larger than the first (130 nests). We estimated the mean laying date as 16 Feb and the mean hatch date as 9 Mar. These chicks had the misfortune of hatching during a period of low prey fish availability. Fish collections were extraordinarily small between the Feb JB sample and the end of Mar, probably due to a large rainfall event. Flooding in urban and agricultural areas prompted water managers to shunt much of the unwanted water to the coastal areas causing unseasonably high water levels at our

fish sampling sites. As water levels increased, fish dispersed over a much wider area, thereby lowering availability. The predictable consequence for spoonbills was that the second nesting failed. On March 26, only 40% of the nests were still active. Although the success ratio was relatively high (0.8 chicks/attempt), the chicks were still relatively young (mean age 11d) and in poor condition. Most were emaciated, lethargic and many appeared dead until the nest was touched. Only 2 adults were seen in the colony, indicating recent abandonment. It was unlikely that any of the remaining chicks survived. Other species were still active so no more spoonbill surveys were performed so as minimize disturbance. However, the Key was visited on 2 subsequent occasions and observations were made from outside the colony. No fledglings or adults were observed, as would have been expected had any of the chicks survived. We believe that the second nesting was a complete failure (probably <0.1 chick per attempt, if any). This event once again demonstrates how anthropogenically-induced pulses in water depth can have lethal consequences for spoonbills.

SE Sub-Region: Middle Butternut Key

Nesting surveys were conducted at Middle Butternut Key on 15 Dec and 4 and 29 Jan. The first egg was laid approximately 5 Dec, the mean laying date estimated as 8 Dec, and the last clutch started about 16 Dec. The estimated mean hatch date was 29 Dec and the mean fledging date was 8 Feb. There were 24 nests; down from 47 in 1999 but well within the range observed over the last 20 years (low: 10 in 1989; high: 66 in 1986; mean = 29 based on the 11 years surveyed). On average, the colony was very successful, with 1.83 chicks per nest attempt reaching the age of 30 d. Historically, the SE colonies foraged mostly in mangrove wetlands on the mainline Florida Keys. Although most of these wetlands were filled by 1972 as part of Keys land boom, we presume (based on anecdotal evidence) that the few remaining wetlands still serve as important foraging habitat. Since 1972 (when large scale filling of wetlands ended), nesting attempts in the SE sub-region generally failed, with 7 failures in 10 years (no estimates were collected between 1986 and 1999). Based on these observations it appears that conditions during the 2001 nesting were above average. Although speculative, one conclusion might be that drought conditions and windy weather promoted high concentrations of fish in these wetlands. Water levels in the southern bay were observed to be unusually low during the nesting period, possibly allowing spoonbills to feed in areas that were too deep under more typical conditions. Fish collections within these wetlands would aid our understanding of nesting patterns in the SE colonies.

Central Sub-Region: E Bob Allen Key

Surveys at E Bob Allen Key (EBA) were attempted on 15 Dec, 4 and 11 Jan, and 17 and 23 Feb but proved to be problematic. Extremely low water conditions made it impossible to approach the key on 4 Jan and from mid-Jan to mid-Feb. Furthermore, a second nesting area was discovered on EBA during the 23-Feb survey that was previously unknown to us. As a result, surveys of EBA from the previous 2 years may have underestimated the actual number of nests. These complications prohibit estimating the timing of developmental phases. Thirty-four nests were counted which compares well with the counts of G.V.N. Powell from 1987 and 1992 (8, 9 ,15, 34, 35, and 24 respectively). Although the problems encountered prevented an accurate estimate of nesting success, more than 40 fledglings were observed indicating that the colony was successful (>1 chick/nest attempt). Significant nesting in the Central sub-region is a relatively new phenomenon, having started in the mid-1980s. As such, little information has been collected on where these birds feed but the central location suggests that they may opportunistically exploit resources used by the other sub-regions. Although it may be more costly for Central birds to reach a given habitat, they have the ability to get to secondary foraging sites should conditions on the primary site become untenable (as indicated below).

Bay-wide Synthesis

Unfortunately, lack of funding once again limited our ability to perform a total count for all of Florida Bay. However, comparisons of nest numbers on individual keys indicated an overall decline in nesting effort since the previous survey (see Table). Of the 18 colonies surveyed, only Tern Key and Jimmie Channel increased in number since the 1999 survey. Although this may be a continuation of the previously reported trend toward lower nesting effort, the fact that the decline appeared to be bay-wide in nature may indicate

otherwise. Past history shows that, in general, nest numbers within each sub-region change independently of one another. For example, in 1999, the NE sub-region decreased, while the NW sub-region increased. Past incidence where the entire bay uniformly increased or decreased in spoonbill nest numbers generally proved to be single-year events. In this case, it seems likely that the drought may account for the low nesting effort overall.

Nest production estimates made over the last 15 years indicate a spatial pattern in nesting success across Florida Bay such that, during the first (traditional) nesting, the highest success generally occurs in the NW sub-region, followed by the NE and Central sub-regions. The SE and SW sub-regions generally having the lowest success rates. However, during the 2001 nesting, this pattern was reversed. The drought and inclement weather probably explain the disastrous year in the NW sub-region and may possibly account for the mildly low production in the NE. In contrast, these same conditions may have been favorable to SE nesters by lowering water levels in the southern Bay during the period nestlings were present. This prolonged low water may have increased the available foraging grounds on the mainline keys and in the southern Bay itself.

The success rate of birds nesting in the Central sub - region can be viewed as supporting our hypothesis that these birds opportunistically exploit all the primary resources used by the other sub-regions. Compared to the Central colonies, the stringent foraging nature of birds in the other 4 sub-regions commits them to a particular foraging habitat. If, for some reason, that habitat becomes compromised, than the nesting attempt is likely doomed (as occurred in the NW this year). However, spoonbills nesting in the Central sub-region have access to the entire mosaic of foraging habitats found in the other 4 sub-regions. This catholic foraging style may cost a little more energetically (longer flights to foraging areas), but the increased likelihood in finding suitable foraging locations may counterbalance the cost. For example, this year Central nesting birds had relatively easy access to the southern bay where conditions were good, possibly explaining their high success rate compared to the northern colonies. However, the increased distance that Central birds had to travel when compared to birds nesting the SE colonies may explain why success was higher in the Southeastern sub-region. Aerial surveys would be needed to further evaluate this hypothesis.

Number of ROSP nests and nesting success in Florida Bay Nov. 2000-May 2001. * indicates colony with nesting success surveys.

Sub-region	Colony	2000-2001 first nesting period	Nesting success	1999 first nesting period
Northwest	Sandy*	130	0.09	177
	Oyster	0		23
	Frank	89		125
	Total NW region	**219**		**325**
Northeast	Tern*	65	0.77	60
	N. Nest	0		0
	S. Nest	14		19
	Porjoe	0		9
	N Park	19		39
	Duck	13		9
	Pass	0		0
	Total NE Region	**111**		**136**
Cental	E. Bob Allen*	34	>1.0	11 (inc.)
	Little Pollach	8		ns
	Caloosa	0		ns
	Manatee	0		0
	Jimmie Channel	33		23
	S. Park	6		7
	Total Central Region	**81**		**?**
Southwest	E. Buchanon	ns		0
	W. Buchanon	ns		0
	Barnes	ns		0
	Twin	ns		2
	Total SW Region	**ns**		**2**
Southeast	M. Butternut*	24	1.83	47
	Bottle	ns		28
	Stake	A		0
	Cowpens	ns		10
	Cotton	ns		0
	West	ns		0
	Low	ns		0
	Pigeon	ns		8
	Crab	ns		7
	East	0		2
	Crane	ns		11
	E. Butternut	ns		2
	Total SE region	**?**		**115**

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SOUTHWEST COAST

On the face of it, this year almost appeared to be a replay of last year but I feel that it was quite different (see hydrology section). Although the interior wetlands dried down fairly quickly there was no appreciable change in the timing of wader nesting. The most noticeable difference from last year was that Great Egrets started many less nests at Marco, but the nests they did start appeared to be successful, unlike last year. The numbers of small wader nests were just a little lower than last year. The overall picture for this year was that the waders at the three colonies that I monitor were down by about 50% from the 19 year mean (See Table) and that Great Egrets had many fewer nests. The sundown censusing in the area showed that the numbers of waders were not down as much as the numbers of nests but were down (See Table). At Corkscrew Swamp and in the surrounding area as far as I know, Wood Storks did not nest this year. To confound the picture the usual second wave of nesting started quite late (mid-Jul) with a few Great Egrets, Snowy Egrets, Little Blue Herons and good numbers of Cattle Egrets.

Location and Methods

Rookery Bay (RB): 26°01'51"N 81°44'43"W. Two Red Mangrove islands, 0.22 ha. Nest census conducted 7 Jun, walk through, complete coverage; 1-person, 1 hr. This year all but 2 Tricolored Heron nests were on the S island. This is the first time this pattern has occurred. Note: at both the RB and ABC colonies, sundown fly-in is censused (25 years, bi-weekly and 23 years, monthly respectively) this gives an index to the numbers of birds using the roosts at night and thus in the area.

Marco Colony (ABC) (named, ABC Islands by State of Florida): 25°57'24"N 81°42'13"W. Three red mangrove islands, 2.08 ha. Nest census conducted 10 Apr and 5 Jun, walk through, complete coverage; 1 person, 2 hrs.

East River (ER): 25°55'39"N 81°26'35"W. Three red mangrove islands, roughly 0.25 ha. Nest census conducted 14 Jun, canoe, complete coverage, 1 person, 1 hr. Unlike the last several years, nesting did not start earlier at this colony than at the other colonies I monitor. It was on the same schedule. Like last year, numbers of nests were quite low, 40% below the 19-yr mean (2000, was 45% below the mean).

Chokoloskee Bay (CHOK): 25°50'43"N 81°24'46"W. Four red mangrove islands, roughly 0.2 ha. Inactive last year, this year most of the waders in the area used 2 of the 4 islands, boat census 18 Jun. Several aerial surveys over the area confirmed that this was the only appreciable nesting.

Chokoloskee Pass (CHPS): 25°46'48"N 81°24'26"W. One mostly red mangrove (2-3 black mangroves) island, roughly 0.5 ha. Aerial survey conducted 22 Jun, photographed, 2 people, 0.25 hr. Surveyed 17 Jul by powerboat circling the islands, 2 people, 0.5 hr. On the aerial survey 42 Great Egrets were recorded but no nests observed. During the boat census, just 4 nests were recorded. Note that all of the walk or canoe censuses are conducted during peak nesting, about the beginning of Jun.

Results

Great Egret: For the peak months of the nesting season (Apr-Jul) there were an average number of Great Egrets in the area (Table #2). But with the low number of nests it would appear that not many birds attempted to nest, those that did seemed successful. Most years there is a second wave of nesting; This year it was late and although I have not done any counts yet, there does not appear to be many nests.

Snowy Egret: This year was very much like last year. Except for changing the dates and numbers, the following paraphrase of last year's quote is applicable. "The numbers of nests for this egret have dropped slowly at both RB and ABC for the past 6 years, this year was no exception. The numbers of Snowy Egrets coming into both RB and ABC to roost at night pose a puzzle. At both night roosts the numbers start increasing before there is any fledging in the area. For example, on 7 Apr 2000, 103 Snowy Egrets, about the number of adults to account for the 59 nests, came in to roost at RB. In 2 weeks (21 Apr) the number more than doubled (264) and by 23 Jun, 441 came in to roost. Each year similar seasonal increases occur in the small herons and egrets (except Cattle Egrets). This indicates that many more small waders are using the area than are breeding there." Note that most adult wading birds that breed in the second wave appear to be in high breeding condition. Their plumes, feather color, and lores were similar to birds at the beginning of the breeding season. This leads me to wonder if these birds are making their first attempt to breed this season or whether they are re-nesting. In Brown Pelicans I have evidence that birds that re-nest do not come into high breeding plumage.

Little Blue Heron: This species started nesting a little early but was similar to last year, which was low.

Tricolored Heron: I wrote the following last year and it still applies. "The drop in nesting has not been as dramatic over the years as with the Little Blue Heron but there has

Number of wading bird nests in coastal Southwest Florida during 2001

Colony	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	GLIB	Total
Rookery Bay		4	57	7	27		43		**138**
Marco (ABC)	14	44	64	17	100	11	168	32	**450**
East River			16	2	114				**132**
Chokoloskee Bay	1	35							**36**
Chokoloskee Pass		4							**4**
Total	**15**	**87**	**137**	**26**	**241**	**11**	**211**	**32**	**760**
Mean (19-year)	**9**	**179**	**297**	**68**	**492**	**4**	**455**	**42**	**1546**

Number of wading birds seen on evening roost counts in Southwest Florida for Apr, May, Jun, and Jul (major part of nesting season).

	GREG	SNEG	LBHE	TRHE	CAEG	WHIB	Mean
MEAN	157	260	185	496	334	2508	657
2001	158	175	121	317	213	2188	529
% CHANGE	0	-33	-35	-36	-36	-13	-20

been a slow decline both in numbers of nests and numbers of Tricolored Herons roosting at both RB and ABC. Again nesting was quite low for ABC and it was the first year since 1981 that Tricolored Herons haven't nested on C Island." This then is the second year that Tricolored Herons have not nested on the C island.

Reddish Egret: This species has nested in the area over the period of the study and has very slowly increased in numbers of nests. This year was the best year ever recorded, with about 11 nests at ABC. All nests appeared successful and fledged 2-3 chicks (1 white chick fledged).

Cattle Egret: Low numbers again this year, but there were quite a few nests initiated at the end of Jul, as mentioned above.

White Ibis: Eight pairs moved in to ABC late (6 Jul) in high breeding plumage but only 1 nested. This species typically nests inland, and then adults and fledglings start to come back in the beginning of Jul. As of yet, there are not enough in the area to comment on their success.

Glossy Ibis: Nest numbers were lower this year and they did not appear to fledge many chicks. What is puzzling is that the numbers of birds roosting at both ABC and RB is increasing.

Note that this work would not be possible without a great crew of dedicated volunteers.

Last year I wrote "In all an interesting and puzzling year." but then isn't every year?

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NORTH FORK OF THE ST. LUCIE RIVER

Methods

The colony is situated near the boundary of the St. Lucie River State Buffer Preserve at 27°15.7 N and 80°19.0 W. It has been active since at least 1998, although it was only surveyed formally in 2000. This year, casual observations were made from a boat on 18 Jun 2001 during a recreational outing. The timing was so late in the year that most nesting was already completed. The numbers here are of young birds still in the colony.

Results

On 18 Jun 2001 there were 12 young Wood Storks, 6 Anhingas, numerous Cattle Egrets, and 4 Tricolored Herons. The birds were already moving around the colony and it was apparent that most birds had already fledged.

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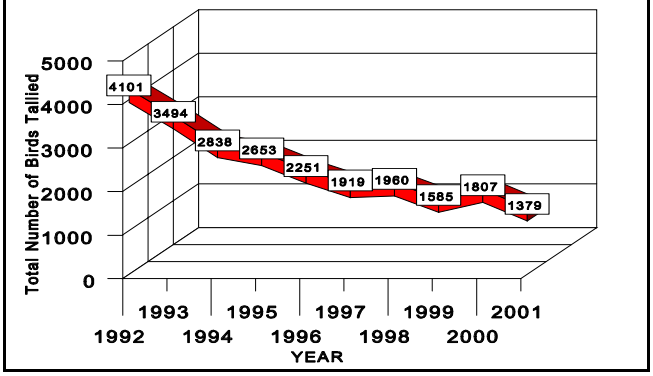
J.N. "DING" DARLING NATIONAL WILDLIFE REFUGE COMPLEX

Methods

Colonial Nesting Bird Surveys at J.N. "Ding" Darling National Wildlife Refuge are conducted via motorboat once per month each year during the months of Apr-Aug at 7 active rookery islands located within Tarpon Bay (Tarpon Bay Keys), Pine Island Sound (Hemp Island, Bird Key and Broken Island) and Matlacha Pass (Lumpkin Island, Upper Bird Island and Lower Bird Island). A decision was made to drop Broken Island from the survey effort after the 2000 nesting season, owing to the relatively low tallies. Total nests are estimated from the maximum total number of nest-tending adult birds tallied for each species during surveys. Surveys are conducted during high tide in the early morning by slowly circling each island and counting all nest-tending adult birds observed. Immature birds of all species are tallied separately. Pelicans are counted as adults, juveniles, and nestlings. Observers attempt to determine breeding stages including whether birds are nest building, on nest, feeding young, or if young have fledge. Observers also tally non-breeding birds at colonies and whether birds are loafing or roosting, feeding or flying. Estimates are based on all observable birds (i.e., "best guess" estimate). Two observers conducted all surveys (23 Apr, 20 Jun, 19 Jul) in 12 hrs.

Fig. 1. Overall Trends in Refuge Complex Nesting Effort at Tarpon Bay Keys and Florida Gulf Refuge Islands, 1992-2000.



Results

This report presents preliminary information because it is based on surveys only through Jul. The 2001 peak estimate (1,379 birds) was 23% below the 2000 peak estimate (1,807 birds). Trends in the maximum total number of estimated nests indicate a 66% decline in overall nesting effort since 1992 (Fig 1). I speculate that this continuous, steady downward trend in nesting effort is associated with declining habitat quality and forage availability. Although Sanibel Island wetland habitats have been restored through exotic plant removal and hydrologic restoration, wetland habitat on the mainland has been degraded by residential and commercial development. Other potential deleterious factors in the area include: 1.) Potential historic atmospheric mercury deposition associated with an incinerator constructed up-river in the Caloosahatchee River watershed within the city of Ft. Myers; 2.) Increasing point-source and non-point source pollution runoff into the estuary resulting from an increasing population in coastal southwest Florida; 3.) Disturbance from increasing water craft operators at nesting rookeries in Pine Island Sound and Matlacha Pass; 4.) Birds moving to alternate nesting locations.

Tarpon Bay Keys: Maximum total number of nest-tending adults decreased by 6.0 % from 2000.

Pine Island Sound: Maximum total number of nest-tending adults decreased by 22% and 19% as compared to 2000 at Hemp Island and Bird Key, respectively.

Matlacha Pass: Maximum total number of nest-tending adults decreased from 2000 by 8% and 38% at Upper Bird Island and Lower Bird Island, respectively, and decreased from 2000 by11% at Lumpkin Island.

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Colonial bird nesting survey peak estimates for J.N. "Ding" Darling National Wildlife Refuge Complex, April-July, 2001. Counts reflect the maximum number of nest-tending adults during four monthly surveys.

Island	BRPE	ANHI	DCCO	BCNH	GRHE	TRHE	LBHE	REEG	CAEG	SNEG	GREG	GBHE	WHIB	Total
Tarpon Bay Keys	66	0	49	5	0	7	2	4	15	21	24	0	0	**193**
Hemp Island	243	1	118	0	0	3	1	1	1	4	1	4	15	**392**
Bird Key	348	10	120	2	2	4	3	7	0	7	3	2	7	**515**
Upper Bird Island	61	1	16	0	2	3	3	4	5	6	8	3	0	**112**
Lower Bird Island	35	0	20	1	0	2	1	0	1	0	4	1	0	**65**
Lumpkin Island	2	28	42	1	1	3	3	0	7	10	1	4	0	**102**
Total	**755**	**40**	**365**	**9**	**5**	**22**	**13**	**16**	**29**	**48**	**41**	**14**	**22**	**1,379**

WADING BIRD ABUNDANCE (FORAGING & NESTING)

EVERGLADES NATIONAL PARK AREA

Methods

Systematic reconnaissance flights (SRF) were performed monthly Dec 2000 - May 2001. Flights were done over 3 consecutive days using a fixed-wing Cessna 182 at an altitude of 60 m. The area covered included ENP and the southern region of Big Cypress National Preserve (transects 55 to 90). These transects were oriented E to W and separated by 2 km. Wading birds were counted, identified, and geographically located using a GPS unit. Changes in surface water patterns (hydropatterns) were also recorded. Five categories were used to describe hydropatterns:

Estimated abundance of wading birds in the Everglades National Park and adjacent areas, Dec-2000 to May-2001

Species	Dec-00	Jan-01	Feb-01	Mar-01	Apr-01	May-01
GREG	28,155	30,357	33,095	28,455	12,505	7,743
GBHE	28	62	21	21	21	82
SMDH	2,424	2,455	2,563	2,162	925	426
SMWH	40,267	51,543	44,738	31,661	11,878	6,787
WHIB	909	513	1,346	795	209	28
GLIB	4,590	2,624	2,116	2,162	2,491	469
WOST	1,802	2,344	1,767	2,264	2,252	1,043
ROSP	2,416	3,406	2,921	2,248	2,020	1,225
GWHE	742	435	467	514	1,363	495
Total Abundance	**81,333**	**93,739**	**89,034**	**70,282**	**33,664**	**18,298**

Estimated abundance of wading birds (all species combined) for the different drainage basins in the Everglades National Park, Dec-2000 to May-2001

Month	SBC	BCME	SS	NESS	ES	SSME	NTS	LPK/STS	EP	CS	LPK/ STSM	EPME	Total
Dec-00	4,441	11,314	12,939	2,125	11,743	15,843	892	4,202	1,842	10,262	4,174	1,556	81,333
Jan-01	3,639	8,318	28,319	3,108	10,252	22,101	1,081	1,771	2,327	7,104	4,250	1,469	93,739
Feb-01	6,124	9,196	27,170	7,016	8,476	16,974	235	2,107	1,955	4,114	4,469	1,198	89,034
Mar-01	2,475	8,264	25,362	10,169	5,373	4,762	20	2,151	1,788	1,845	7,002	1,071	70,282
Apr-01	40	1,463	15,193	4,567	230	1,162	7	5,207	130	1,383	4,234	48	33,664
May-01	13	429	7,937	1,067	396	2,121	33	162	270	2,033	3,775	62	18,298
Total	16,732	38,984	116,920	28,052	36,470	62,963	2,268	15,600	8,312	26,741	27,904	5,404	386,350

SBC = Southern Big Cypress (South of US 41)
BCME = Big Cypress Mangrove Estuary (South of US 41)
SS = Shark Slough
NESS = Northeast Shark Slough
ES = East Slough
SSME = Shark Slough Mangrove Estuary
NTS = Northern Taylor Slough
LPK/STS = Long Pine Key / South Taylor Slough
EP = Eastern Panhandle
CS = Cape Sable
LPK/STSM = Long Pine Key / South Taylor Slough Mangrove Estuary
EPME = Eastern Panhandle Mangrove Estuary

DD - absence of surface water with no groundwater visible in solution holes or ponds; WD - absence of surface water but groundwater present in solution holes or ponds; DT - ground surface area mostly dry but small scattered pools of surface water present and groundwater visible in solution holes or ponds; WT - ground surface area mostly wet but small scattered dry areas; WW - continuous surface water.

Data from each SRF were entered into a database and checked for errors and analyzed using Excel®, Access®, and ArcView®. Densities of birds were estimated using a 2x2-km grid. The number of birds counted inside the 300-m strip was extrapolated to the rest of the 4-km^2 cell by dividing the number of birds observed by 0.15.

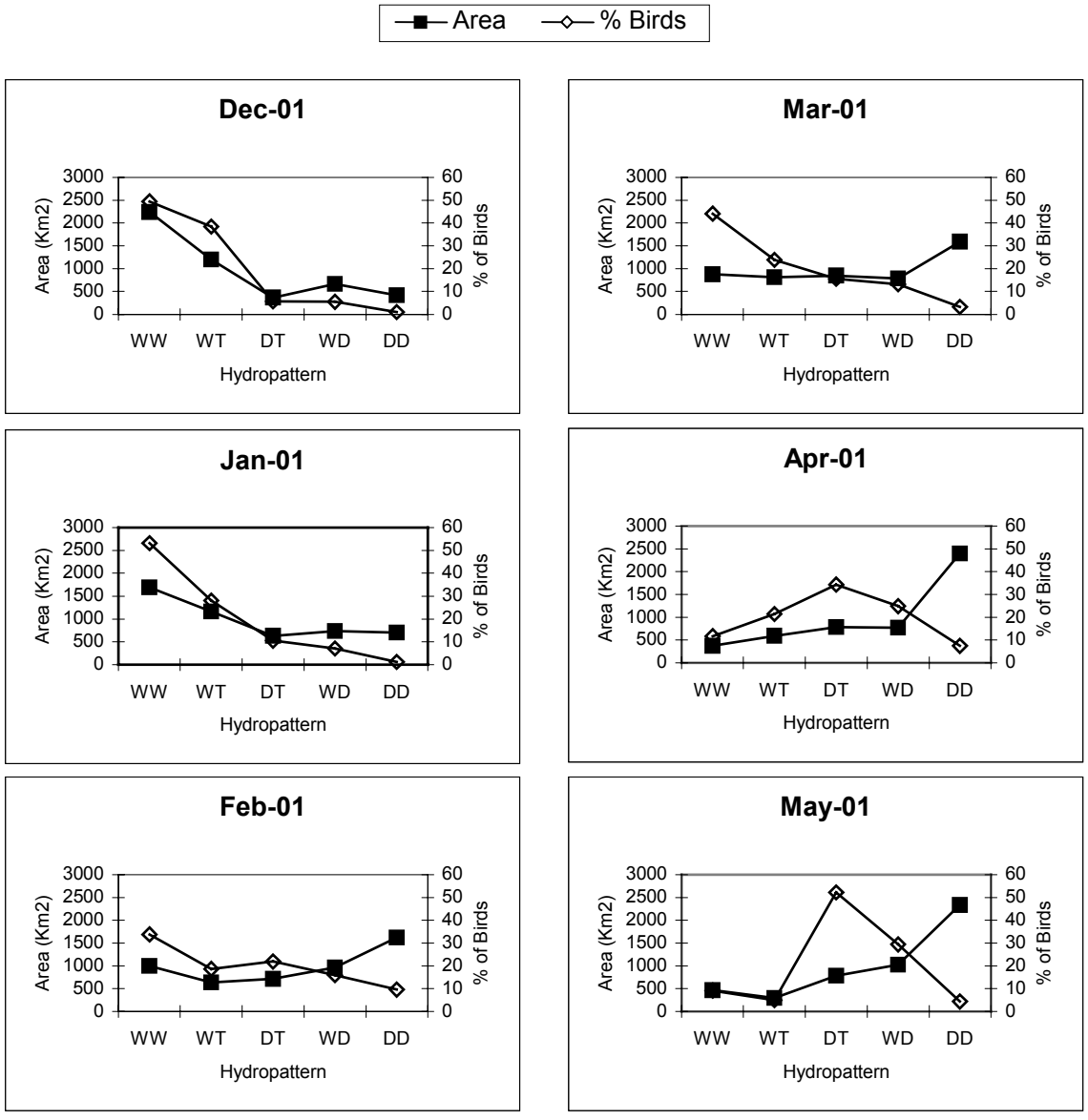
Results

This year showed an overall 10% increase in the estimated number of wading birds compared to the past year (see previous report). The increase in abundance was due to increases in the White Ibis (56%), small dark herons (41%) and small white herons (79%). However, there was a decrease in abundance of the Glossy Ibis (78%), Great White Heron (76%), Wood Stork (31%), and Great Egret (13%).

Peak density for most species occurred in Jan and Feb. However, Wood Storks were most abundant in Dec, Roseate Spoonbills in Apr, and Great White Herons in May.

This year, the lack of normal rainfall produced unusually low water levels that altered the distribution and abundance of wading birds. During the survey period, 57% of the total

The areal extent and percentage of wading birds (all species pooled) in each surface water category. WW = continuous surface water; WT = mostly wet with scattered dry areas; DT = mostly dry with small scattered pools of water; WD = dry with water only in solution holes; DD = dry.



number of birds were found in 3 main drainages (SS, SSME, and BCME). SSME was the basin with the maximum concentration of birds (19%) in Dec.

Usually SS has the lowest density of birds during the first 3 months of the survey due to normally high water levels in that basin. However, this year SS had the largest concentration of birds for all months except Dec due to the absence of water in other basins.

Drastic changes in hydropatterns and bird distributions were observed throughout the season. In Dec, when most of the area was covered by water, the greatest number of birds occurred in the areas classified WW (49%) and WT (38%). During this month, WW accounted for 46% and WT for 25% of the total area surveyed. Jan showed a similar pattern in bird distribution. Despite the important reduction of 25% in the WW area, 53% of the total number of birds occurred in this type of hydropattern. The area covered by WT was very similar to the previous month. However, the number of birds declined by 10% in relation to the previous month. Dec and Jan showed small areas covered by the other hydropatterns with low bird abundance.

As the dry season progressed, the amount of WW and WT area decreased drastically (41% and 45%, respectively) in Feb with a corresponding reduction in bird abundance (19% and 11%). By Mar the areas covered by WW and WT represented only 18% and 16% respectively. However, 68% of the total number of birds observed were found in those areas.

During the last 2 months of the survey, ENP became very dry (DD and WD). In April DD covered 49% and DT 16%, of the area whereas in May, DD covered 47% and WD 21% of the total area. As suitable foraging areas such as WW and WT became scarce and over-foraged at the end of the season, birds shifted to DT. The highest concentration of birds occurred in DT during the months of Apr and May (34% and 52%, respectively) despite only representing 16% of the total area.

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WATER CONSERVATION AREAS & SOUTHWEST FLORIDA

Methods
Wading bird surveys (SRF) were conducted from a fixed-wing aircraft at an altitude of about 60 m along parallel transects with 2-km spacing each month from Jan to Jun 2001. Wading birds were identified to species when possible, enumerated, their locations recorded, their data entered into a database, and summarized into tables. Densities of each species were separated into 4-km^2 cells and plotted onto maps. Data were recorded using HP720 palm top computers linked to GPS. The data were downloaded into a computer spreadsheet, edited for errors, and compiled using a program written in Dephi® programing language. Transects were recorded with a high-resolution digital video linked with GPS.

Results
Overall 2001 was a dry year, with surface water decreasing from Jan until Jun. In the WCAs, monthly wading bird abundance was higher in 2001 than 2000. The wading bird monthly relative abundance peaked in Feb, then declined each month to a low in Jun. In the Big Cypress National Preserve, monthly wading bird abundance was lower in 2001 than 2000 with almost no surface water after Jan 2001. In the Holey Land WMA, wading bird monthly relative abundance peaked in Jan, then decreased to just a few birds as the surface water dried up. Fakahatchee Strand State Preserve, Golden Gate Estates, and 10,000 Islands NWR had very little surface water from Jan to Jun 2001 and correspondingly, had low wading bird numbers.

Final reports from 1996 to 2000 are currently available and the 2001 report should be available in Dec.

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UPCOMING MEETINGS

Waterbird Society: 7-11 Nov, 2001, Niagara Falls, Ontario.

Wilson Ornithological Society: 11-14 Apr, 2002, Fort Myers, Florida.

Third North American Ornithological Conference (theme is "Birds of the Bayou"): 24-30 Sep, 2002, New Orleans, Louisiana

Estimated Wading Bird Abundance in 2001 from SRFs

Region	Species	Jan	Feb	Mar	Apr	May	Jun
Water Conservation Areas	GREG	30,593	49,906	32,620	23,648	20,281	13,486
	GBHE	1,553	1,814	1,573	681	661	473
	SMDH	1,327	1,527	560	627	781	107
	SMWH	380	460	547	474	3,681	806
	WHIB	46,308	69,547	31,900	26,241	20,693	6,767
	GLIB	273	1,447	1,313	620	200	20
	WOST	1,719	1,826	2,961	2,900	3,661	47
	CAEG	0	81	0	233	120	0
	GWHE	0	0	413	460	260	693
	ROSP	0	14	386	193	194	0
	Regional total	**82,153**	**126,622**	**72,273**	**56,077**	**50,532**	**22,399**
Big Cypress National Preserve	GREG	6,153	4,233	1,133	1,213	147	587
	GBHE	427	487	87	67	13	40
	SMDH	67	40	7	7	13	13
	SMWH	160	127	87	227	20	147
	WHIB	25,080	3,493	687	173	80	2,293
	GLIB	7	67	0	0	0	0
	WOST	1,733	947	327	213	7	167
	CAEG	300	240	120	953	927	1,567
	GWHE	0	87	27	27	0	113
	Regional total	**33,927**	**9,721**	**2,475**	**2,880**	**1,207**	**4,927**
Fakahatchee Strand State Preserve, Southern Golden Gates Estates, and 10,000 Islands NWR	GREG	360	287	273	347	167	633
	GBHE	0	33	7	100	27	40
	SMDH	27	7	13	0	7	13
	SMWH	0	7	0	20	7	180
	WHIB	393	80	80	0	133	760
	GLIB	0	13	0	33	0	0
	WOST	13	47	20	40	60	0
	CAEG	13	7	47	0	47	7
	GWHE	0	7	13	7	47	7
	ROSP	7	0	0	0	0	0
	Regional total	**813**	**486**	**453**	**547**	**487**	**1,640**

STATUS OF WADING BIRD RECOVERY – 2001

This is the sixth annual report (1996 – 2001) on the status of nesting by wading birds in the Everglades basin. Previous annual reports were included in Gawlik & Ogden (1996), and Gawlik (1997, 1998, 1999, 2000). The purpose of these reports is to compare the annual nesting patterns of 5 species of wading birds in the Everglades basin with a set of baseline data for these same species between 1986-1995, and with a wading bird restoration goal proposed for the Comprehensive Everglades Restoration Plan (Ogden et al. 1997, RECOVER 2001). Information used in this summary report is restricted to data collected on surveys of nesting colonies LNWR, WCAs 2 & 3, and mainland ENP. See the earlier reports for additional information.

Results

Numbers of Nesting Birds: In 2001, the total number of nesting pairs for the 5 indicator species in the Everglades was 5,450 Great Egret pairs, 3,600 Snowy Egret pairs, 2,200 Tricolored Heron pairs, 17,300 White Ibis pairs, and 2,050 Wood Stork pairs. The total for the 5 species was 30,600 nesting pairs, compared to 8,012 pairs in 1996, 8,301 pairs in 1997, 6,936 pairs in 1998, 21,590 pairs in 1999, and 32,872 pairs in 2000. No storks nested at Corkscrew Swamp Sanctuary in 2001, the major stork nesting site in south Florida in some years.

Ogden et al. (1997) recommended using a 3-year running average of numbers of nesting pairs as a means for measuring long-term trends in nesting effort. The attached table shows the highest and lowest values from among the 3-year running averages for the base years (1986-1995), the 6 recent annual assessments, and the restoration targets recommended in Ogden et al. (1997). In this table, numbers for Snowy Egrets and Tricolored Herons are combined.

Seasonal Timing of Nesting: The restoration target is to shift the timing of nesting to earlier in the dry season, to a time frame that more closely matches pre-C&SF Project nesting patterns (Ogden et al. 1997). The wading bird that has shown the greatest change in timing of nesting is the Wood Stork. On average storks initiated nesting in Dec during the 1930s-1940s, in Feb during most of the 1980s (Ogden 1994), and in Mar in a number of years since the late 1980s. Although the current colony surveys are not well designed to determine the timing of nesting initiation, most storks in the Everglades in 2001 began nesting in Jan and Feb. The comparatively early nesting this year was presumably prompted by the early and rapid drying that occurred as a result of system-wide drought conditions.

Location of Colonies: The restoration target is to recover large, sustainable nesting colonies in the areas of the greater Everglades basin where the largest colonies occurred in the pre-drainage system. These large historical colonies were, in-so-far as we know, located along the marsh-mangrove ecotone downstream from the major Everglades flows. In most years before the C&SF Project an estimated 75-95% of all nesting birds for these 5 species nested in the ecotone sites (Ogden 1994).

The number of wading birds of these 5 species that nested in the southern mainland ecotone region in 2001 was about 500 pairs, or 1.6% of the total Everglades nesting effort (The Tamiami Trail Colony is included as part of the cluster of interior Everglades colonies). The number of birds nesting in the ecotone region averaged 26% in the baseline years, 1986-1995 (range 6-58%). The number from previous assessment years was 11% in 1996, 2% in 1997, 4.6% in 1998, 3.5% in 1999, and 4.0% in 2000. In 2001, approximately 52% of the total number of nesting birds nested in LNWR, and 46% in WCAs 2 and 3.

Discussion

The total numbers of nesting birds in the Everglades for the past 3 years (1999–2001), has been higher than for almost any year between the late 1970s and 1998 (1992 was in this same numerical range). The total numbers in 2001 met the restoration target for Great Egrets (see Table), was about 50% of the minimal target for Snowy Egrets and Tricolored Herons, and met the target for White Ibis and Wood Storks. Overall nesting success in 2001, however, was probably lower than last year, mostly due to poor success in WCA 2 & 3 (Frederick et al., this report) and ENP (Alvarado and Bass, this report). It is too soon to say whether the high numbers in these recent 3 years are indicative of some real improvement, or whether they represent the upper end of a highly variable "base-line" condition for the pre-restored Everglades.

My current view is that the restoration targets for numbers of nesting birds in the Everglades basin suggested by Ogden et al. (1997) are too cautious. It is probably time for a team

Species	Base high/low	1994-96	1995-97	1996-98	1997-99	1998-00	1999-01	Target
GREG	1,163/3,843	4,043	4,302	4,017	5,084	5,544	5,996	4,000
SNEG/TRHE	903/2,939	1,508	1,488	1,334	1,862	2,788	4,270	10,000-20,000
WHIB	2,107/8,020	2,172	2,850	2,270	5,100	11,270	16,555	10,000-25,000
WOST	130/294	343	283	228	279	863	1,538	1,500-2,500

of Everglades ecologists to re-assess the targets for this parameter. The current restoration target for total numbers is 25,000-50,000 pairs for the 5 species (see table).

The estimated total number of nesting pairs for these 5 species averaged about 35,000 to 45,000 pairs between 1931-1946, but peaked in at least 2 years at over 100,000 pairs (Ogden 1994). Estimates of total nesting averaged 16,000 pairs during the 1970s (highest was 20,000-25,000 pairs in 1975-1977), and averaged 5,000 pairs during the 1980s (highest was about 8,500 in 1982) (Ogden 1994).

Recommendation

The accuracy and value of wading bird colony surveys in south Florida continue to be limited by inconsistencies in survey protocols, and from large spatial and temporal gaps in coverage. Although in recent years there has been some improvement in documenting survey methods and effort, standardizing modes of survey (i.e., by helicopter, fixed-wing aircraft, airboats or boats), and standardizing frequency of surveys, there has yet to be acceptance and adherence to strict survey protocols system-wide. Surveys are still lacking in the expansive Big Cypress Swamp, which is known to be an important wading bird nesting area. Most existing surveys are conducted only from Jan through Jun, thus missing nesting that may occur between Jul and Oct. Large late summer nesting colonies have been documented in south Florida in some earlier years. These inadequacies must be corrected.

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SPECIAL TOPICS

COUNTING ACCURACY DURING AERIAL SURVEYS

Many of the waterbird biologists in south Florida are aware that we have been trying to measure counting accuracy for individual observers flying aerial surveys. Most biologists are aware that aerial survey estimates are probably biased, as a result of observer bias, visual obstruction by vegetation, layering of nests, glare, etc. Yet we are almost never in a position to know the degree of our error simply because we never know the true numbers of birds.

To address this problem, we have been using a scaled model of a wading bird colony complete with vegetation, upon which we can place pre-counted numbers of "birds" (actually alfalfa seeds). Observers who are unaware of the true numbers then attempt to estimate the colony size, by walking around the model at the same scaled altitude as they would in an aircraft. We have so far tested only biologists who have been trained in aerial survey, and have some experience with the technique in the field.

Our preliminary results suggest that there is wide variation among observers in their accuracy, and that even experienced biologists tend to underestimate true numbers by a large amount. We have documented overall undercounts in the range of 40 – 50% for small colonies (<1000 individuals), 20 – 30% for medium colonies (2,500 – 3,500) and up to 50% undercount for large colonies (>5,000 individuals). This problem is not necessarily fixed by counting aerial photos – we have taken photos of the colony model under excellent lighting conditions, and then hand-counted the projected slides. We are finding up to 35% overcounts for colonies below 1,000, 15 – 30% undercounts for colonies of 1 – 3000, and >40% undercount for colonies of >4000 nests. Although photos may reduce the variation in inter-observer counts, it is clear that the use of photos induces large biases as well.

We are planning on continuing our measurements with this model in order to increase the sample size and investigate the effects of age and experience of observers, and calibration training on accuracy and interobserver variation.

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Part of a White Ibis colony (01083) in LNWR on 16 Mar 2001. Small pools of surface water still present along edges of tree islands.

A TOOL TO ASSESS THE IMPACT OF DROUGHT CONDITIONS ON WADING BIRD COLONIES

This year's drought in south Florida created a situation where water managers had to ensure that an adequate supply of water was available for human use while minimizing impacts to the Everglades ecosystem. There was concern for all components of the ecosystem with special emphasis on wading birds, snail kites, exotic vegetation, and peat fires. To aid managers with their task, South Florida Water Management District staff created a series of indices that formalized current knowledge of the effects of drought on these ecosystem attributes. The indices are compiled in Drought Ecological Impact reports that were updated monthly and can be found at: http://www.sfwmd.gov/curre/watshort/index2_sept.html Included in these indices were a wading bird foraging suitability index and a wading bird colony suitability index. Here, we describe the Wading Bird Colony Suitability Index.

Colonies are impacted when the surface water directly at the colony site disappears, thus providing access to mammalian predators and potentially causing abandonment of the colony (Rodgers 1987, Frederick and Collopy 1989). We reference the role of mammalian predators with some reservation because direct evidence for their impact is scarce. Nevertheless, regardless of the cause of abandonment, the relationship between colony abandonment and dry conditions appears in the literature

and has been observed in the Everglades (J. Ogden, pers. comm.).

We only included colonies containing Wood Stork and White Ibis nests because they are species of top management concern whose populations have declined over the last several decades. The Wood Stork is a federally Endangered Species and the White Ibis is a Florida Species of Special Concern. Also, nesting data (Crozier et al. 2000) have shown that in years with drought conditions, few herons and egrets attempt to nest whereas large numbers of Wood Storks and White Ibises may. Focusing attention on the species that have the best chance of success during drought years is the most prudent management strategy because there is at least some chance that they will nest successfully.

Colonies with Wood Stork or White Ibis nests located in the WCAs and northern ENP that were active in the 2000 breeding season, as well as any new colonies that were found during the 2001 breeding season, were monitored with aerial surveys from helicopters. Colonies were surveyed monthly between 16 Mar and 7 Jun to determine the number of Wood Stork and White Ibis nests in each colony. Six colonies were monitored in the WCAs and ENP (Fig. 1).

Because the suitability of a nesting colony requires information on the surface water at a colony site rather than at a gage, the first step in the index development was

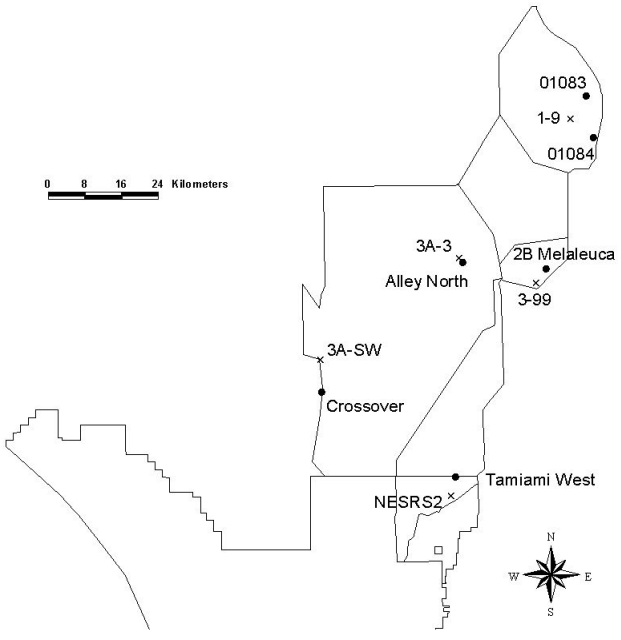
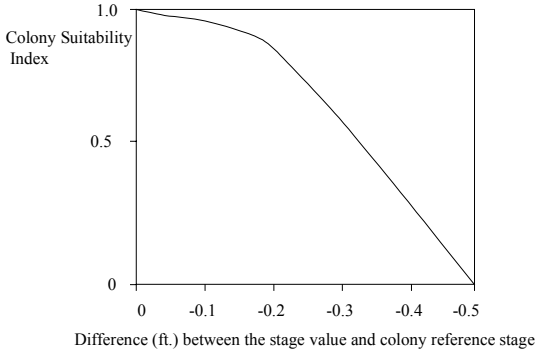


Fig. 1. The location of the water depth gages (cross hairs) and Wood Stork and White Ibis colonies (dot) in the Water Conservation Areas and Everglades National Park.

Fig. 2. Colony suitability index as a function of colony reference stage. Colony reference stage is the stage at which the surface water at a colony dries.



to link surface water conditions at colonies with stage readings at gages. Colony locations were overlaid onto a 4km^2 grid of the WCAs and ENP. For each grid cell containing a colony, surface water estimates were obtained from aerial SRF wading bird surveys (Bancroft and Sawicki 1995). SRF surveys provided monthly estimates (Jan - Jun) of surface water (wet - entire cell covered with water; transitional - only a portion of the cell covered with water; dry - no surface water present) from 1986 to the present. Surface water estimates were examined to determine times when cells with colonies were first recorded as dry following at least 1 survey when surface water was present. Stages (NGVD) were obtained for those dates from corresponding gages (Table 1). The gages chosen were on telemetry (with the exception of 3A-SW), had data for the period of record, and were close to the wading bird colonies (Fig. 1).

A mean stage was calculated and used to represent the average point at which a colony site was dry and colony site suitability began to decrease (hereafter termed the colony reference stage; Fig. 2). The colony reference stage was 14.8 ft (gage 1-9) for colonies 01083 and 01084, 6.9 ft (gage 3-99) for the 2B Melaleuca colony, 7.9 ft (gage 3A-3) for the Alley North colony, 9.0 ft (gage 3A-SW) for the Crossover colony, and 5.5 ft (gage NESRS2) for Tamiami West colony. Initially, we chose 7.1 ft as the colony reference stage for 2B Melaleuca. But, this value was too high based on personal observations and we adjusted the value to 6.9 ft. The colony site suitability function (Fig. 2) assumes that any amount of surface water produces a suitability of 1.0 (highly suitable). Suitability begins to decrease when water levels fall below the colony reference stage, and suitability decreases to 0 when stage drops to 0.5 ft below the colony reference stage. At that point it is likely that the marsh surface will be completely dry and the colony will be abandoned.

Index validation

To validate the colony suitability index, the date the colony

Table 1. Year and month White Ibis and Wood Stork colonies in the WCAs (1986-1995) and ENP (1985-2001) went dry based on surface water estimates from SRFs and corresponding gage readings.

Colony	Location	Species	Year	Month	Gage	Stage (ft)
01084	LNWR	WHIB	1989	May	1-9	14.77
01083	LNWR	WHIB/WOST	1989	Feb	1-9	14.73
01083	LNWR	WHIB/WOST	1989	Apr	1-9	14.73
01083	LNWR	WHIB/WOST	1992	Jun	1-9	15.13
2B Melaleuca[1]	WCA 2B	WHIB/WOST	1992	Apr	3-99	7.11
Alley North	WCA 3A	WHIB	1989	Mar	3A-3	7.93
Alley North	WCA 3A	WHIB	1990	Feb	3A-3	7.94
Alley North	WCA 3A	WHIB	1992	Jun	3A-3	7.74
Crossover	WCA 3A	WOST	1989	Apr	3A-SW	9.06
Crossover	WCA 3A	WOST	1989	Jun	3A-SW	9.21
Crossover	WCA 3A	WOST	1990	Apr	3A-SW	8.47
Crossover	WCA 3A	WOST	1992	Jun	3A-SW	9.25
Tamiami West	ENP	WOST	1985	Feb	NESRS2	5.74
Tamiami West	ENP	WOST	1989	Feb	NESRS2	5.24
Tamiami West	ENP	WOST	1991	Jan	NESRS2	Not Avail.
Tamiami West	ENP	WOST	1992	May	NESRS2	5.24
Tamiami West	ENP	WOST	2001	Mar	NESRS2	5.70

[1] This colony went dry in Mar 1989, Jan 1990, and Mar 1991 but lack of stage data prohibited the use of these dates. No surface water estimates were available for Mar 1992 so the colony may have gone dry in Mar, but it is unlikely according the surface water patterns in Apr.

was predicted to go dry based on the suitability index (0.5 ft below colony reference stage) was compared with surface water observations made during monthly aerial surveys (Table 2). The suitability index accurately predicted when the 01084, 01083, and Crossover colonies would be unsuitable (i.e., no surface water present). It is likely that the index also accurately predicted when the Tamiami West colony went dry because the colony may have been predicted to be dry as early as 26 April (we do not have stage data for 26 Apr - 11 May), but by 12 May the colony was already 0.5 ft below the point at which the suitability index = 0. We believe the 2B Melaleuca colony prediction may also have been accurate because although we never saw a lack of surface water at the colony on aerial survey dates (isolated pools were always present), it is probable the colony went dry between surveys. The colony suitability index was not correct for the Alley North colony. As a result, we have adjusted the colony reference stage for this colony to 9.3 ft based on the gage reading on 19 Apr when colony suitability was 0.

Index application

We used the index to assess colony suitability (i.e., risk of abandonment) under different water management scenarios by comparing the index values calculated from predicted stages of the South Florida Water Management Model Position Analysis. These comparisons allowed us to focus our management actions on the colonies most in need of attention, and they provided some assessment of the relative effects of various water management scenarios.

As the drought progressed and the predicted suitability of the Tamiami West colony decreased to 0, managers were able to stay abreast of the situation. Personnel from various agencies began discussions on how to reduce the risk of nest abandonment to the largest colony of Wood Storks in South Florida. In the end, there was only a limited ability to slow the lowering of the water table under the colony; by reducing flows out of the adjacent canal. Nevertheless, that action was taken and the colony

Table 2. Validation of the colony suitability index based on stage values and surface water patterns from the 2001 dry season.

Colony	Colony Reference Stage (ft)	Date Colony Suitability Index = 0[a]	Date Surface Water = 0[b]	Colony Response
01084/01083	14.8	Never	Never	Both successful; some abandonment of 01083 by 19 Apr and of 01084 by 11 May
2B Melaleuca	6.9	30 Apr	Never	WOST abandoned between 19 Apr and 11 May. Some WHIB abandoned by 25 May
Alley North	7.9	Never	19 Apr	Abandoned by 19 Apr
Crossover	9	24 Apr	19 Apr	Abandoned by 19 Apr
Tamiami West	5.5	12 May[c]	19 Apr	Some abandonment by 11 May

[a] First date in the 2001 dry season that the stage minus the colony reference stage $\leq$ - 0.5 (i.e., the point at which the colony was predicted to be dry based on the colony suitability index).

[b] First date in the 2001 dry season that the colony was dry based on surface water observations made during monthly aerial surveys. Survey dates were 16 Mar, 19 Apr, 11 May, 25 May, and 7 Jun.

[c] Stage data missing between 26 Apr and 11 May.

Tamiami West Wood Stork colony on the northern edge of ENP on 10 May 2001. The only visible surface water is in a small ditch bisecting the colony.

ultimately fledged about 900 young storks. It is not known whether this management action played any role in the success of the colony. Tamiami West was unusual in that the storks were further along in the nesting cycle than those at Crossover colony, which failed as predicted. It may have been that the adults at Tamiami West were more hesitant to abandon their older young, highlighting the importance of early nest-initiation, which we use as a measure of restoration success. Also, Tamiami West was bisected by a small ditch that held surface water throughout the nesting period. Perhaps the presence of some water was enough of a stimulus to keep birds from abandoning. On our final aerial survey, we located several flocks of fledgling storks feeding 9 mi W of the colony in the southern end of WCA3A. Their ability to find some of the only remaining foraging habitat within miles of the colony was our final concern for the birds. It is by no means sure that they will survive to adulthood, but it is certain that they had the opportunity because of some combination of management concern and good luck.

Acknowledgments

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HYDROLOGIC AND DROUGHT-RELATED IMPACTS TO WADING BIRDS IN A.R.M. LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Water levels within the LNWR were close but slightly below the recommended maximum schedule set by USACOE at the beginning of Jan 2001. A combination of lack of rain and water releases to LWDD and WCA 2A (USACOE & SFWMD) saw marsh interior water levels plummet nearly 2.5 ft from Jan to the end of Feb. In Feb, the LWDD requested that the USACOE and SFWMD consider a temporary deviation from the current regulation schedule for LNWR and lower the minimum, or floor, from 14.00 ft M.S.L. to 11.00 ft M.S.L. As the drought intensified, LWDD staff became concerned over water supplies to local agricultural interest, urban areas, and intrusion of saltwater into freshwater wells. Interior water levels continued to plummet throughout Mar and reached a low of 13.36 ft M.S.L. on 10 Mar at the 1-8C canal gauge. A rain event on 19 Mar (4.40 in) and water inflows from the S-5A drove water levels at the 1-8C gauge to 15.20 ft M.S.L. LNWR managers and biologists feared this rapid (nearly 2 ft) rise in the water levels would have detrimental impacts on wading bird nesting efforts by scattering forage which had become concentrated in shallow pools. However, no impacts to wading bird nesting were observed because most of the smaller wading birds (i.e., Little Blue Heron, Tricolored Heron, Snowy Egret, and White Ibis) had not yet built nests. It is highly unlikely that this weather event affected nesting Great Blue Herons. Great Egrets seem to be a little more sensitive to hydrologic changes even though they are only slightly smaller in size than Great Blue Herons.

Between 9 Apr and 23 May, canal L-40 water levels plunged nearly 3 ft and reached a low of 12.06 ft M.S.L. LNWR staff again were concerned that water releases and the protracted drought would adversely impact wading bird nesting. As of late Apr, the only portions of LNWR retaining visible water were the central slough, southern end, and isolated alligator holes. Large flocks of wading birds were seen feeding in alligator holes. During the week of 23 Apr, the SFWMD and USACOE approved, after considerable research and discussions on potential impacts to wildlife and habitats, a temporary lowering of the water regulation schedule for LNWR to a floor of 11.00 ft M.S.L. The LWDD justification for water releases continued to focus on saltwater intrusion in well fields and water supply for local agricultural interests. By mid-May even the outer edges of the central slough in LNWR were dry.

During the last week of May, 5 in of rain were recorded at the Refuge and along with water inflows at the S-5A, canal water levels rose nearly 2.5 ft M.S.L. from the previous low. Marsh interior water levels rose over 0.8 ft in a 3-day period and many areas that were completely dry became re-hydrated. LNWR managers requested that the SFWMD limit inflows for the benefit of wading birds, which were still actively nesting. There was some concern that the rain event may have affected birds that had just initiated nesting or had small nestlings but there was no evidence to show that it caused nest abandonment. It is believed that the majority of nests had already fledged young by the time the event took place and that young would find suitable foraging elsewhere. Water levels at the L-40 canal gauge and within the marsh interior continued to rise as the result of frequent heavy rains throughout Jun and Jul 2001. A Cattle Egret colony along the airboat trail was still active the first week of Aug.

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