SOUTH FLORIDA WADING BIRD REPORT

Volume 10 Gaea E. Crozier and Mark I. Cook, Editors November 2004

SYSTEM-WIDE SUMMARY

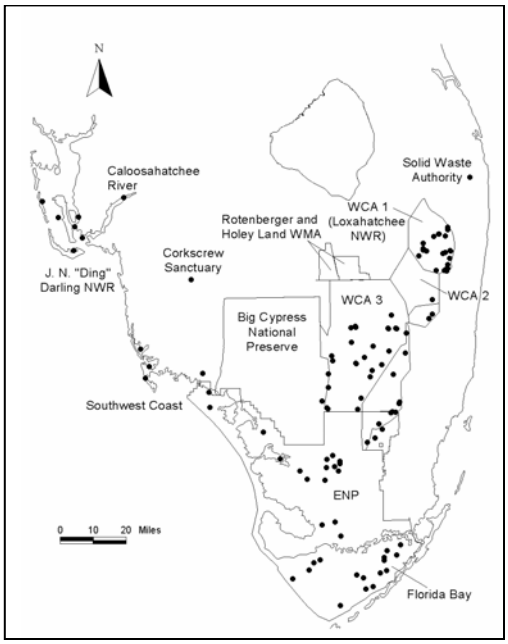
The estimated number of wading bird nests (excluding cattle egrets, which are not dependent on wetlands) in South Florida in 2004 was 54,187. This is a 61% increase from last year and a 22% decrease from the record year of 2002, which was the best nesting year on record in South Florida since the 1940s. In terms of the total number of nests, this year is on par with historic nesting events of the 1940s and is the second best nesting year on record in South Florida since this time period. The increased nesting effort this year can be attributed to almost 18,000 more White Ibis nests in the Water Conservation Areas compared to last year, approaching that observed in the record year of 2002. However, there was a 21% decrease in Wood Stork nests in South Florida compared to last year and a 37% decrease from 2002. Although there were more Snowy Egret nests compared to last year, the number of nests was relatively low (70% decline) compared to the record year of 2002.

As usual, nesting effort differed among regions in the Everglades. WCA 3 supported the largest number of nests (64%) and WCA 1 supported 29% of the nests in the Everglades, whereas ENP supported the lowest number of nests (7%). This pattern is similar to 2003 (52% in WCA 3, 39% in WCA 1, and 8% in ENP) and is almost identical to the record year of 2002 (70% in WCA 3, 25% in WCA 1, and 5% in ENP). Similar to 2002, almost 40% of the nests in South Florida this year (19,170 nests) were concentrated in a single colony (Alley North) located in northeast WCA 3A. Fifty percent of the White Ibis nests in South Florida were located in this colony.

Unfortunately, 2004 was noteworthy in that wading birds generally initiated nesting later than usual this year, and there was considerable nest failure by some species (i.e., Wood Storks and Roseate Spoonbills). Heavy rains caused water levels to increase rapidly multiple times during the breeding season. A high proportion of Wood Stork nests were abandoned after water level reversals occurred in late February when birds were brooding eggs. Only minor or no abandonment was observed by Wood Storks during water reversals in April and May when chicks were older. These observations are consistent with information gathered in previous years suggesting that birds may be more sensitive to water level reversals during the earlier part of the nesting cycle. In contrast, only minor abandonment was observed by White Ibises, and the timing of the water level reversals may have been key with the February reversal occurring before ibises began nesting and the late spring reversals occurring late enough in the nesting cycle that ibises were less sensitive.

The 2004 nesting season was similar to 2003 in that higher than normal nesting asynchrony occurred compared to recent years. This year, wading birds initiated new nests throughout the entire breeding season, even as late as mid June. The cause of this asynchrony may be related to the multiple water level reversals that occurred this year which may have delayed nesting and caused some birds to re-nest after previous nests had failed. Notably, June was exceptionally dry this year, and optimal feeding

Locations of wading bird colonies in South Florida in 2004. Colonies with ≥ 50 nests are depicted in LNWR and the WCAs.



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conditions were extended much longer than normal. As a consequence, many wading birds that delayed nesting or re-nested were able to successfully fledge offspring. Optimal feeding conditions in June were also beneficial to the large numbers of nestling White Ibises that began to fledge during that month.

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HYDROLOGY 2004

The rainfall and associated stage readings for the 2004 water-year (May 2003 – April 2004) are shown in Table 1 below. In general, the 2004 hydrologic conditions were lower than the average throughout the Everglades Protection Area. Like last year, WCA-1 and WCA-2 were 15% below average. On-the-other-hand, WCA-3, which was slightly above average last year, was 9% below average this year. The ENP, which was also slightly above average last year, was 14% below average this year.

These below average 2004 rainfall amounts were not indicative of the 2004 stage data, which were in general, above average. The below average stage for WCA-2 was due to lower than average inflows through structures and above average outflows through structures. The above average stage for WCA-1 appears to be due to a concerted effort by water management to reduce the amount of structure outflow. However, the above average stages for WCA-3 and the ENP appears to be due to an effort to increase the amount of structure inflows to the Everglades.

These average data are not significantly different from the historic means and as such, are not indicative of the dynamics of the water level changes that occurred during the nesting season, nor can they explain why there was a 61% increase in the 2004 wading bird nests relative to the previous year and one of the best breeding years in recent decades. To explain this 2004 trend we must examine the daily water levels and we must extend our period of analysis beyond the typical water-year.

The daily water level changes during the nesting season were very similar throughout the Everglades. The 2004 wet season ended in October of 2003 with "typically high" water levels throughout the Everglades, and water levels began to drop in November at rates that were expected to produce the spring water depths and recession rates that would concentrate fish and support essential wading bird foraging habitat. However, with the approach of spring and lower water levels, large rainfall events produced numerous and significant water level reversals everywhere in the Everglades, except in the small, and often ignored WCA-2B. These trends are shown in Figures 1 – 4.

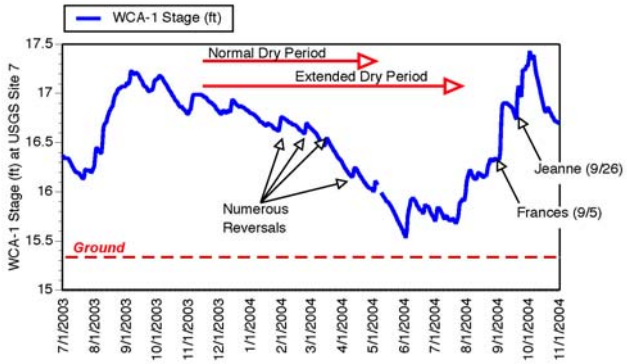

Figure 1. Hydrograph for WCA-1 for the 2004 water-year.

Table 1. Average, minimum and maximum stage (ft NVGD), and total annual rainfall (inches) for water-year 2004 in comparison to historic[a] stage and rainfall. Subtract elevation from stage to calculate average depths.

Area	2004 Rainfall	Historic Rainfall	2004 Stage Mean (Min; Max)	Historic Stage Mean (Min; Max)	Elevation
WCA-1	44.1	51.98	16.61 (15.8; 16.6)	15.63 (10.0; 18.2)	15.1
WCA-2	44.1	51.98	12.40 (11.2; 13.4)	12.58 (9.3; 15.6)	11.2
WCA-3	46.9	51.37	10.30 (9.1; 11.5)	9.50 (4.8; 12.8)	8.2
ENP	47.4	55.24	6.68 (5.9; 7.4)	5.96 (NA; NA)	5.1

[a] See Chapter 5 of the 2004 and 2005 Everglades Consolidated Reports (Abtew et al.) for a more detailed description of rain, stage, inflows, outflows, and historic databases.

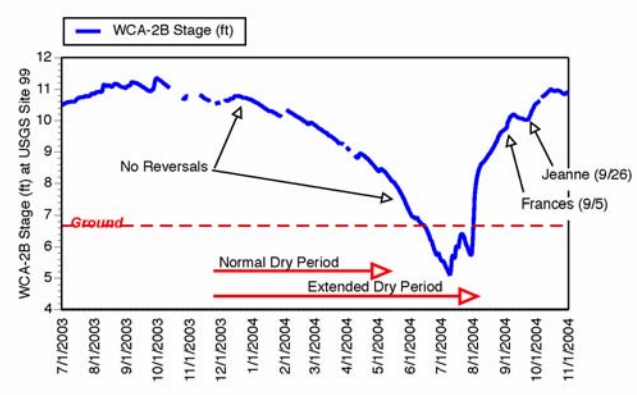

Figure 2. Hydrograph for WCA-2B for the 2004 water-year.

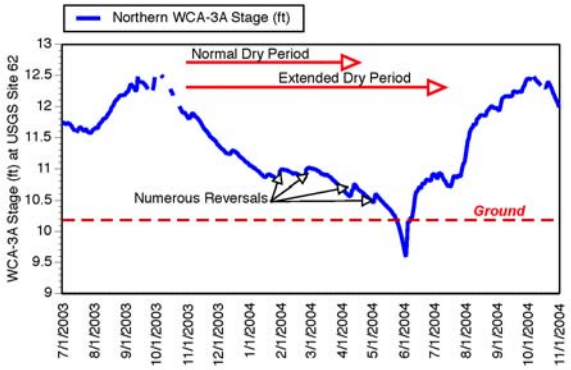

Figure 3. Hydrograph for WCA-3A for the 2004 water-year.

What is apparent from the hydrographs throughout the Everglades is that water levels continued to decline past the typical May 15th end-of-the-dry-season. June and July were very dry months and the Everglades entered a drought period. In places where water levels went below ground and had earlier experienced multiple recessions, such as in northern WCA-3A, foraging was very poor and poor nesting success was expected. However, it appears that wading bird nesting, and especially white ibis nesting, in northern WCA-3A and in most regions of the Everglades was very good. The hydrographs indicate that this was likely due to two reasons; (1) Some regions, like WCA-2B did not experience any spring-time reversals; and (2) Regions that are normally too deep for wading bird foraging in the spring, such as WCA-1 or the southern regions of WCA-3A, became available foraging habitat during the drought.

The hydrographs appear to support the hypothesis that wading birds initiated new nests throughout the entire breeding season, even as late as mid June due to the many water depth reversals that occurred during the 2004 dry season. And, this did NOT cause a significant decline in fledglings because 2004 was also notable for an exceptionally dry June and, therefore, optimal feeding conditions in the Everglades were extended far longer than normal. Consequently, many wading birds that delayed or reinitiated nesting were able to fledge their offspring successfully.

SW Coast Hydrology:
Each year Ted Below, at the Rookery Bay Preserve, uses a long

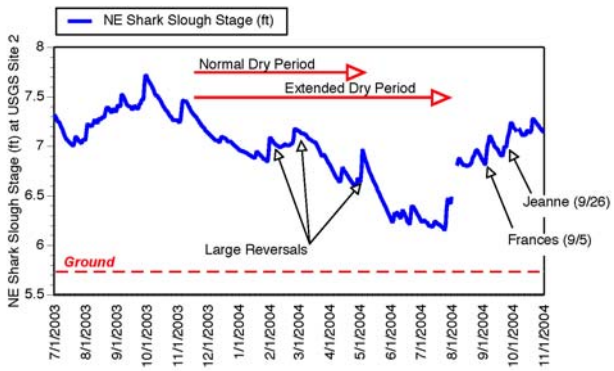

Figure 4. Hydrograph for ENP for the 2004 water-year.

term data base (40 years) of inland water levels recorded at Corkscrew Swamp Sanctuary (CSS) and coastal pond water levels at Rookery Bay (RB; 23 years) to compare to the current nesting. Over the years he has found that water levels in RB generally fluctuate in unison with the inland ponds at CSS (36 km. N), and this year was no exception. At both CSS and RB water levels were slightly higher in 2003. This trend continued into 2004 to the point that the driest month was May rather than April as is typical.

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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 white herons (SMWH).

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), Systematic Reconnaissance Flights (SRF), Comprehensive Everglades Restoration Plan (CERP), and Natural Systems Model (NSM).

REGIONAL NESTING REPORTS

WATER CONSERVATION AREAS 2 and 3, AND A.R.M. LOXAHATCHEE NATIONAL WILDLIFE REFUGE

In 2004, the University of Florida team monitored nesting in WCAs 2 and 3 as it has for the past 17 years, and continued similar survey work in Loxahatchee National Wildlife Refuge. We also monitored nest success of Great Egrets, White Ibises, and Wood Storks, and continued our studies of juvenile stork movements and survival.

Methods

We performed 2 types of systematic surveys in 2004: aerial and ground surveys. The primary objective of both kinds of surveys is to systematically encounter and document nesting colonies. On or about the 15th of each month between February and June we performed systematic aerial surveys for colonies, with observers on both sides of a Cessna 182, flight altitude at 800 feet AGL, and east-west oriented flight transects spaced 1.6 nautical miles apart. These conditions have been demonstrated to result in overlapping coverage on successive transects under a variety of weather and visibility conditions, and have been used continuously since 1986. We took aerial photos of all colonies from directly overhead and from multiple angles, and made detailed counts of the birds showing in these slides via projection.

The reported numbers of nest starts are usually "peak" counts, in which the highest count for the season is used as the estimate of nests. The only exceptions to this rule were colonies in which clearly different cohorts were noted in the same colony, in which case the peak counts of the cohorts was summed. In most cases we also modified total aerial counts with information from ground checks.

Systematic, 100% coverage ground surveys of colonies by airboat were performed throughout WCAs 1, 2 and 3 once between early April and late May, and were designed to document small colonies or those of dark-colored species that are difficult to detect from aerial surveys. GPS-guided belt survey transects were generally in north-south orientations, and were designed to give overlapping coverage. The width of belt transects varied between 0.6 miles apart in extremely open habitat of southern WCA 3, to 0.1 miles apart in the heavier cover of Loxahatchee NWR. All tree islands were approached closely enough to flush nesting birds, and nests were either counted directly, or estimated from flushed birds.

We also estimated nest success in several colonies, by repeatedly recording the contents and fates of marked nests. We established belt transects in Alley North, False L-67, Tamiami West and Hidden colonies early in the nesting period and marked active nests within a designated distance from the center of the transect. We then returned every 5-7 days to walk the transect and check the progress of those nests, count failures and add new nesting attempts to the transect. Nest success has not yet been analyzed but will be expressed using the Mayfield method.

Results

Counting error: As is typical, the numbers of ibises dominated the total counts (over 50%) and were also the most difficult species to count accurately. This is partly because many of the nests are located under the canopy and thus cannot be seen from the air, and partly because annual nesting is comprised of asynchronous but overlapping cohorts, which are nearly impossible to distinguish from one another. We therefore suspect that the number of ibis nests we report here is quite conservative as an estimate of total nest starts; modeling of the asynchrony and the visual occlusion errors suggests that our direct peak counts underestimate true numbers by at least 50%.

We have reported in Tables 1 & 2 that about 30,000 ibis nests were initiated in the WCAs of the Everglades, based on peak estimates made using fixed-wing aerial estimates and slide counts, and some educated guesses about the numbers of birds nesting under the canopy. The error due to asynchrony was not figured into this total estimate, however.

Total counts in the WCAs and Loxahatchee NWR: Combining all species at all colonies in LNWR, WCA 2, and WCA 3, we estimated a grand total of 46,205 nests of wading birds (Cattle Egrets, Anhingas and cormorants excluded) were initiated between February and July of 2004. Note that this figure does not include birds nesting at the Tamiami West and East colonies, which we also monitored intensively in ENP.

For perspective, the size of the nesting aggregation in 2004 in the WCAs and LNWR combined was 2.2 times the average of the past ten years, 1.3 times the average of the last five years, and 1.7 times the total nesting in 2003. Numbers of Great Egret nests were 1.11 times the average of the last five years, and 1.6 times the last ten. In 2004, Wood Stork nests were 0.54 times the average of the last five years, and 1.06 times the average of the last ten years. White Ibis nests were 3.1 times the average of the last ten and 1.6 times the average of the last five years.

In terms of total numbers, the 2004 nesting event can be considered a large and important one, ranking second largest in the 19 years during which systematic surveys have been conducted in the WCAs. This continues a recent trend towards distinctly larger numbers of total nesting

Table 1. Numbers of wading bird nest attempts found in WCAs 2 and 3, Jan - Jul 2004

Latitude[1]	Longitude	Area	Colony name	GREG	WHIB	WOST	ANHI	GBHE	TRHE	BCNH	SNEG	LBHE	ROSP	YCNH	GLIB	CAEG	Colony total[2]
N26 12.13	W80 31.75	3A	Alley North	1,000	16,000		200	10	600	200	1,000	200	10		150		**19,170**
N25 46.36	W80 50.24	3A	Hidden	165	2,480		150		685		1,160						**4,490**
N25 48.08	W80 29.40	3B	3B Mud East	350	1,153	130	53	5	141	190	45	65					**2,079**
N25 46.62	W80 50.56	3A	Hidden North				8		383	4	787	4					**1,178**
N25 47.76	W80 29.49	3B		335													**335**
N25 55.51	W80 50.10	3A	Crossover	150		130											**280**
N26 7.32	W80 32.50	3A	Cypress City	180													**180**
N26 7.44	W80 32.61	3A		180													**180**
N26 1.48	W80 32.36	3A	Donut	175													**175**
N26 3.77	W80 43.30	3A			150												**150**
N25 54.76	W80 37.87	3A	False L-67	135			20	15									**150**
N26 6.11	W80 27.27	3A	Holiday Park	140													**140**
N26 2.75	W80 37.10	3A	Big Mel	130													**130**
N26 7.72	W80 42.10	3A		130													**130**
N25 52.11	W80 50.61	3A	Jetport	130													**130**
N26 7.78	W80 20.74	2B	2B Mel	125			50						5				**130**
N26 7.97	W80 42.16	3A		125			50						5				**130**
N26 7.33	W80 30.20	3A		120													**120**
N26 7.40	W80 30.38	3A		117													**117**
N25 56.41	W80 37.25	3A	Starter Mel	95			15	3									**98**
N25 57.88	W80 34.48	3A	L67	95													**95**
N25 59.01	W80 48.78	3A							21			64					**85**
N26 10.93	W80 19.77	2B		80													**80**
N25 49.24	W80 40.63	3A		75			2										**75**
N26 7.64	W80 43.44	3A							18			48					**66**
N26 14.81	W80 19.67	2A		65													**65**
N25 46.27	W80 41.60	3A		65													**65**
N26 7.72	W80 42.10	3A		65			1										**65**
N25 55.40	W80 31.14	3B		63													**63**
N26 0.27	W80 49.20	3A			56												**56**
N25 48.45	W80 51.92	3A	South Jetport	25		29											**54**
N25 58.28	W80 42.09	3A		50			10	1									**51**
N26 2.26	W80 45.72	3A	Mud Canal	15												55	**15**
Totals from colonies with <50 pairs				673	116	6	562	356	99	42	5	164	0	21	0	0	**1,482**
Total Nesting Attempts				**5,053**	**19,955**	**295**	**1,121**	**390**	**1,947**	**436**	**2,997**	**545**	**20**	**21**	**150**	**55**	**31,809**

[1] Latitude and longitude in degrees, decimal minutes.

[2] Totals are for wetland waders and do not include Cattle Egrets or Anhingas.

attempts. Since 1999, 6 of the 7 largest nestings in the 19-year history have been recorded (1992 being the only outlier). In fact there appears to be a distinct trend towards larger nesting numbers since 1998 (see Figure) suggesting either that the Everglades has had consistently favorable conditions for nesting since 1999, or that something fundamental has changed about the ability of the ecosystem to support large breeding populations of wading birds.

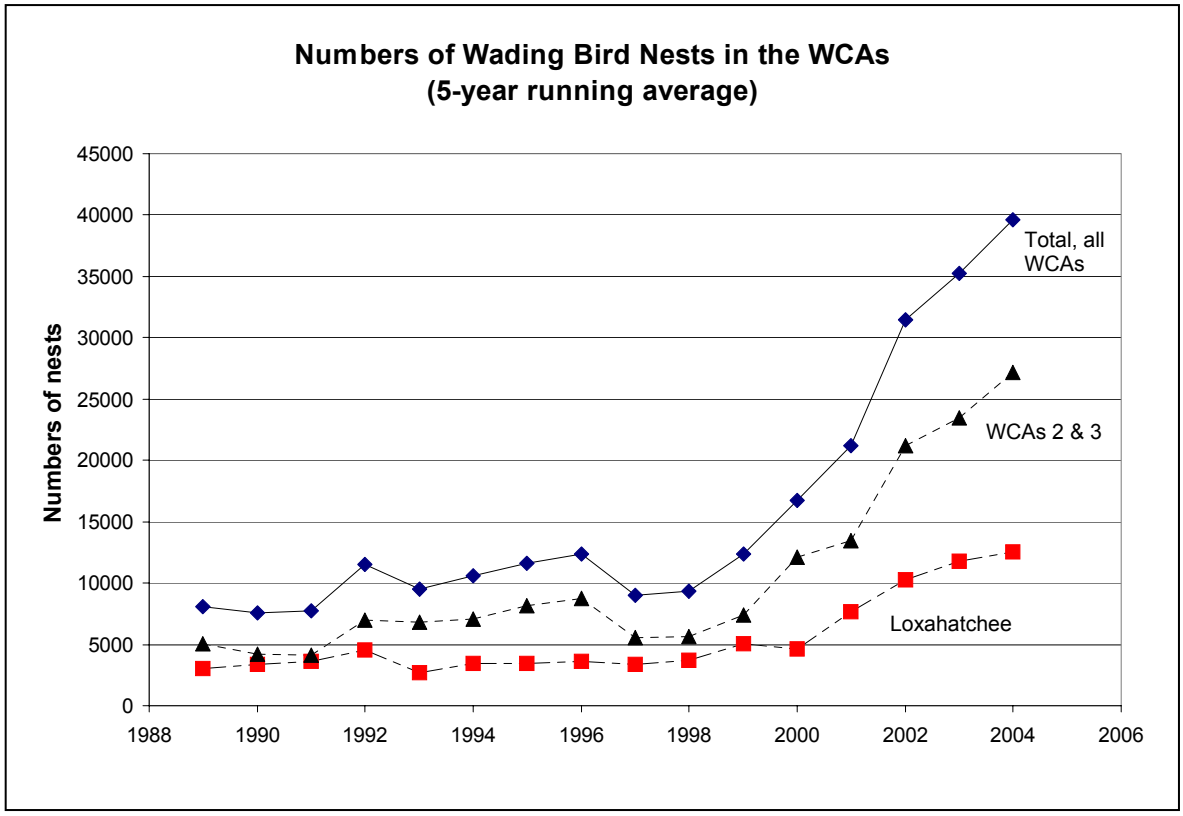
Nesting Success: Nesting success varied widely across species. Wood Storks initiated nesting somewhat late even by the standards of the last 20 years. They were nesting at

Table 2. Numbers of wading bird nest attempts found in A.R.M. Loxahatchee National Wildlife Refuge, Jan - Jul 2004

Latitude[1]	Longitude	Colony name	GREG	WHIB	WOST	ANHI	GBHE	TRHE	BCNH	SNEG	LBHE	ROSP	YCNH	GLIB	CAEG	Colony total[2]
N26 26.25	W80 14.58	Lox 70		8,000												**8,000**
N26 26.35	W80 23.51	Lox 99	220	1,000												**1,220**
N26 27.52	W80 14.40		300	350		200		25	10	50	40			20	50	**795**
N26 28.13	W80 22.32		300			50			30							**330**
N26 31.34	W80 15.81		25	100	4	35		30	11	125	7			22		**324**
N26 27.45	W80 14.20		300													**300**
N26 22.96	W80 15.32		259													**259**
N26 33.58	W80 15.06	Canal North		250												**250**
N26 31.91	W80 17.69		32					25	4		60					**121**
N26 27.44	W80 21.24		20			4		2	3		90					**115**
N26 27.01	W80 15.80					1		12			100					**112**
N26 33.23	W80 15.06		80		20											**100**
N26 22.31	W80 18.57		95													**95**
N26 33.04	W80 15.01		90													**90**
N26 27.75	W80 22.36					42					87					**87**
N26 31.17	W80 19.14								2	2	80					**84**
N25 59.79	W80 39.51					20	1		35		45					**81**
N26 22.18	W80 15.48		80													**80**
N26 26.84	W80 16.54		5								75					**80**
N26 29.53	W80 22.34							80								**80**
N26 31.86	W80 17.69							5	1	12	54				1	**72**
N26 29.54	W80 22.35					3		5			60					**65**
N26 22.40	W80 16.08		60													**60**
N26 22.80	W80 15.10		60													**60**
N25 58.24	W80 42.03		55			6	1									**56**
N26 23.86	W80 15.15		55													**55**
N26 33.00	W80 15.09		50			22	2									**52**
N26 31.86	W80 17.70							4		12	36					**52**
N26 22.65	W80 15.66		50													**50**
Totals from colonies with <50 pairs			278	4	3	267	231	46	178	40	441	0	0	50	35	**1,271**
Total Nesting Attempts			**2,414**	**9,704**	**27**	**650**	**235**	**234**	**274**	**241**	**1,175**	**0**	**0**	**92**	**86**	**14,396**

[1] Latitude and longitude in degrees, decimal minutes.

[2] Totals are for wetland waders and do not include Cattle Egrets or Anhingas.



Tamiami West and Crossover and in courtship at Jetport by late February but did not achieve peak numbers until early March. Birds at Tamiami West began abandoning nests in response to heavy rainfall in early March, and no nests were found in surveys by the third week in March. Similarly, the birds courting at Jetport disappeared at about the same time. However there was no evidence of abandonment at Crossover colony, and the birds there appeared to have fledged substantial numbers of young. By mid-April what appeared to be many of the birds from Tamiami West apparently re-nested at the 3B Mud East colony (130 pairs), but none of these nests appear to have fledged young. Similarly new nests started up near Jetport (Jetport south, 29 pairs), and their fate was unclear. Some abandonment probably occurred at Paurotis Pond in ENP, but most of these nests produced young, and most (75%) had three chicks in the latter part of the nestling period. Cuthbert Lake also appeared to fledge young from most nests. It is important to remember that most of the late initial and re-nesting events would certainly have failed entirely if the onset of summer rains had not been delayed by over a month (early July).

We did not note large abandonments of Great Egrets at any of the colonies we studied intensively (Alley North, Tamiami West, Hidden, False L-67), nor did we see evidence of abandonment at other colonies monitored monthly. Although the nest success data has not yet been analyzed using Mayfield's method, Great Egret nests did appear to be largely successful (84% of nests monitored succeeded). Although we did not see evidence of nest failure on any of our intensively visited White Ibis nest check transects (63% of nests monitored succeeded), there is some information that suggests abandonments at both Alley North and Lox 70 sometime in early March.

The very obvious abandonments by storks and the lack of it by Great Egrets and to a lesser extent the ibises was puzzling, since stork and ibis abandonments usually co-occur, and poor years for storks are often marked by poor nesting success by Great Egrets. In 2004, however, the timing may have been key. The storks abandoned fairly early in March at a time when ibises were only just beginning to nest. So the slightly later than usual nesting by ibises (late March) may have put them out of risk of the same conditions that caused storks to abandon.

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EVERGLADES NATIONAL PARK

Methods

Aerial colony surveys were conducted monthly (January through July) by 1 or 2 observers using a Cessna 182 fixed-wing aircraft (~20 person hours). Traditional colony sites as well as new colonies discovered during colony and other project flights were surveyed. Survey dates were: 16 January, 13 February, 12 March, 21 April, 21 May, 18 June, and 19 July.

Results

Wading birds in Everglades National Park formed colonies and initiated nesting later than usual this year. Nesting was not initiated until March at most sites. Most colonies had fledged all young by the end of May, however several colonies were still active into late June and July.

We observed a significant increase in the numbers of colonies formed and numbers of nesting wading birds compared to the 2003 nesting season. We located approximately 3515 wading bird nests within 22 colonies. Total nest numbers increased by 32% compared to 2003. White Ibis and Great Egret nest numbers more than

Peak numbers of wading bird nests found in Everglades National Park mainland colonies, Jan - Jul 2004

Latitude	Longitude	Colony name	GREG	WHIB	WOST	SNEG	CAEG	ROSP	TRHE	LBHE	BCNH	Colony total
N25 12.56	W80 46.50	Cuthbert Lake	75		75							**150**
N25 16.12	W80 52.07	East River Rookery	25									**25**
N25 37.68	W80 38.74	Grossman Ridge	150				50		+		+	**200**
N25 38.81	W80 36.55	NE Grossman A	8				+					**8**
N25 41.10	W80 34.50	NE Grossman B	75				150		+		+	**225**
N25 16.89	W80 48.18	Paurotis Pond	200	300	195	+		2	+			**697**
N25 33.40	W81 04.19	Rodgers River Bay	175		150							**325**
N25 45.46	W80 30.48	Tamiami East	20									**20**
N25 45.56	W80 31.47	Tamiami East-2	15									**15**
N25 45.45	W80 32.70	Tamiami West [a]	175		50		50		+		+	**275**
N25 42.46	W80 35.45	2004 new colony1	25				+					**25**
N25 34.24	W80 48.87	2004 new colony2	25									**25**
N25 33.15	W80 50.52	2004 new colony3 [b]	75		20							**95**
N25 32.01	W80 46.77	2004 new colony4	40									**40**
N25 31.06	W80 50.76	2004 new colony5	15									**15**
N25 30.18	W80 58.46	2004 new colony7	30	+		50			+			**80**
N25 28.07	W80 56.26	2004 new colony8 [c]	200	200	50	200						**650**
N25 27.81	W80 51.15	2004 new colony9	60	+		+		+				**60**
N25 31.29	W80 48.31	2004 new colony10	15									**15**
N25 30.10	W80 47.18	2004 new colony11	20									**20**
N25 32.72	W80 46.81	2004 new colony12	50									**50**
N25 40.26	W81 08.83	2004 new colony13	100	300		100			+	+		**500**
		TOTAL	**1,573**	**800**	**540**	**350**	**250**	**2**	**+**	**+**	**+**	**3,515**

+ Indicates species present but unable to determine numbers.

[a] 50 WOST nest starts in February but gone by March

[b] 20 WOST nests in April – except for 4 nests, most failed by 5/21/04 flight

[c] 50 WOST nests in April -- all failed by 5/21/04 flight

doubled this year. The increase was due to a number of new mixed-species and great egret colonies that formed along the eastern and western edges of Shark River Slough.

Some notable differences in colony nesting sites were seen this season. Drought conditions prevailed and water levels in northern Shark River Slough were drastically reduced. The relatively small transient (mostly Great Egret) colonies that appear each year at the eastern and western sides of Shark River Slough were located further south than in previous years. These colonies appeared to be successful as the southern reaches of Shark River Slough maintained continuous water levels throughout the nesting season.

Three of the new colonies that formed this season were most noteworthy. Two of these ("New 7" and "New 8" colonies) were located in areas that have not been used by wading birds for many years. The "New 8" colony formed in the headwaters of the Shark and Harney Rivers. It was a large mixed-species colony (~650 nests total) consisting of mostly Great Egrets, White Ibises, and Snowy Egrets, but also contained approximately 50 Wood Stork nests. The Wood Stork nests contained eggs and new young in April, but the nests had been abandoned when checked again in May. The "New 7" colony was a small Great Egret and Snowy Egret colony but was also located in the southern Shark River Slough region at the headwaters of the Broad River. A third colony, "New 13", was located in an area not previously known for wading bird colonies –it was located approximately 9 miles north of the Rodgers River Bay colony and east of Alligator Bay.

Overall most colonies were successful this year, however Wood Storks failed completely at the large Tamiami West colony. Wood Storks also attempted to nest in some of the smaller "new" colonies, but failed there as well. The southern Wood Stork colonies (Rodgers River Bay, Paurotis Pond and Cuthbert Lake) appeared to have successfully fledged young. Great Egrets and White Ibises at the same colonies also succeeded in fledging young.

The most prevalent species recorded nesting in Everglades National Park colonies were Great Egrets, White Ibises, Wood Storks, Snowy Egrets and Cattle Egrets. The following species were found in nesting colonies but numbers of nests could not be estimated due to their location within the colonies: Little Blue Heron, Tricolored Heron, Black-Crowned Night Heron, and Roseate Spoonbill.

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EVERGLADES NATIONAL PARK - FLORIDA BAY

As has been the case the past few years, a formal wading bird survey was not conducted in Florida Bay this year. Last year and some previous years wading bird nests have been recorded during Bald Eagle surveys, but this was not possible this year. However, Frank Key (N25 6.15, W80 54.40) was surveyed and had 375 wading bird nests: 175 GREG, 100 WHIB, and 100 SNEG. ROSP were present.

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WOOD STORK NESTING AT CORKSCREW SWAMP SANCTUARY

Methods

The initial assessment of wood stork nesting activity in Audubon's Corkscrew Swamp Sanctuary colony was made from a helicopter aerial survey on January 6th. From January 7th to May 13th no aerial surveys were performed. During this time period ten ground surveys were conducted using a 20-60x spotting scope to gather data on a subset of the colony. Seven aerial surveys were conducted from May 14th to July 8th using fixed-wing aircraft. Jason Lauritsen made visual estimates of colony size from the aircraft by counting all individual nests when the colony size was small (three counts were made and averaged to establish the aerial estimate). Once the colony was too large to accurately use this method, counting was done in clusters of 5 (again three estimates were made and averaged). To improve accuracy of nest counts, slide photos were taken with a 70-200mm lens of the entire colony on each survey date from approximately 1000 ft, circling the colony until full slide coverage was attained. Photos of each sub-colony were taken from 400 ft during a single pass to assist in productivity estimates and stage of development. (52 person-hours).

Analysis

Photos of several aerial surveys were projected on a grid and analyzed. Photos from 1000 ft were used to identify the total number of possible wood stork nests. Slide photos taken from approximately 400 ft were further analyzed to determine what proportion of the colony were wood stork nests, great egret nests, loafing birds, or birds of indeterminate status, in order to reduce the error associated with the image quality of slides taken at 1000 ft. Nest productivity was also determined using the slides taken at 400 ft. On June 2nd there were 2.26 chicks per active nest; this was the last photo date before chicks began to leave the nests to roost on the branches. On June 23rd recently fledged chicks were observed in flight around the colony. On June 29th there were 1.83 chicks per active nest, however, there were many chicks on branches at varying distances from the nearest nest. Although these individuals could be counted as successful fledges, there is no sure way of assigning these birds to the appropriate nest, therefore confidence in this number is diminished. Birds were assigned to nests in such cases where chicks were sitting within a meter (estimated from slides) of an intact nest. (15 hours).

Results

Approximately 450 chicks fledged from approximately 520 nest attempts. Approximately 210 of these nests were successful. Productivity per nest attempt was calculated to be 0.88 chicks/nest attempt, and 2.26 chicks/successful nest. Heavy local rainfall events occurred in January and February likely contributing to early nest failures. No weather induced abandonment or nest failure was observed from May 14th or later. Late season dry-down was conducive to foraging. All nests observed with chicks on June 2nd were considered successful.

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WOOD STORK NESTING ON THE CALOOSAHATCHEE RIVER

Methods

Nest counts were conducted on two occasions (4/23/04, 5/19/04) from a boat drifting with the current past the strip of mangrove islands where wood storks were nesting (N26 41.38, W81 49.87). All sides of the island were visible, and the number of nests obscured by vegetation is thought to be very low. Accurate counts of nests and nest contents were obtained where chicks were 4 weeks or older. Binoculars were used to count chicks. Slides were shot of the colony using a 70-200mm zoom lens to compare chick age with stock photos of wood stork nestlings of known age. The colony was located just downstream of channel marker 25 on the Caloosahatchee River in Ft. Myers Florida.

Analysis

The count from May 19th determined probable nesting success. Chicks in many nests were very close to fledging. An estimated 80% of the chicks observed appeared to be at least 6 weeks old. Nests averaged between 2 and 3 chicks.

Results

There were 263 successful nests, containing approximately 2.3 chicks per nest. Total colony productivity is estimated to be 600 fledged birds. No nest failures were observed. The history of nesting at this site is unknown.

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SOLID WASTE AUTHORITY OF PALM BEACH COUNTY COLONY

Methods

From February – July 2004, Breeding Bird Censuses (BBCs) were conducted in the SWA Roost by two observers every 8-10 weeks, representing approximately 12 man-hours. During the BBC, all islands from three abandoned shell pits were systematically surveyed from a small boat, and the identified bird species and nest numbers were recorded. Surveys were conducted during the morning hours so as to minimize any burden caused by the presence of observers.

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 (Water Catchment Area), a 44 km^2 remnant of the Loxahatchee Slough.

Results

This report presents preliminary data for the 2004 breeding season. Typically nesting activities have been observed at this colony through September, and these surveys being reported are only through the end of July. Nest surveys were conducted on February 26th , April 14th and July 6th 2004. Only the peak nest numbers are being reported for each of the bird species.

The estimated peak number of wading bird nests for the SWA Colony is 2712 which represents an 11% decrease from the previous 2003 season. The number of Great Egret, White Ibis, Snowy Egret, and Wood Stork nests are higher during this year than the 2003 season. Anhinga, Cattle Egret, Tricolored Heron, Little Blue Heron, and Great Blue Heron nest numbers appeared to be less than observed in 2003. There is a 71% increase in Wood Stork nests from last year.

It should also be mentioned that there was a confirmed Roseate Spoonbill nest that fledged 3 young. There were several Glossy Ibis nests and young observed this year in the SWA Rookery. However, Glossy Ibis nests are not easily identified during the nest surveys and therefore are not included in the reports.

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Peak number of wading bird nests in the SWA Rookery, Feb-Jul 2004

GREG	SNEG	CAEG	GBHE	LBHE	WOST	WHIB	ANHI	TRHE	ROSP	GLIB	Total nests
131	40	407	2	47	240	1,430	325	89	1	present	**2,712**

ROSEATE SPOONBILLS IN FLORIDA BAY

INTRODUCTION

With the exception of the 1993-94 nesting cycle, Audubon staff have monitored nesting success and nesting effort of Roseate Spoonbills in Florida Bay since 1984-85. Beginning with a pilot study last year, we have also initiated a program of banding nestling spoonbills in Florida Bay and Tampa Bay to not only track survivorship from their natal colony but also to assess the demographics of this important indicator species. This report first addresses the continuing study to monitor nesting effort and nesting success in Florida Bay which is followed by a separate section on the banding program.

ROSEATE SPOONBILL NESTING EFFORT AND SUCCESS IN FLORIDA BAY

Spoonbill Monitoring Methods

Thirty-four of Florida Bay's keys have been used by Roseate Spoonbills as nesting colonies (Figure 1, Table 1). These colonies have been divided into five distinct nesting sub-regions (Table 1) based on each colony's primary foraging location (Figure 1, Lorenz et al. 2002). During the 2003-2004 nesting cycle (Nov-May), complete nest counts were performed in all five sub-regions. Nest counts were performed by entering the active colony and thoroughly searching for nests. Nesting success was estimated for the four active sub-regions through mark and re-visit surveys of the most active 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 four sites (TR, JB, HC, and BS) in the coastal wetlands of northeastern Florida Bay (see Lorenz et al. 1997 for location coordinates) known to be spoonbill foraging locations for the Northeastern 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 nesting in the Northwestern sub-region regularly feed. Prey fish were collected monthly from Nov through 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.

Spoonbill Monitoring Results

Northwestern Sub-Region: Sandy Key

A new spoonbill nesting colony was discovered on Palm Key bringing the number of active colonies in the northwestern sub-region to five. Nest counts were made at all five colonies with a total of 250 nests (Table 1). Nesting success surveys were conducted at Sandy Key on Nov 21, 26, Dec 4,

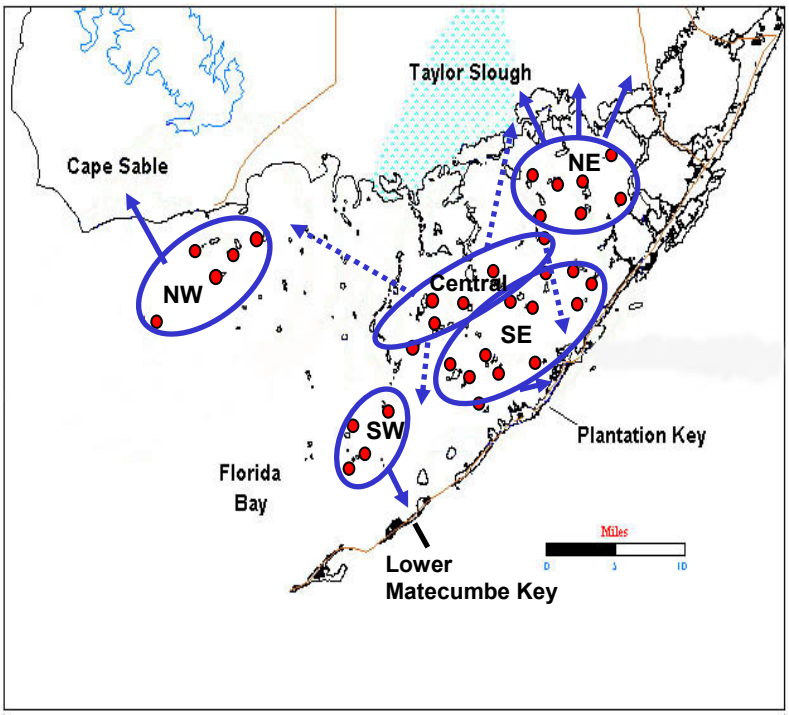

Figure 1. Map of Florida Bay indicating spoonbill colony locations (red circles) and nesting sub-regions (blue circles). Arrows indicate the primary foraging area for each sub-region. The dashed lines from the central sub-region are speculative.

Table 1. Number of ROSP nests in Florida Bay, Nov 2003-May 2004. An asterisk (*) indicates a colony with nesting success surveys (see Table 2).

Sub-region	Colony	2003-2004	Summary since 1984		
			Min	Mean	Max
Northwest	Sandy*	96	62	162.58	250
	Frank	111	0	49.15	125
	Clive	22	15	20.33	24
	Palm	21	21	21	21
	Oyster	0	0	7.69	45
	Subtotal	**250**	**65**	**205.79**	**325**
Northeast	Tern*	83	60	112.32	184
	N. Nest	0	0	0	0
	S. Nest	3	0	20	59
	Porjoe	0	0	35.06	118
	N Park	10	0	21.21	50
	Duck	10	0	2.46	13
	Pass	0	0	0.67	4
	Subtotal	**106**	**101**	**201.35**	**333**
Central	E. Bob Allen*	9	0	17	35
	Manatee	0	0	0	0
	Jimmie Channel	14	6	20.29	47
	Caloosa	15	0	9.5	15
	Little Pollach	0	0	4.4	13
	S. Park	1	0	10.79	39
	Subtotal	**39**	**15**	**52.46**	**96**
Southwest	E. Buchanon	2	0	8.17	27
	W. Buchanon	0	0	4.64	9
	Barnes	0	0	0	0
	Twin	0	0	2.09	8
	Subtotal	**2**	**0**	**13.27**	**35**
Southeast	M. Butternut*	7	7	24.64	66
	Bottle	2	0	12.15	40
	Stake	3	0	4	19
	Cowpens	0	0	7.67	15
	Cotton	0	0	0	0
	West	0	0	3.73	9
	Low	0	0	0	0
	Pigeon	6	0	4.17	12
	Crab	4	0	2.09	8
	East	8	0	3	12
	Crane	8	8	14.75	27
	E. Butternut	4	0	4.64	11
	Subtotal	**42**	**39**	**81.64**	**117**

12, 18, 22, 31, Jan 9, 16, 26, Feb 13, 21, Mar 19 and Apr 18. Individual nest attempts were remarkably asynchronous compared with previous years. We estimate that the first nest to lay eggs was on Nov 10 while the last nest did not lay eggs until Jan 5. Usually, all nests are initiated within 14 to 21 days of each other. The mean egg laying date was Dec 2, and mean hatch date was Dec. 23 (based on previous years, the average nest initiation date is Nov 25). The 96 nests counted were well below the average (163 nests since 1984), and was the lowest recorded nest count since 1985. Forty-one nests were marked for revisitation. Of these, only 44% were successful at raising chicks to at least 3 weeks old (the time when they first leave the nest) with the average of 0.86 chicks per nest attempt (Table 2). Resighting data supported the nest monitoring estimate: the fate of 24 chicks banded at Sandy Key are known and 75% of these survived to become flighted juveniles (Table 3). The fledging rate was well below average (1.26 chicks/attempt since 1984; Table 2) and was only marginally successful (the standard for being considered a successful nesting is at least 1 chick fledged per nest on average). Total production for Sandy Key was estimated at a disappointing 82 chicks fledged. This estimate was confirmed by the observation of 50-75 chicks flying around the island on Jan 21. The only bright point was that of those nests that succeeded, the production rate was 1.94 chicks fledged per successful attempt indicating that parents who were able to raise young did so at a high level of success.

A discussion of water levels and prey fish availability at the BL fish collection station is pertinent to understanding why spoonbills nesting in the Northwestern sub-region failed to achieved a higher degree of success. Lorenz (2000) estimated that prey fish become concentrated into small pools when water levels on the surrounding wetland drop to about 12.5 cm, thereby making them susceptible to predation by spoonbills and other wading birds. In Oct, water levels at BL were declining but remained well above the fish concentration threshold. Fish availability on the foraging site (i.e. the concentration of fish that a foraging wading bird would encounter) was estimated about 2g/m^2 of fish biomass. In mid Nov water levels dropped below the concentration threshold of 12.5cm for the first time and fish density increased to 15g/m^2. This corresponds to a period of increased nest initiations at Sandy Key. Unfortunately, unseasonable rainfall events occurred in Dec and Jan causing reversals in the dry-down process and water levels fluctuated. We attribute the asynchronous nature of spoonbill nesting to these water level fluctuations. Available fish biomass during Dec and Jan were estimated to be well below average (Dec 2003=6.5g/m^2, Dec mean 1990-2002=25g/m^2; Jan 2004= 5.5g/m^2, Jan mean 1991-2003=40g/m^2). Given the mean hatch date of Dec 23, most chicks hatched when foraging conditions were relatively poor. For the six weeks post-hatching (when chicks are most susceptible to mortality), parental spoonbills likely experienced a relatively low degree of foraging success as a result of the low and fluctuating prey availability on proximal wetlands (as indicated by BL samples). This likely explains the high rate of nest failure and the below average success rate per nesting attempt. Over the course of Feb and Mar, water levels steadily

Table 2. Mean number of chicks per nest attempt. Numbers in parentheses indicate the percentage of nest attempts successful. Success is defined as fledging 1 or more chicks per nest. Second nesting attempts not included.

Sub-region	Colony	2003-2004	Summary since 1984			
			Min	Mean	Max	% of years successful
Northwest	Sandy	0.86 (44%)	0.00	1.26	2.50	63%
Northeast	Tern	0.15 (8.7%)	0.00	0.78	2.20	32%
Central	E. Bob Allen	0.00 (0%)	0.00	0.72	1.52	33%
Southeast	M. Butternut	0.14 (14%)	0.14	0.96	2.09	33%

declined with only minor reversals. Fish availability were estimated at 14 and 22g/m^2 in these months, respectively. Those nests that survived the poor conditions in Dec and Jan found very good conditions in Feb and Mar, thereby explaining the high degree of production if only successful nests are taken into account.

Northeastern Sub-Region: Tern Key

All seven colonies in the northeastern sub-region were surveyed for nesting activity, however, only four were active with one of the active colonies having only 3 nests (Table 1). The 106 total nests in the sub-region was the second lowest nesting effort in terms of the number of active colonies since 1962 (last year's count was 101). Spoonbill nesting success surveys were conducted at Tern Key on Nov 18, Dec 2, 10, 17, 23, 31, Jan 8, 15, 22, 27, Feb 3, 11, 17, 24, Mar 2, 11, 19, 25, Apr 5, 11, 19, 27, and May 5. As has been the norm for the last several decades, there were two distinct nestings at Tern Key during the 2003-04 breeding cycle. During the first nesting, the first egg was laid on Dec 9 and the last nest initiated on Jan 10 with the mean laying date estimated at Dec. 23. The mean hatching date was Jan 31. As at Sandy Key, the nesting was asynchronous, but not as severe and the mean initiation date was much later than that of Sandy Key. As has been the trend in recent years, the first nesting effort was alarmingly small: only 83 nests compared to almost 200 nests ten years ago and over 500 nests twenty-five years ago. We believe this decline in northeastern Florida Bay is due to water management practices on the foraging ground. In addition to the alarmingly low nesting effort, the success rate was abysmal. On average, each nest attempt produced 0.15 chicks per nest, well below the average of 0.78 since 1984 (Table 2) and well below the pre-1980 average of 2.0 chicks/nest (Lorenz et al. 2002). This low rate is confirmed by banding results: the fates of 18 chicks banded on Tern Key are known and these had only an 11% survival rate (Table 3). Almost all of the nests failed (only 9% successful) and total production for the colony was estimated at only 6 chicks.

As at BL, water levels at the northeastern foraging grounds began to decline in Oct, but a rainfall event in early Nov resulted in a major reversal of dry-down patterns throughout the region. Water levels were actually higher mid-Nov than at the traditional peak of the wet season water levels in late Sep. A second rainfall event in mid-Dec also resulted in a reversal but was not as significant as the Nov event. These events combined kept water levels at foraging sites above the concentration threshold of 12.5 cm until early Jan. Similar to the western sub-region, these high water levels on the primary foraging grounds most likely explain the delay and the asynchronous nature in spoonbill nesting in the Northeastern sub-region. An analysis of fish collected at four sampling sites supports this conclusion. Maximum available prey biomass from all four sites (i.e., prey estimates from the site with the highest available biomass were used) was well below average in Nov and Dec (Nov 2003=3g/m^2, Nov mean 1990-2002=10g/m^2; Dec 2003= 9g/m^2, Dec mean 1990-2002=21g/m^2).

In Jan, prey availability was about average (Jan 2004=13g/m^2; Jan mean 1991-2003=16g/m^2) and in Feb it was lower than average but still relatively robust (Feb 2004=10g/m^2; Feb mean 1991-2003=17g/m^2). These data would indicate that post hatch foraging conditions would have been reasonably good for spoonbills, however, a reversal event was not captured by our fish sampling methodology. A small rainfall event resulted in water levels throughout the northeastern sub-region exceeding the 12.5cm threshold from Jan 18 to Jan 26. Although we did not collect any fish availability data during this period, previous analyses of our long term data set indicate that fish would have dispersed across the wetland surface and would have been unavailable to predators such as spoonbills (Lorenz 2000). Fifty-eight percent of the nests at Tern Key failed during this 8 day period. This example demonstrates that use of data means (whether physical or biological) may miss important short-term episodic events that can actually have major implications for the ecosystems (see Bay-wide Synthesis for more). In the upcoming year, we intend to avoid this pitfall by sampling fish at JB (and possibly HC) once a week during the Tern Key post-hatch period.

The second wave of nesting at Tern Key was much more typical of a successful nesting. The nesting began in mid-March and exhibited the stereotypic synchronous nature of nesting spoonbills. The first eggs were laid on Mar 14 and the last nest initiated on Apr 5 with the mean laying date of Mar 23. The mean hatch date was Apr 13. This effort was smaller than the first nesting (64 nest) however 84% of the nests succeeded with an average of 1.38 chicks reaching 21d post-hatching per nest attempt. Of the successful nests, the average production was 2.09 chicks per nest. We estimate that 88 chicks fledged during the second nesting.

The Mar 23 mean hatch date coincided with a decline in water levels to their lowest point of the year on the foraging grounds. In Mar 2004, maximum available fish biomass from the four sampling sites was triple (39g/m^2) that of the 13 year average (Mar mean 1991-2003=13g/m^2). The first chicks of the second nesting hatched a few days after this measurement was collected. In Apr, fish availability declined (16g/m^2) but still remained higher than the 13 year mean (Apr mean 1991-2003 14g/m^2). These low water levels and high prey

availability just prior to and following hatching indicate that above average foraging conditions coincided with the second nesting thereby likely explaining the high degree of success.

Southeastern Sub-Region: Middle Butternut Key

All of the 12 Southeastern colonies were surveyed for nesting activity (Table 1). Nesting success surveys were conducted at Middle Butternut Key on Nov 24, Dec. 9, 23, Jan. 2, 7, 13, 23, Feb 2, 6, 13, 19, 25, Mar 2, 8, 12, 17, 23, 29, Apr 7, 16, and May 6. The first egg was laid on approximately Dec 15, with a mean lay date of Dec 30. The mean hatch date was estimated to be Jan 19. Only 7 nests were initiated on the island, which matches the number of nests in 2003--the lowest ever recorded at Butternut Key since the colony first formed in 1984. This nesting effort was almost a complete failure, with a production rate of 0.14 chicks per nest attempt (the lowest since 1984; Table 2). Only one fledgling was observed flying about the island from Mar 8 through Mar 23.

Historically, the southeastern colonies focused foraging on the mangrove wetlands on the mainline Florida Keys. Although most of these wetlands were filled by 1972 as part of Keys development boom, we presume (based on anecdotal evidence) that the few remaining Keys wetlands still serve as important foraging grounds for these birds. Since 1972 (when large scale filling of wetlands ended), nesting attempts in the Southeastern sub-region generally faired poorly: 6 of 9 years surveyed were failures (Table 2). Based on these observations it appears that conditions during the 2004 nesting were typically poor in the Southeastern sub-region. Based on previous work (Lorenz et al. 2002) it appears that the quality of the Southeastern sub-region for nesting spoonbills is marginal at best thereby explaining the low overall effort. This is stark contrast to the period prior to the keys land boom when spoonbills nesting in the Southeastern sub-region successfully fledged young every year with an average production of >2 chicks per nest (Lorenz et al. 2002).

Central Sub-Region: East Bob Allen Key

All six colonies in the Central sub-region were surveyed in 2003-04 (Table 1). Nesting success surveys at East Bob Allen Key (EBA) were performed on Nov 24, Dec 8, 29, Jan 6, 12, 21, 29, Feb 17, Mar 9, 31, and Apr 20. Only nine nests were found on EBA, which is well below average (17 nests since 1984). Only one nest produced eggs; the first egg was laid on Dec. 14, and the first chick hatched on Jan 3. This nesting was a complete failure with 0 chicks per attempt. The only nest that produced eggs did not succeed in fledging any young (the lowest since 1984; Table 2).

Significant nesting in the Central sub-region is a relatively new phenomenon, having started in the mid-1980's. As such, little information has been collected on where these birds feed but the central locations suggests that they may opportunistically exploit the primary resources used by the other sub-regions. Spoonbills nesting in the Central sub-region have reasonable access to the entire mosaic of foraging habitats found in the other four sub-regions (Figure 1). 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. However, if the specific foraging habitats utilized by spoonbills in all of the other four sub-regions become compromised, the spoonbills of the Central sub-region would also be deleteriously affected (as in this year). This hypothesis will be tested in the future by making flight line observations and through following flights with fixed wing aircraft.

Southwestern Sub-Region: Buchanon Keys

All keys in the southwestern sub-region were surveyed multiple times in 2003-04 but only 2 nests were found on East Buchanon Key (Table 1). Although the Southwest sub-region did produce nests (unlike this sub-region in 2003), neither of these nests fledged any young.

Bay-wide synthesis

Bay-wide Roseate Spoonbills nest numbers were at their lowest since 1969-70 indicating a continued downward spiral that began with completion of these major water management structures in the early 1980's. Historically, the Northeastern sub-region was the most productive sub-region of the bay (Lorenz et al. 2002). Since 1982, this sub-region has been heavily impacted by major water control structures that lie immediately upstream from the foraging grounds (Lorenz 2000).

The foraging grounds associated with the Northwestern sub-region were of relatively moderate quality while those in the Northeastern and Southeastern sub-regions were of poor quality. Nest production rates in these sub-regions reflect these conditions with Sandy Key in the northwest experiencing moderate success and focal colonies in the northeast and central regions essentially experiencing a total failure. It is possible that the birds from the Central sub-region were flying the relatively long distances to the Northwest foraging grounds on Cape Sable, however, the extra travel time and energetic costs of the longer foraging flights, coupled with foraging in marginal quality habitat, may have manifested itself in zero nesting success (Table 2).

Our hydrologic data indicate that major rainfall events occurred in late September and late October of 2003. The

result was major reversals in the drying patterns on the spoonbills primary foraging grounds (i.e. water levels began to decline before the events, but rapidly increased following the rain thereby resetting the drying patterns). In Dec, another rainfall event resulted in a significant reversal, although neither the rain nor the reversal were as severe as the Sep and Oct events. We believe that these reversals disrupted the cue for nesting (which is generally believed to be tied to water levels) thereby resulting in asynchronous and delayed nesting. We also believe that the long delay in nesting and the uncertainty of the cue caused the lower than usual nesting effort. Our hydrologic data from both the eastern and western foraging grounds suggest that this was a regional phenomenon. Furthermore, the timing and asynchronous nature of the spoonbill nesting efforts occurred in both the northeastern and northwestern bay. The observations indicate that this was a naturally occurring event and not a result of water management practices.

The spoonbill nest productivity in the northeastern bay was an order of magnitude lower than that of the northwestern bay. Since the eastern bay foraging grounds are directly affected by water management, and those in the west are only indirectly affected, these results suggest a possible negative impact of water management on spoonbills. Fifty-eight percent of the nests on Tern Key were abandoned between Jan 15 and Feb 3. In contrast, over the approximately same time period (Jan 16-Feb 5) Sandy Key only had 19% of its nests fail. We suspect that water management activities between Jan 15 and Feb 3 exacerbated an already bad situation for spoonbills nesting on Tern Key.

An examination of the rainfall data indicated that a small rainfall event (on the order of 1.25 cm) occurred on Jan 18 and 19. Although only a small amount of rain fell, the storm itself was spatially very large, covering a regional scale. Water levels at spoonbill foraging sites not affected by water management (e.g. western sites) increased 7 cm. This represents the background impact of the rain due to run-off from upstream locations. Foraging sites affected by water management increased 15.5 cm in the eastern bay. We attribute the difference in these water level increases to water management practices that divert unnaturally high amounts of water onto the foraging grounds. Furthermore, water levels on the impacted sites exceeded the point at which fish concentrated from Jan 18 to Jan 27. Although, no fish samples were collected during this period past analyses strongly suggest that this reversal resulted in the dispersal of prey and the high rate of nesting failure during this period.

This year's observations that the nesting effort failed in the Northeastern sub-region while moderately successful in the Northwestern sub-region indicate that up-stream operations continue to damage the Florida Bay ecosystem. Overall, the 2003-04 nesting was generally poor for natural reasons, however, water management practices exacerbated the problems in the eastern bay resulting in an abysmal production rate compared to the western bay. These data suggest that Florida Bay will continue to decline in ecologic health unless major changes are made to water management practices that effect the region.

ROSEATE SPOONBILL BANDING IN FLORIDA BAY AND TAMPA BAY

The purpose of the banding program is to better understand the movements and dynamics of the state's spoonbill population. We are interested in where the post-breeding dispersers go, and if there is an exchange of breeding birds between Florida Bay and Tampa Bay, as well as state-wide and regional movements. We are hoping to see trends in spoonbills' movements with future banding and resighting efforts. Please refer anyone with information on resighting banded spoonbills to the author or our website (http://www.audubonofflorida.org/science/spoonbills.htm).

Methods used in Florida Bay and Tampa Bay

In Florida Bay, Roseate Spoonbill nestlings were banded at 15 out of the 21 colonies in which they nested. In Tampa Bay, we banded spoonbills at the largest colony in the region, Alafia Bank. The 15 colonies in Florida Bay were distributed by sub-region in the following way: 3 colonies in the Northwest, 3 colonies in the Northeast, 3 colonies in the Central, and 6 colonies in Southeast Florida Bay. Although the Southwest sub-region did have 2 nests, the nestlings did not survive to banding age. Nestlings were banded anywhere between 5 days and 20 days of age. We found that a 5-day-old chick was the absolute youngest age we could band due to the small size of their legs. On the youngest chicks, we placed clay on the inner surface of the band to reduce its diameter and thereby stop the band from sliding over the joint. As the chicks age and their legs grow, this soft clay is then displaced, allowing the band to move freely. After approximately 20 days of age, we no longer attempted to band the nestlings due to their extreme mobility. We found that attempting to capture these highly mobile chicks caused unacceptable levels of stress to the chicks and disturbance to the colony. We retrieved nestlings from their nests by climbing the nest trees, or by extending a ladder up to the nest. We then transported the nestlings in five-gallon buckets to a banding station. To keep the birds warm and calm, we lined and covered the buckets with towels.

In Florida Bay, a total of 3 bands were placed on each nestling. A USGS band was placed on the tarsus, and a black, 2-digit alphanumeric band was placed on the opposite tibia. Florida Bay spoonbills received an additional colored celluloid band, placed above the alphanumeric band, to designate the sub-region in which the bird was banded (blue for NW, white for NE, red for Central, and yellow for SE). Tampa Bay birds received a red alphanumeric band but did not receive an additional celluloid band. All Tampa Bay birds were banded from one colony (Alafia Bank). At the time of banding, we recorded the age of each chick and the number of siblings or eggs still in the nest.

Frequent visits to the colonies of Florida Bay and Tampa Bay were required in order to band as many nestlings as possible. During these visits, some nestlings were not banded due to the disturbance it caused to neighboring nests with large, mobile chicks. Although it was our goal to band every nestling in Florida Bay, many nests were not banded because they failed before the eggs hatched, the nestlings died before reaching

Table 3. Number of Roseate Spoonbills banded in Florida Bay, Dec 2003-May 2004, and in Tampa Bay, April 2004.

Estuary	Sub-region	Colony	Number of Nests Banded	Number of Chicks Banded	Number Resighted Alive [a]	Number Resighted Dead	Number Presumed Dead [b]	Number Fate Unknown
Florida Bay	Northwest	Sandy	19	39	18 (46%)	5 (13%)	1 (3%)	15 (38%)
		Frank	18	37	2 (5%)			35 (95%)
		Clive	1	2				2 (100%)
	Northeast	Tern	22	40	2 (5%)	7 (17.5%)	9 (22.5%)	22 (55%)
		N. Park	2	3	2 (67%)			1 (33%)
		Duck	3	6		4 (67%)	2 (33%)	
	Central	E. Bob Allen	1	2				2 (100%)
		Jimmie Channel	1	1				1 (100%)
		Calusa	5	11	2 (18%)	1 (9%)	4 (36%)	4 (36%)
	Southeast	M. Butternut	2	3	1 (33%)	2 (67%)		
		Stake	1	1				1 (100%)
		Crab	1	3			3 (100%)	
		East	4	5	1 (20%)	1 (20%)		3 (60%)
		Crane	2	3		1 (33%)	2 (67%)	
		E. Butternut	3	6	4 (67%)	1 (16%)	1 (16%)	
		Florida Bay Total	**85**	**162**	**32 (20%)**	**22 (13.5%)**	**22 (13.5%)**	**86 (53%)**
Tampa Bay	Alafia Bank		**131**	**233**	**216 (93%)**	**2 (0.6%)**	**0 (0%)**	**15 (6.4%)**

[a] The number of bird resighted after the age of 21+ days.
[b] The number of nestlings that disappeared or for which we found remains, but did not recover bands.

banding age, or it was physically impossible (or too unstable) to reach the nests to retrieve the chicks.

Spoonbill Banding Results

Florida Bay

In all, 162 chicks were banded from 85 nests across Florida Bay. Of these 27% were presumed dead before leaving the nest and 20% were observed post fledging. Outside of their natal colonies, there have been no resightings of these birds nor any of the 30 birds banded in Florida Bay last year.

In the Northwestern sub-region, 78 nestlings from 38 nests within three colonies (Sandy, Frank, and Clive keys) were banded (Table 3). Chicks were banded between Dec 22 and Jan 21. Eight percent of these chicks were found or presumed dead before leaving their nest. Twenty-six percent of the banded chicks were observed post-fledging but before they abandoned their natal colony.

In the Northeastern sub-region, 49 nestlings from 27 nests within three colonies (Tern, N. Park and Duck keys) were banded (Table 3). Chicks were banded between Jan 8 and Feb 17. More than 45% of these chicks were found or presumed dead before leaving their nest. Only 8% of the banded chicks were observed post-fledging but before they abandoned their natal colony.

In the Central sub-region, we banded 14 nestlings from 7 nests within three colonies (E. Bob Allen, Jimmie Channel and Calusa keys; Table 3). Chicks were banded between Jan 12 and Feb 16. At least 46% of these chicks were found or presumed dead before leaving their nest. Eleven percent of the banded chicks were observed post-fledging but before they abandoned their natal colony.

In the Southeastern sub-region, we banded 21 nestlings from 13 nests within six colonies (East and Middle Butternut, Stake, Crab, East and Crane keys; Table 3). Chicks were banded between Jan 12 and Feb 19. More than 52% of these chicks were found or presumed dead before leaving their nest but 25% of the banded chicks were observed post-fledging but before they abandoned their natal colony.

Tampa Bay: Alafia Bank

We began banding spoonbill nestlings at Alafia Bank in 2003 as part of a pilot study for the banding program. We banded 164 birds in April 2003, and since then we have received resight reports for 11 of those birds. These birds were resighted in Polk, Pasco, St. John's (St. Augustine), Hillsborough (Alafia Bank), and Nassau counties, and Merritt Island and Ding Darling National Wildlife Refuges. Out of those 11 birds, only one was found dead. Interestingly, that bird had been resighted alive two weeks earlier at Alafia Bank with a group of hatch-year spoonbills.

Spoonbills nested in 8 colonies in the Greater Tampa Bay area this year. The largest colony in the region is Alafia Bank in Hillsborough Bay, with 320 pairs. A total of 330 fledged birds were observed during one survey of the Alafia Bank Colony this season.

We concentrated our banding efforts for the Tampa Bay area at Alafia Bank. We banded nestlings on April 9, 15, 22, 23, and 29. We banded 233 nestlings from 131 nests (Table 3). In 19 resighting surveys of the colony, 216 of the 233 banded chicks were observed as flighted juveniles. We have band recoveries for only 2 dead birds, and only 15 of the total birds banded have not been resighted at all. Based on our estimation of 1.65 fledged birds/nest (216 resighted nestlings/131 nests), we

expect about 530 spoonbills (320 pairs X 1.65 birds/nest) fledged from Alafia Bank.

Discussion of Banding Results

The high degree of mortality observed and the low resighting rate of banded spoonbill chicks before they abandoned their natal colony further demonstrates the poor conditions in Florida Bay. That 98% of the birds banded in Tampa Bay were resighted as flighted juveniles not only demonstrates that the techniques used were not harmful but that spoonbills are highly productive when conditions are appropriate for reproduction. It is also interesting to note that the rapid growth of spoonbill numbers at the Alafia Colony in Tampa Bay coincides with the rapid decline in spoonbill numbers in Florida Bay since the early 1980's. We will continue to band in both locations using Alafia Bank as control of sorts for Florida Bay as well as source of information on spoonbill demographics in Florida and the larger Gulf of Mexico and Caribbean geographical regions.

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BIG CYPRESS NATIONAL PRESERVE

No wading bird activity was documented in Big Cypress this year.

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HOLEY LAND AND ROTENBERGER WMAs

Unfortunately, due to time and equipment constraints, a wading bird survey was not conducted in 2004 for Rotenberger and Holey Land. Surveys are planned for next year.

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UPCOMING MEETINGS

First National Conference on Ecosystem Restoration: Dec 6-10, 2004, Orlando, FL (for more information visit: http://conference.ifas.ufl.edu/ecosystem)

Florida Chapter of The Wildlife Society: approximately March 15-18, 2005, Tarpon Springs, FL (for more information visit: http://fltws.org)

Waterbird Society: proposed meeting for Fall 2005, Jacksonville, FL (for more information visit: http://www.waterbirds.org)

SOUTHWEST COAST

As usual Great Blue Heron nesting activity started at the Marco colony in December. What was unusual was Great Egrets getting started in late January; most years they start in mid to late April. Also unusual was the slow inland wetland dry-down exhibited along the Tamiami Trail east of Naples (see Hydrology 2004 section). By February, when typically there are large aggregations of waders (300-500 individuals) feeding along the Trail several miles west of C29, there were only little groups (10-15 individuals). The area never did dry out as it normally does; nor was it used much by the waders. Different also this year was the lack of a second thrust in wader nesting. It is customary for the initial nesting of waders at Marco to slack off late May and then pick up again (but in fewer numbers). This year it did not happen. Fledging success, which is difficult to assess accurately for the small waders, was mixed and will be discussed in the species accounts. In all there were variations this year and it did not seem as productive as other years but little stands out in the numbers to support the feeling.

Location and Methods

Rookery Bay (RB): 26°01'51"N 81°44'43"W. Two Red Mangrove islands, 0.22 ha. Nest census conducted 4/3 and 6/5, walk through, complete coverage, one person, one hour. This year all the wader nests were on the southern island; this is the third year this has happened.

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 4/17 and 5/28, walk through, complete coverage, one person, two hours each census.

East River (ER): 25°55'39"N 81°26'35"W. Three Red Mangrove islands, 0.25 ha (about). Nest census conducted 5/25, canoe, complete coverage, one person, one hour. The big difference this year was that there were more SNEG than TRHE nesting; always before it has been the reverse.

Chokoloskee Bay (CHOK): 25°50'43"N 81°24'46"W. Four Red Mangrove islands, 0.2 ha (about). This year most of the waders in the area used three of the four islands, boat census, two people, one hour, 5/4.

Chokoloskee Pass (CHPS): 25°46'48"N 81°24'26"W. One mostly Red Mangrove (2-3 Blacks) island, 0.5 ha (about). Boat census, two people, one hour, 5/4. This year, as last, almost no wader activity.

Caxambas Pass (CAX): 25°54'17"N 81°43'19"W. One Red Mangrove island, 0.5 ha (approximate). Walk through nest census, 5/27, one person, one hour.

Note: All of the walk or canoe censuses are conducted during peak nesting, about the beginning of June.

Comment: It is about time to comment on a phenomenon that is increasing more and more along this coast; that is the creation of small islands in relatively small water impoundments by the escalating amount of human land modification. Some of these islands are being used as colonies and/or roosts by waders. This causes several problems not only in trying to get a handle on nesting but also for the waders themselves. It is next to impossible with the resources available to assess the numbers of these scattered small colonies. Another problem is with people living close to these colonies and wanting to get rid of them (this is often the way we learn the colony exists). Then there is always the problem of land management around the colonies; a good example occurred this year. At a local park that has a large lake, county employees were observed spraying exotic vegetation using an airboat. At the same time LBHE (50-100) were observed apparently trying to start to nest in back of the vegetation being treated; the LBHE were not seen after that. We do not know how much wader nesting is being diverted to these new sites nor do we know how successful they are.

Sundown Censusing: For two of the colonies, birds coming in to roost for the night are censused; the goal of this project is to get an index of the numbers and species in the area year round. References below to the use of the area by the different species is derived from this project.

Marco Colony (ABCSD): Censused monthly with two boats and various numbers of volunteers (4-8). Boats are anchored in the two major flyways and record species and numbers of birds flying in (and out during the nesting season); one hour before sunset to one half hour after sunset. This project is ongoing and started in 1979.

Rookery Bay (RBSD): Censused bi-weekly with one boat and two observers (one a volunteer). The boat is anchored so that most of the birds can be observed flying in one hour before sunset to one half hour after sunset. Species and

Number of wading bird nests in coastal Southwest Florida during 2004

Colony	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	GLIB	Total
Rookery Bay		23	57	4	49	1	48		**182**
Marco (ABC)	19	199	60	7	97	4	109	18	**513**
East River			186	2	72		1		**261**
Chokoloskee Bay		108							**108**
Chokoloskee Pass		0							**0**
Caxambas Pass		4	11		9		4		**28**
Total	**19**	**334**	**314**	**13**	**227**	**5**	**162**	**18**	**1,092**
Mean (21-year)	**12**	**208**	**293**	**63**	**478**	**4**	**431**	**476**	**1,965**

numbers of birds flying in (and out during the nesting season) are recorded. This project is ongoing and started in 1977.

Species Accounts

Great Egret (GREG): As mentioned previously, nesting started early this year and there was no second thrust of later nesting. At all of the three colonies (ABC, CHOK and RB) where most of the GREG nesting occurs, good numbers of chicks fledged. One example; at CHOK in June, 194 large chicks were recorded and, as there was a lot of fledgling in/out activity, there had to be more in the region. With the peak number of nests at 108 (see Table), there ought to have been at least two fledglings per nest. Both of the other colonies had good numbers of large chicks; this appears to have been a successful year for this species.

Snowy Egret (SNEG): Began nesting about on schedule but in lower numbers than usual at ABC and the numbers never picked up. As mentioned above, SNEG increased their nesting at ER, and the number of nests at ABC were low possibly because some of these birds moved to ER. The total numbers of nests were quite close to the 21 year mean (see Table).

Little Blue Heron (LBHE): "This is a species to watch; Audubon wardens in the nineteen thirties recorded them as the most numerous small wader species in South Florida; now in Southwest Florida they are the least numerous. Numbers coming in at sundown and nests are still declining." The preceding is what I wrote last year and I see no reason to change it; nesting and numbers in the area are still going down.

Tricolored Heron (TRHE): Nesting for this species declined considerably this year as did their numbers in the area.

Reddish Egret (REEG): Did not have as good a year as the last few; nor did they seem to fledge as many chicks. In general they appear to be slowly increasing in the region.

Cattle Egret (CAEG): "Another species to watch; the general decline in nesting is now starting to be reflected in the numbers coming to roost at sundown (one would think it would be the other way)." This is what I wrote last year and the trend continues. It would be interesting to know what is going on with them in other areas.

White Ibis (WHIB): This species breeds along the coast in such small numbers that it is not reasonable to analyze the nesting. Considerable numbers come into both of the sundown roosts and are in the area a good part of the year. For the ABCSD the 18 year mean is 5760 with a range of 83-17562; 20% of the WHIB using this night roost are immature. WHIB at ABC peaked in 1993 and have declined almost steadily since; as of 2003 they were down 61% from 1993. Interestingly the numbers of immatures are about stable; this may indicate that many of the adult WHIB that use these night roosts are not breeders (or that most of the fledglings are not accompanying the adults to this coast). This year the numbers in July were average for the study.

Glossy Ibis (GLIB): Nesting down at ABC (the only nesting location I know of along this coast) as is the numbers coming in at sundown. Hardly any fledglings observed; this does not appear to be a good year for them.

Comment: Three species (LBHE, TRHE and CAEG) have declined coming into the night roosts over the last five years; this downtrend is also reflected in their nesting.

As in any other individual year there are differences, but over time trends are emerging. GREG are still going up both in nesting and in the region. SNEG appear to be holding their own but may be moving around. In the area, TRHE are dropping some and their nesting is starting to reflect this. Both LBHE and CAEG have declined considerably in nesting and night roosting. Although WHIB numbers were average for July, the general decline in the vicinity over the years seems to be continuing. In all it is a mixed picture and difficult to make any generalizations about.

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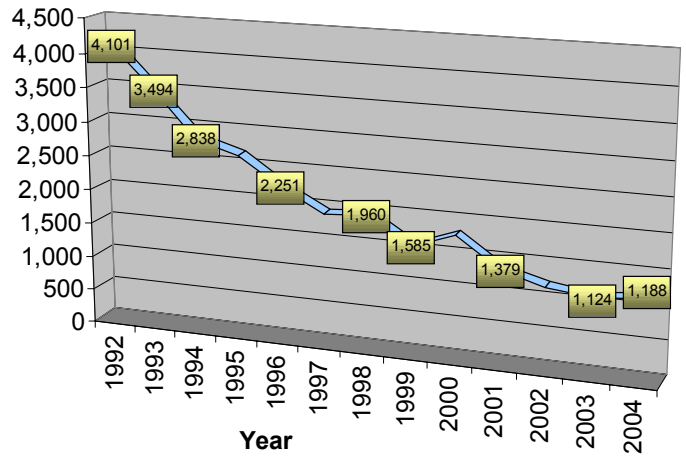
J.N. "DING" DARLING NATIONAL WILDLIFE REFUGE COMPLEX

Methods

Colonial nesting bird surveys at J.N. "Ding" Darling National Wildlife Refuge Complex were conducted via motorboat within Pine Island Sound (Hemp Island and Bird Key), Tarpon Bay (Tarpon Bay Keys) and Matlacha Pass (Lumpkin Island, Upper Bird Island and Lower Bird Island) in February, April, and June. Staff were unavailable to conduct surveys in March and May this year. Colonial nesting bird surveys include wading birds (herons, egrets and ibis) as well as diving birds (brown pelicans, double-crested cormorant and anhingas). Total nests are derived from the maximum number of nest-tending birds observed for each species. All distinguishable immature birds are tallied separately. Survey dates for Matlacha Pass in 2004 were February 25th, April 29th, June 14th and June 28th. Survey dates for Pine Island Sound were April 21st, June 9th and June 25th. Survey Dates for the Tarpon Bay Keys were March 17th, April 22nd, June 14th and June 28th.

Fig. 1 Colonial Bird Nesting Effort at J. N. "Ding" Darling NWR Complex, 1992-2004



Results

The 2004 peak estimate for colonial nesting birds was 1,188. Two-hundred-and-sixty-eight of these were wading birds while 920 were diving birds.

Tarpon Bay Keys: The peak estimate for colonial nesting birds on the Tarpon Bays Keys was 155, 65 of which were wading birds and 90 of which were diving birds.

Pine Island Sound: The peak estimate for colonial nesting birds on the islands of Pine Island Sound was 618, 53 of which were wading birds and 565 of which were diving birds. On Hemp Island, 337 colonial nesting birds were counted. Forty-three of those were wading birds while 294 were diving birds. On Bird Key, 281 birds were counted, 10 of which were wading birds and 271 of which were diving birds.

Matlacha Pass: The peak estimate for colonial nesting birds on the islands of Matlacha Pass was 415 birds. One-hundred-and-fifty of these birds were wading birds while the other 264 were diving birds. One-hundred-and-fourteen of these birds were documented on Upper Bird Key, 117 on Lower Bird Key and 184 on Lumpkin. On Upper Bird Key, 30 wading birds and 84 diving birds were counted. On Lower Bird Key, 40 wading birds and 77 diving birds were seen. On Lumpkin Island, 80 wading birds and 104 diving birds were documented.

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Table 1. Colonial nesting bird survey peak estimates for J. N. "Ding" Darling National Wildlife Refuge Complex, Feb, Apr, and Jun 2004. Counts reflect the maximum number of nest-tending adults. Note that survey effort was reduced this year compared to last year.

Island Surveyed	BRPE	ANHI	DCCO	BCNH	GRHE	TRHE	LBHE	REEG	CAEG	YCNH	SNEG	GREG	GBHE	WHIB	TOTAL
Tarpon Bay Keys	32	2	56	1	0	5	0	3	4	0	31	20	1	0	**155**
Hemp Island	146	0	148	0	0	2	2	1	3	0	8	1	2	24	**337**
Bird Key	218	1	52	2	0	1	3	0	1	0	1	2	0	0	**281**
Upper Bird Island	65	10	9	0	0	4	9	1	6	0	1	8	1	0	**114**
Lower Bird Island	28	0	48	1	0	4	1	1	6	0	2	19	6	0	**117**
Lumpkin Island	73	18	13	2	2	11	3	0	38	1	10	11	2	0	**184**
TOTAL	**562**	**32**	**326**	**6**	**2**	**27**	**18**	**6**	**58**	**1**	**53**	**61**	**12**	**24**	**1,188**

WADING BIRD ABUNDANCE (FORAGING & NESTING)

EVERGLADES NATIONAL PARK AREA

Methods

Systematic reconnaissance flights (SRF's) were performed monthly between Dec 2003 and May 2004. Flights were conducted over 3 consecutive days using a fixed-wing Cessna 182 at an altitude of 60 m. The area covered included Everglades National Park and the southern region of Big Cypress National Preserve. The area was surveyed using transects oriented E to W and separated by 2 km (Figure 1). Wading birds were counted, identified and geographically located using GPS units. Changes in surface water patterns (hydropatterns) were also recorded. Five categories were used to describe the hydropatterns: DD - absence of surface water and 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; and WW - continuous surface water over the area.

Data obtained during each SRF were compiled into a database, which contains the information collected since 1985 to the present. During this period, SRF surveys were not conducted during Dec 1984, Dec 1987 and Jan 1998. Missing data for those months were estimated using a general-purpose multiple imputation model (Honaker *et al.* 2001, King *et al.* 2001). Densities of birds were estimated using a 2x2 km grid. The number of birds counted during the SRF inside the 300m strip width was extrapolated to the rest of the 4 km^2 cell by dividing the number of birds observed by 0.15.

Results

During the survey period (December 2003 – May 2004), a decrease of 10% in the abundance of wading birds was observed, for all the species combined, in comparison to the previous year (Figure 2). Despite the decrease in the number of birds observed in 2004, an overall slight increase persists when numbers from 1985 to the present were compared using a linear regression model.

Figure 3 shows that the number of birds for six of the nine species declined in relation to those observed in 2003. Glossy ibis (GLIB) declined 49%, small dark herons (SMDH) 47%, great white heron (GWHE) 45%, wood stork (WOST) 37%, small white heron (SMWH) 29%, and white ibis (WHIB) 13%. The only species with an increase in the number of birds were roseate spoonbill (ROSP) 16%, and great egrets (GREG) and great blue herons (GBHE) with 7% respectively. Figure 3 also shows the annual estimates of the number of birds by species from 1985 to the present. Linear regression models were used to determine the general trend for each species. A tendency to increase in the number of birds estimated for GREG, GBHE, GLIB and WHIB was observed. Some species such as ROSP, WOST, and SMWH showed a stable trend; while only two species, SMDH and GWHE, showed

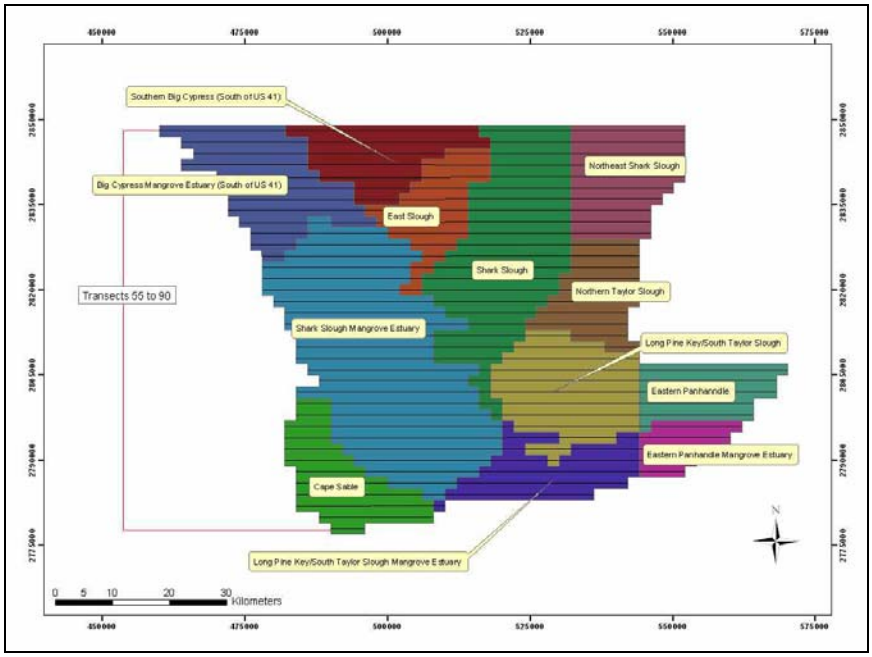

Figure 1. Map of ENP and southern Big Cypress National Preserve with sampling transects and drainage basins.

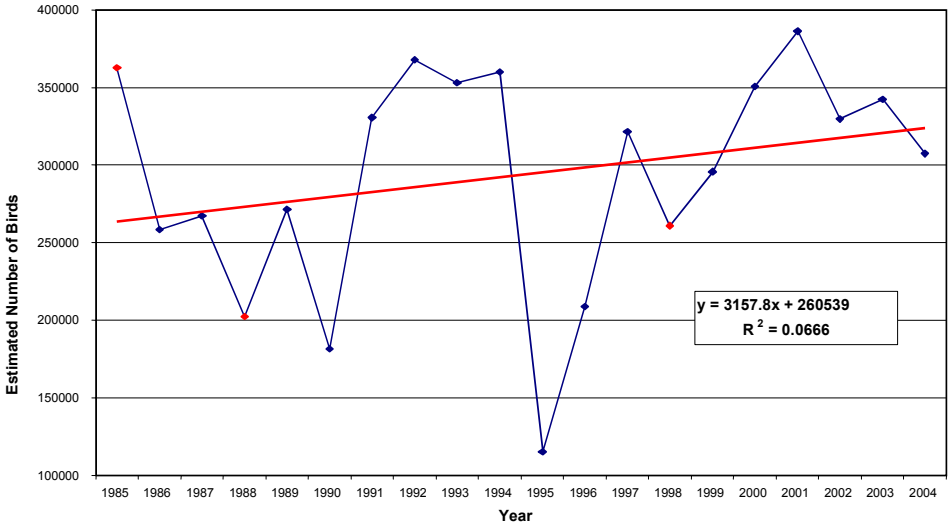

Figure 2. Estimated number of wading birds (all species pooled) observed from the months of Dec - May from 1985 - 2004. Red marks represent years with estimated missing data.

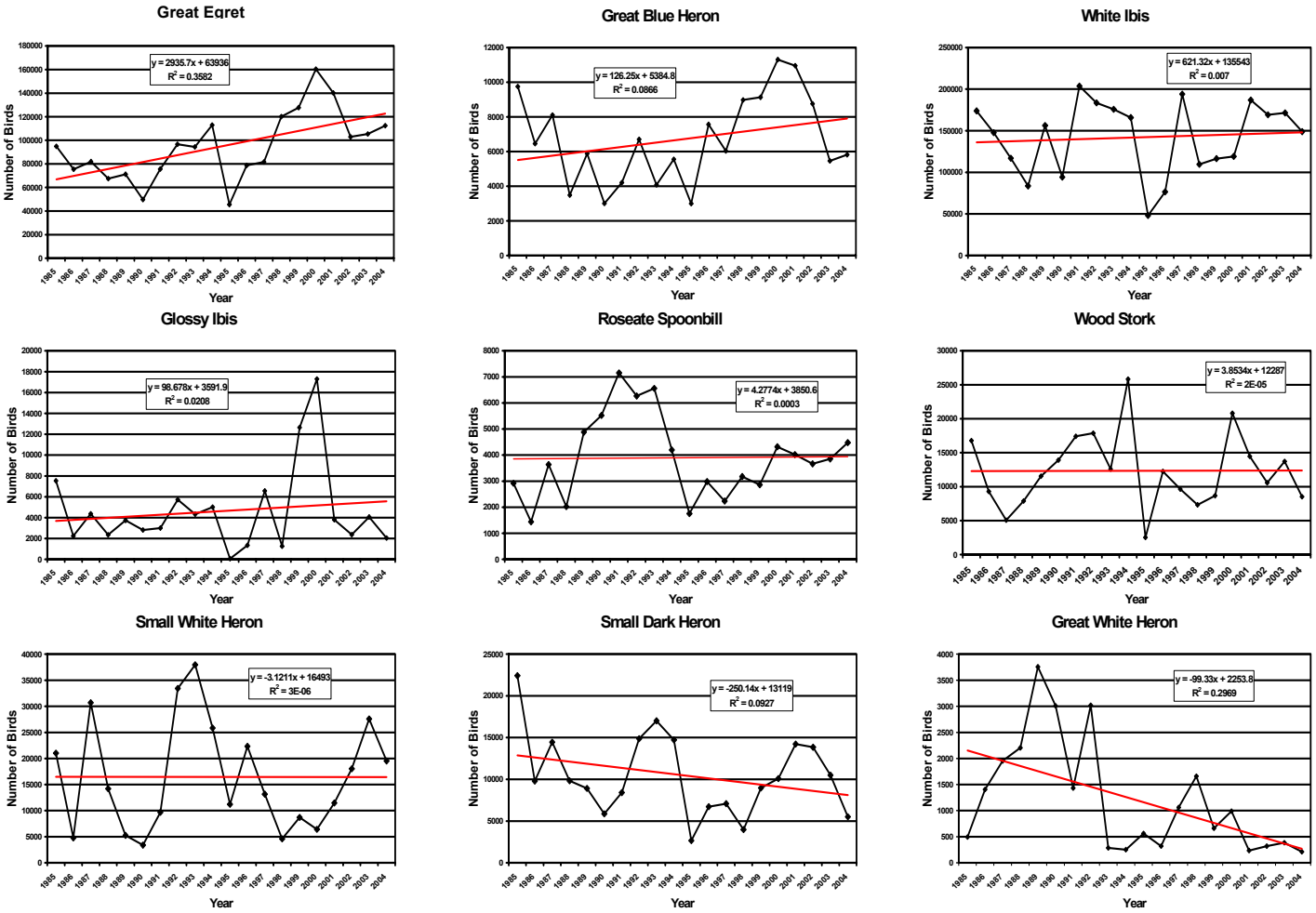

Figure 3. General trends in wading bird populations based on the total number of birds estimated during the surveys performed each year in the Everglades National Park from 1985 to the present.

tendencies to decrease. Although these analysis can give us an idea of the general trends observed for each species or groups of birds through those years, additional studies and data analysis will be necessary in order to evaluate the significance of these observations and its relevance to the wading bird populations at the Everglades National Park.

The maximum density of birds occurred this year during the month of January (see Table 1), with seven of the nine species surveyed showing peak numbers, including those species with the largest number of individuals such as GREG and WHIB. Other species such as WOST and GLIB reached maximum densities in March and April respectively. The month of May, however, was the month with the overall lowest number of individuals for all the species but for SMWH, GLIB and ROSP.

Table 2 shows the distribution and abundance of wading birds in the different drainage basins in what could be considered a year with normal precipitation throughout the survey season. Shark Slough (SS) was the basin where most of the birds (25%) were found, followed by Shark Slough Mangrove Estuary (SSME) with 16%, and Big Cypress Mangrove Estuary (BCME) and East Slough (ES) with 10% in each. These four basins combined made up 61% of the total number of birds observed during the entire season.

Most birds were concentrated in SSME and BCME during December. By January, as the water receded, a great increase in the number of birds in the SS basin was noticed, despite that SSME still had the largest number of birds. In February, as water continued receding, a large number of birds moved to the SS basin where they remained until the end of the season.

Considerable changes in hydropatterns and bird distribution were observed throughout the season as

Table 1. Estimated abundance of wading birds in the Everglades National Park and adjacent areas, Dec 2003 -May 2004.

Species	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04
GREG	21,633	25,134	21,973	16,761	13,727	13,190
GBHE	1,262	1,935	1,182	637	413	383
SMDH	1,107	1,558	757	685	960	448
SMWH	4,787	5,815	2,093	1,142	2,889	2,798
WHIB	21,179	41,059	27,072	27,633	19,903	12,033
GLIB	81	401	380	313	548	321
WOST	1,079	1,866	1,178	1,912	1,507	978
ROSP	1,122	1,313	448	175	906	513
GWHE	47	62	42	0	39	21
Total Abundance	**52,297**	**79,143**	**55,125**	**49,258**	**40,892**	**30,685**

Table 2. Estimated abundance of wading birds (all species combined) for the different drainage basins in the Everglades National Park, Dec 2003 - May 2004.

Month	SBC	BCME	SS	NESS	ES	SSME	NTS	LPK/STS	EP	CS	LPK/STSM	EPME	Total
Dec-03	1,770	11,651	4,239	1,297	2,510	14,177	897	2,614	2,610	6,470	2,589	1,473	**52,297**
Jan-04	7,967	6,771	14,546	1,992	8,285	15,092	861	1,711	2,531	8,609	9,412	1,366	**79,143**
Feb-04	6,484	3,908	17,175	1,738	7,077	4,174	1,453	3,714	2,392	3,777	1,925	1,308	**55,125**
Mar-04	3,982	4,430	18,607	2,111	6,383	6,771	702	1,542	1,179	1,684	1,172	695	**49,258**
Apr-04	2,302	2,565	10,682	2,225	4,314	6,560	80	2,304	745	941	7,949	225	**40,892**
May-04	1,392	2,236	11,202	2,440	2,828	2,132	53	2,209	60	1,792	4,300	41	**30,685**
Total	**23,897**	**31,561**	**76,451**	**11,803**	**31,397**	**48,906**	**4,046**	**14,094**	**9,517**	**23,273**	**27,347**	**5,108**	**307,400**

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

shown in Figure 4. From December to May, a gradual reduction in surface water was observed, except in February and March. During February, a considerable rain episode increased the area covered by water with a subsequent reduction in the number of birds in those areas.

From December to March, highest densities of birds were observed in WT areas where water depth was suitable for them to forage successfully. As water depth decreased during those months, densities at the WT areas began to decrease while densities at WW gradually increased. By May, highest densities were observed in WW areas. Despite that the WW areas were covered completely by water, low water levels made these new territories accessible to foraging birds. During May, there were still considerable densities of birds in the WW areas; however, peak densities occurred mainly in areas with a DT hydropattern. The fact that high densities occurred in DT areas was probably due to the necessity of wading birds to forage in small ponds or alligator holes common in this type of hydropattern.

Figure 5 shows the relative water depth, using the mean stage at the Everglades hydrology station P33, for the time the SRF's were conducted from 1985 to present and the corresponding estimated number of birds. Series of fluctuations were observed for both water levels and number of birds. A detailed observation of the plotted data suggested the possibility to fit a quadratic regression in order to generate a parabola-shape model, since one can expect and observe that small numbers of birds will occur at high water levels as well as low water levels. The regression coefficient indicates that this simple model

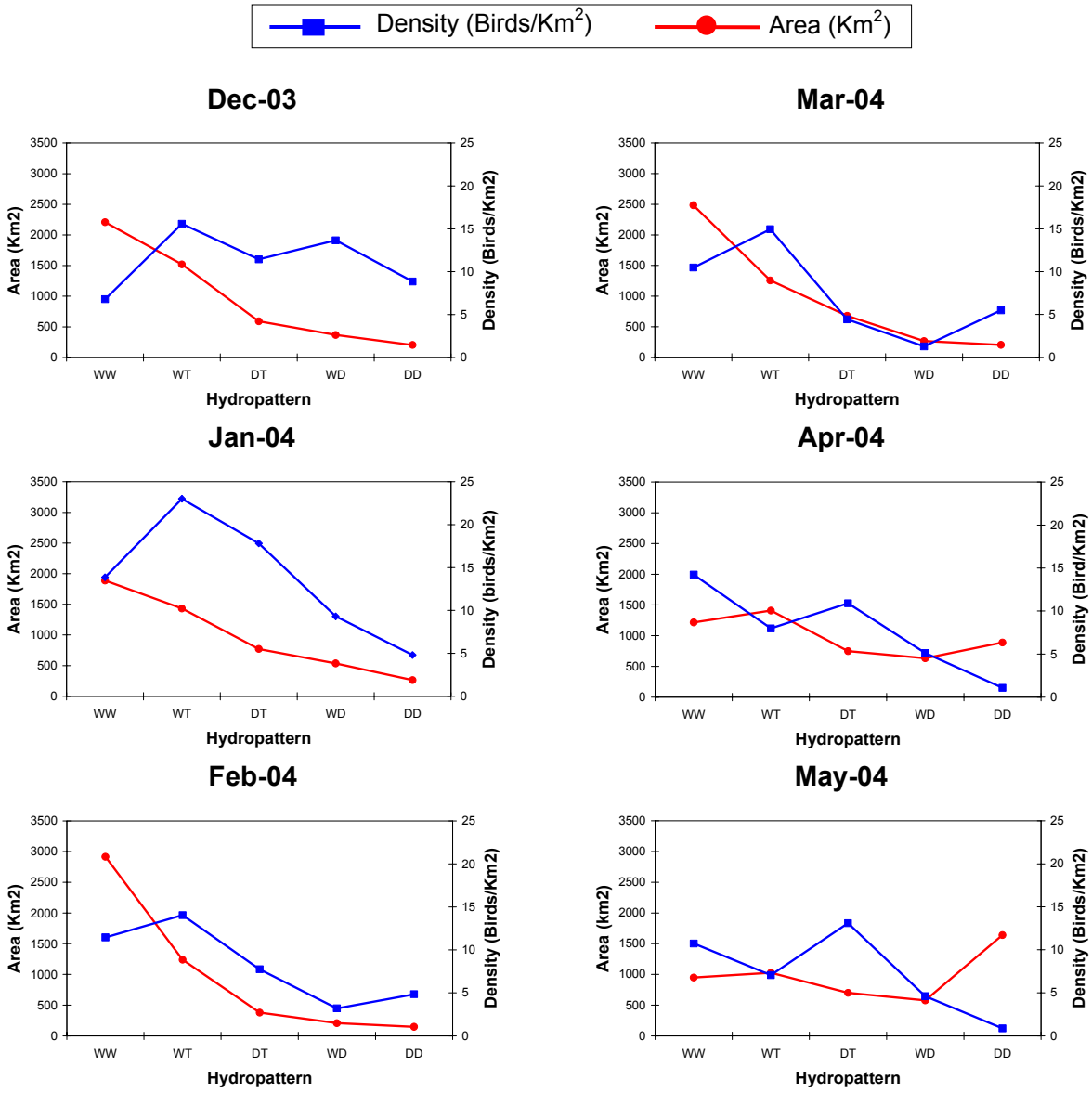

Figure 4. The areal extent and density of wading birds (all species pooled) in each surface water category. WW = continuous surface water; WT = mostly wet with scattered dry areas; DT = mostly dry with small scattered pools of water; WD = dry with water only in solution holes; DD = dry surface.

could explain 50% of the total variance (Figure 6). This model may be used also to estimate the stage depth where one can expect to have the maximum number of birds. Even though this model does not pretend to solve the complex factors that determine wading bird abundance in the Everglades National Park, it may provide a starting point for more complex analysis using more stations to estimate actual water depth at bird locations and food availability among others.

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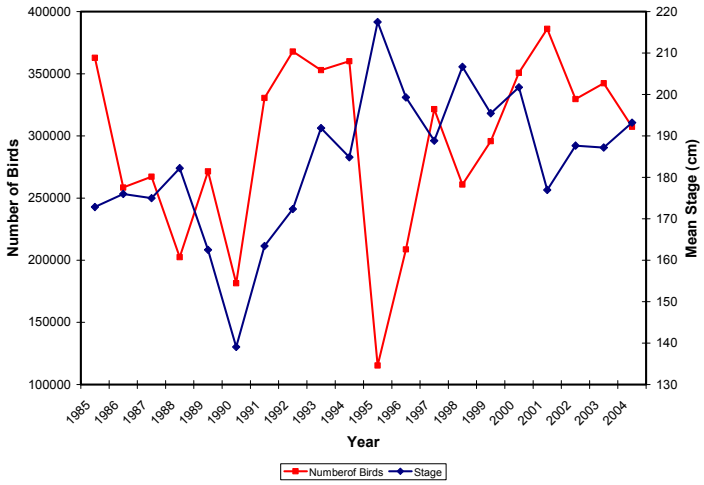

Figure 5. Mean water depth (mean stage at P33 hydrological station) and total number of birds estimated yearly during SRF's at the Everglades National Park since 1985 to present.

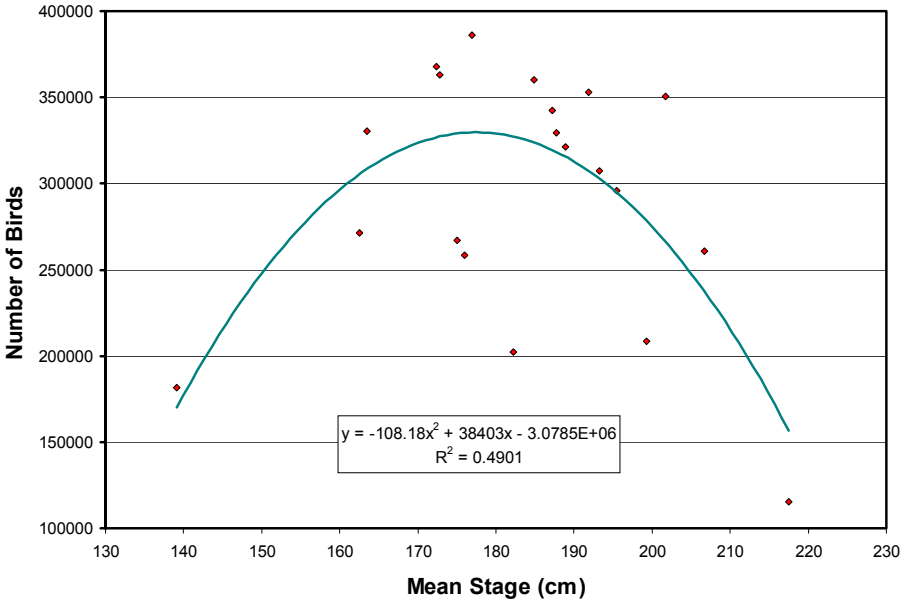

Figure 6. Quadratic regression used to fit a parabola-shape model to water depth (stage at P33 hydrological station) and total number of birds estimated yearly since 1985 to present.

Northern and Central Everglades

Methods

Wading bird surveys (SRF's) were flown with a fixed wing aircraft at an altitude of about 60 meters along parallel transects with 2-km spacing each month from February to July 2004. 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 programming language. High resolution digital video linked with GPS recorded each transect.

Results

In the Water Conservation Areas, monthly wading birds abundance was lower in 2004 than 2003. In 2004, the wading bird monthly relative abundance generally increased from February to June then declined in July. In the Big Cypress National Preserve, monthly wading bird abundance was lower in 2004 than 2003. In the Big Cypress National Preserve, monthly wading bird abundance peaked in February then declined until June and increased in July. In the Holey Land Wildlife Management Area, wading bird monthly relative abundance peaked in March (2,267), then decreased as the surface water dried up in April (7) and May (33), and then increased with increased surface water in June (590) and July (600). Final reports from 1996 to 2004 are currently available.

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Estimated wading bird abundance (15% coverage) in 2004 from SRFs.

Region	Species	Feb	Mar	Apr	May	Jun	Jul
Water Conservation Areas	GREG	10,727	16,140	19,007	35,880	40,867	28,007
	GBHE	440	660	667	1,067	1,367	1,287
	SMDH	107	433	480	927	1,413	540
	SMWH	307	293	213	1,060	507	580
	WHIB	13,307	25,460	23,067	17,807	13,213	6,180
	GLIB	320	260	420	373	353	213
	WOST	2,387	2,687	367	500	2,747	520
	ROSP	27	40	120	180	140	0
	GWHE	940	1,367	767	667	833	733
	Regional total	**28,560**	**47,340**	**45,107**	**58,460**	**61,440**	**38,060**
Big Cypress National Preserve	GREG	11,540	6,873	3,807	2,047	1,373	3,280
	GBHE	120	120	20	87	13	27
	SMDH	107	320	80	147	60	127
	SMWH	180	553	53	507	877	140
	WHIB	10,020	11,220	4,500	747	747	3,360
	GLIB	0	53	0	0	0	0
	WOST	3,540	520	1,000	327	20	20
	ROSP	7	7	0	0	0	0
	GWHE	1,380	633	133	67	87	53
	Regional total	**26,893**	**20,300**	**9,593**	**3,927**	**2,387**	**7,007**

STATUS OF WADING BIRD RECOVERY – 2004

Over the years (since 1995) these annual reports have been used to summarize the overall status and trends of wading birds nesting in the mainland, greater Everglades. I have focused my comments on five species which historically have dominated freshwater and estuarine nesting colonies in the Water Conservation Areas and Everglades National Park. These are Great Egret, Snowy Egret, Tricolored Heron, White Ibis and Wood Stork.

A central purpose for these reports has been to present the summaries of status and trends in the context of the goals of Everglades restoration. Restoration planners and scientists, especially those associated with the implementation of the Comprehensive Everglades Restoration Plan (CERP), have established the restoration of healthy wading bird populations in the greater Everglades ecosystem as a primary goal of the Plan. The four key indicators that have been established for this goal are based on our current understanding of the characteristics of the wading bird population in the pre-drainage Everglades. These wading bird indicators and the desired restoration endpoints are, (1) a substantial increase in the total numbers of nesting pairs for the five species, as shown by three-year running averages of nesting numbers, (2) a recovery of nesting in the region of the traditional "rookeries" in the southern, mainland estuaries downstream from Shark Slough, (3) a return to early dry season nesting by Wood Storks, and (4) an increase in the frequency of supranormal nesting events (i.e., "super colonies").

The importance of documenting and tracking the status and trends in wading bird nesting patterns has recently become elevated in the context of restoration programs because of a new requirement from Congress that Interim Goals be set for the natural system goals of CERP. The logic of this requirement is that the funding sources (the Federal and State governments) do not wish to wait until the implementation of the Plan is completed in approximately 2035 to determine if it is meeting its goals. Congress now requires "interim" goals, which are "predictions" or expectations of the level of performance by key CERP indicators for 5-year increments of time throughout the implementation of the Plan. Reports on how well the Plan is meeting its Interim Goals will go to Congress at five-year intervals (and annually to the National Academy of Sciences, which also will be reporting to Congress on how well CERP is meeting its natural system goals). Needless to say, the four wading bird indicators will be included in the periodic Interim Goals reports produced by the multi-agency RECOVER team.

2004 Results

Numbers and Locations of Nesting Birds: The total of approximately 46,700 nesting pairs for the five species is among the highest recent totals. The break down among species is as follows: Great Egret, 9,040 pairs; Snowy Egret and Tricolored Heron combined, 5,770 pairs; White Ibis, 30,460 pairs; Wood Stork, 865 pairs. The three-year running averages (2002-2004) for two of these are the highest ever recorded since these annual wading bird reports were initiated in 1995 (2002-2004 running averages of 9,656 pairs for Great Egrets; 24,947 pairs for White Ibis). The three-year running average for Snowy Egret and Tricolored Herons combined was 8,079 pairs, which is similar to the previous two reporting periods. The Wood Stork running average for 2002-2004 was 1,191, the lowest since the 1998-2000 reporting period.

Continuing the recent distribution pattern for colonies, only 6.9% of the total number of nesting pairs were in colonies located in the southern Everglades mainland mangrove estuaries in southern Everglades National Park. Less than 10% of birds have nested in the traditional southern estuaries since the mid-1990s. In contrast, over 90% nested in this region (e.g., East River, Lane River, Rookery Branch, Broad River, Cuthbert Lake, etc.) in most years prior to extensive drainage and management of the Everglades.

Discussion

One of the requirements for measuring the progress of CERP and other restoration programs is to determine the conditions in the natural system prior to the implementation of the plans, as a basis for detecting changes brought about by restoration. However, if we use the nesting record for the years 1995-2004 as a basis for characterizing the "pre-CERP" condition for wading

The three-year running averages of the number of nesting pairs for the five indicator species in the Everglades.

Species	1986 -88	1987 -89	1988 -90	1989 -91	1990 -92	1991 -93	1992 -94	1993 -95	1994 -96	1995 -97	1996 -98	1997 -99	1998 -00	1999 -01	2000 -02	2001 -03	2002 -04
GREG	1,946	1,980	1,640	1,163	2,112	2,924	3,677	3,843	4,043	4,302	4,017	5,084	5,544	5,996	7,276	8,460	9,656
SNEG/ TRHE	2,057	1,680	1,229	903	1,965	2,792	2,939	2,060	1,508	1,488	1,334	1,862	2,788	4,270	8,614	8,088	8,079
WHIB	2,974	2,676	3,433	3,066	8,020	6,162	6,511	2,107	2,172	2,850	2,270	5,100	11,270	16,555	23,983	20,758	24,947
WOST	175	255	276	276	294	250	277	130	343	283	228	279	863	1,538	1,868	1,596	1,191

birds, we do not find the declining populations that one might expect in a seriously degraded Everglades ecosystem. The three-year running averages for nesting wading birds for the five species have been showing increasing numbers, especially since the mid-to-late 1990s. These increases have been occurring prior to any system-wide benefits from CERP. Great Egrets show a progressive increase that began in the 1991-1993 period, White Ibis show increases beginning in the 1997-1999 period, Snowy Egrets and Tricolored Herons beginning in 1999-2001, and Wood Storks beginning in 1998-2000. The complete picture provided by the running averages calculated for all years since 1986 show that all five species have more than tripled their nesting effort in less than 20 years. So what is my point? It is that if these trends continue (I don't know why they began in the first place; also see Frederick et al. in this 2004 report) we will have a difficult time showing the benefits of the Plan for these five species, especially during the early years of Plan implementation.

It is especially interesting that the numbers of nesting wading birds (for these five species) have been substantially increasing, while at the same time there has been no return by nesting birds to the traditional colony locations in the southern, mainland estuaries of Everglades National Park. One could make the argument that this region is one of the best protected and least altered in the remaining greater Everglades. This may be true, although greatly reduced freshwater flows out of the southern Everglades may have caused a substantial reduction in secondary production in these mainland mangrove forests where many of these wading birds once fed. I have no certain explanation for why the historical "rookeries" in southern Everglades National Park are not being occupied, during a period of years when so many birds are nesting only 50 – 100 km to the north in the interior Everglades. One part of the story may be the fact that the old historical rookeries have become structurally altered due to the expansion of mangroves that is occurring through this region. A comparison of aerial photos of these historical colony sites taken during the late 1960s and again in 2003 shows that the patterns of discreet islands and ponds that once characterized these sites is now largely lost due to the expansion of mangroves. The reasons for the mangrove expansion are not certainly known, but the combined effects of sea level rise and reduced freshwater flows probably are the cause. The obvious question is whether there are alternative sites in the southern estuaries that could be used by large numbers of nesting wading birds.

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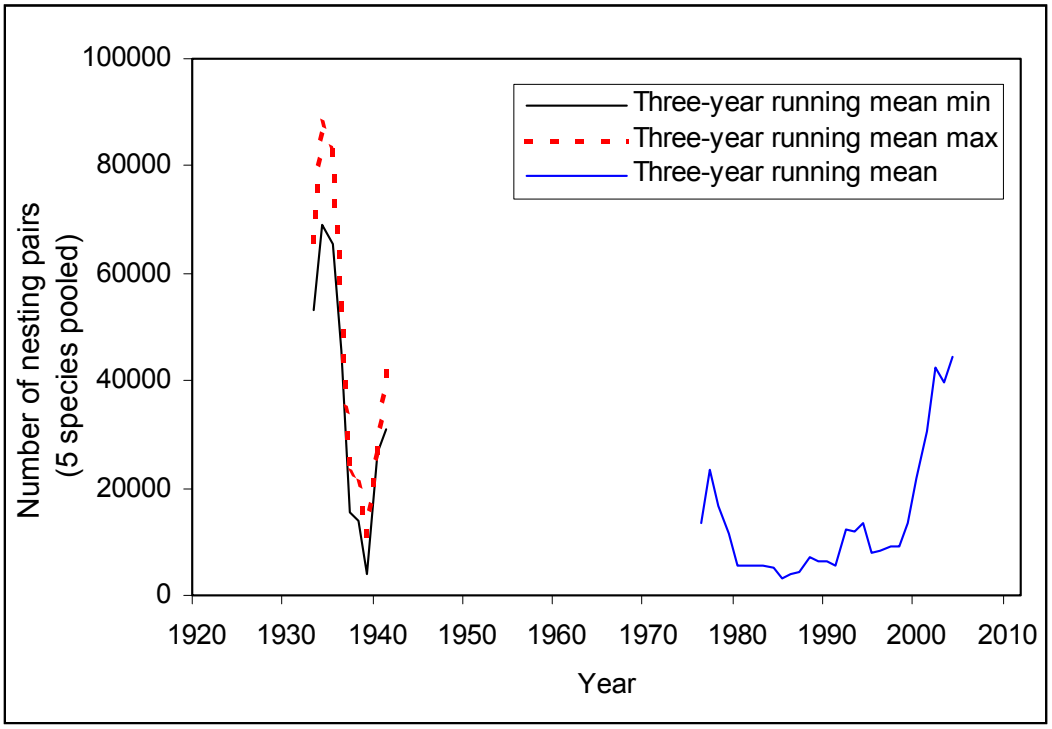
Three-year running averages for total number of nesting pairs for the 5 indicator species in the mainland Everglades basin. A low and high value was calculated for each 3-year period, 1931-1941, using low and high estimates of annual nesting.



SPECIAL TOPICS

WADING BIRD PREY CONCENTRATIONS IN THE EVERGLADES

This section summarizes the first year of a project that monitors small patches of concentrated prey during the dry season in the Everglades. A key hypothesis underlying the Everglades restoration is that there is a strong linkage among hydrologic patterns, fish populations, and wading birds. The importance and strength of the linkage has been demonstrated in field studies (Kahl 1964, Kushlan 1976, Ogden et al. 1976), experiments (Gawlik 2002) and modeling (Fleming et al. 1994), and it is obvious from the repeated inclusion of these three ecosystem components in the conceptual models of the Monitoring and Assessment Plan for the Comprehensive Everglades Restoration Plan (CERP). This project was needed because the quantitative link between wading bird nesting and food in the landscape has been elusive. Gawlik (2002) proposed a conceptual model with a list of factors that could mask the effect of prey density on wading birds. The model depicts how factors that affect regional prey populations might only partly affect the *availability of prey* for wading birds, which is the variable to which birds respond. Although people commonly use the terms food or prey "availability" and "density" interchangeably, the terms are quite different (Morrison et al. 1992). It is possible that factors affecting the concentration of prey could limit nesting more than factors that produce large prey population sizes, thus producing a disconnect between wading bird nesting and prey populations. It is analogous to looking at a supermarket for a link between olive sales and olive prices by correlating olive sales with the average price off all food items. The latter include olive prices, but it is not likely to be driven up or down by it. This project provides some of the first field data on the spatial and temporal distribution of maximum prey densities across the landscape. It will better define and monitor that fraction of the aquatic fauna biomass on which wading birds depend. In other words, it is looking for olives.

Methods

We sampled prey with 1-m^2 throw traps (Kushlan 1974, Jordan et al. 1997) at random sites just as they were drying up and contained shallow pools (Fig. 1). We were transported by helicopter because there was not enough water for airboat travel. These difficult sampling conditions are an important reason why so few previous studies have examined fish concentrations during the dry season. Water depths typically ranged from 10 cm to 28 cm, including a flocculent layer about 10 cm thick. The sampling area (roughly 8000 km^2) included ENP and the WCAs. The landscape was divided into landscape units (LSUs) by CERP personnel based primarily on hydroperiod and vegetation, which approximate a physiographic region (Fig. 2). Our sampling frame consisted of a multi-stage design with the stages being LSUs, primary sampling units (PSUs), sites, and

Figure 1. Two photos of sloughs in WCA 2A. The left photo depicts shallow water in sloughs and no water on ridges. Prey are not yet concentrated in refuges. The right photo shows a small (roughly 3 m diameter) refuge created by alligator movements. Less than one-third of the slough contained surface water. Prey density in the refuge was 1695 prey/m^2.

throw trap subsamples. PSUs were 500 m x 500 m in size, each containing two random sites. A site represented a patch of suitable habitat of variable size that contained two throw trap subsamples. Suitable habitat is loosely defined as moderate to sparse emergent vegetation with less than one-third of the area containing surface water. These areas were typically sloughs (Fig. 1). In addition to random sites we also sampled prey at foraging locations of large flocks (>30 birds) of mixed wading bird species. The comparison of random to foraging sites is equivalent to the comparison of habitat availability versus use.

Preliminary Results

From 25 March, 2004 to 7 June, 2004 we collected 117 throw trap samples distributed from central LNWR to southern ENP across 10 LSUs, 13 PSUs, and 40 sites (Fig. 2). The preliminary results reported here reflect the density of all prey items (fish and invertebrates) in a 1-m^2 throw trap. We captured 32 species of aquatic fauna. Five species comprised 90% of all large individuals captured. In descending order of frequency these were mosquito fish, flagfish, grass shrimp, sailfin molly and bluefin killifish. When pooling all prey items, prey density ranged from 0 – 1695 prey/m^2 and biomass ranged from 0 – 675 g/m^2. Foraging sites averaged 125 prey/m^2, whereas random sites averaged 31 prey/m^2. Although the Everglades is characterized as an ecosystem with unusually low standing stocks of fish (Turner et al. 1999), wading birds were able to find places with high densities, much higher than densities reported in fish population studies (e.g., Loftus and Eklund 1994, Trexler et al. 2002).

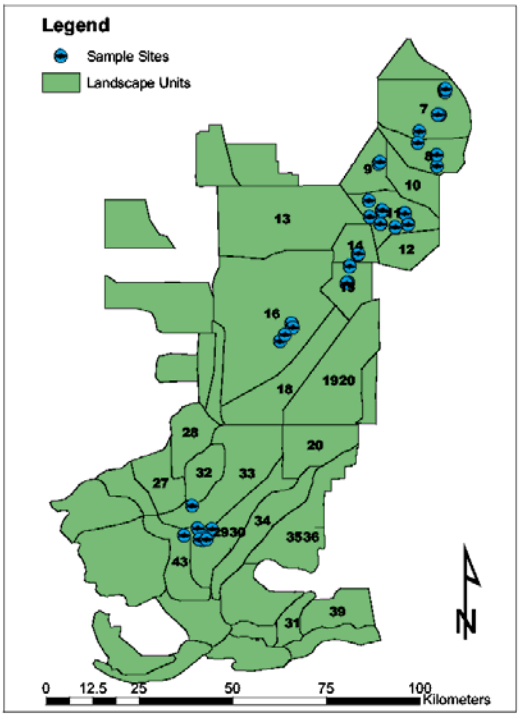


Figure 2. Map of landscape units and sites sampled during 2004.

Another striking contrast between random and foraging sites was that foraging sites contained a much higher density of large (> 2 cm) prey (Fig. 3). This pattern was fairly consistent across the LSUs. There was a tendency for the density of small fish to be higher at foraging locations, but that may be an artifact of small fish co-occurring in places with large fish. The variability was also higher at foraging sites, but we suspect that was due at least partly to sampling some foraging sites after birds had removed many of the prey items.

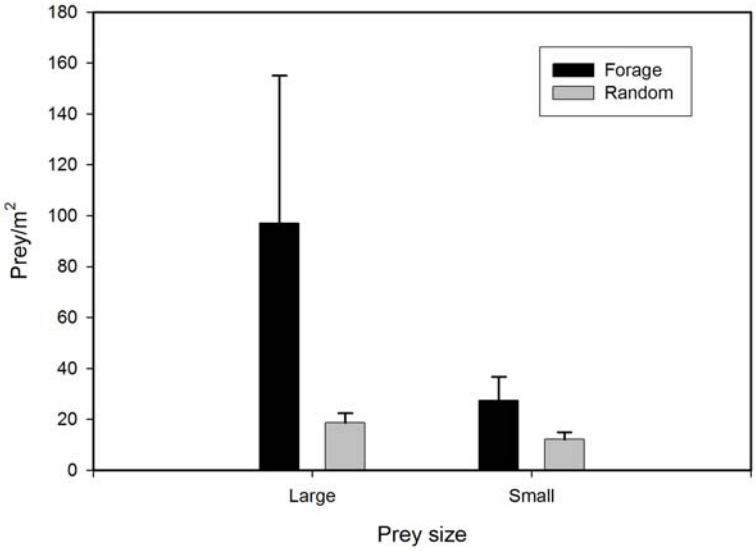


Figure 3. Density of all prey items in 1-m^2 throw traps at random sites and wading bird foraging sites. Error bars are +1 SE.

Future years of data will better define the fraction of the landscape and prey community on which wading birds depend. This information will be used by CERP to assess through the eyes of a wading bird, the progress made by Everglades restoration.

Acknowledgements
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