SOUTH FLORIDA WADING BIRD REPORT

Volume 12 | Mark I. Cook and Erynn M. Call, Editors | October 2006

SYSTEM-WIDE SUMMARY

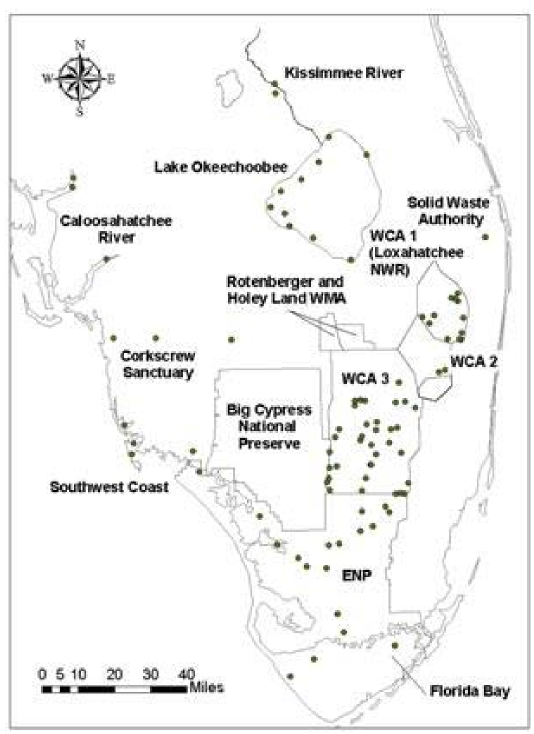
Total rainfall for water year 2006 was close to average but a very wet June '05 and consistent rainfall through October '05 produced above average water levels over most areas until the onset of the dry season. Tropical Storm Katrina and Hurricane Wilma were not major rain events and failed to have a significant impact on stage. Subsequent below average rainfall from November '05 to July '06 led to generally 'good' water recession rates and provided suitable foraging conditions over large areas of the system for much of the breeding season.

The estimated number of wading bird nests in South Florida in 2006 was 54,634 (excluding Cattle Egrets, which are not dependent on wetlands). This is a large increase in nest numbers compared to last year (71%), and only 20% less than the banner year of 2002 (68,750 nests). Note that this year's total is likely a conservative estimate. Surveys were not conducted this year at J. N. 'Ding' Darling National Wildlife Refuge Complex, which usually adds approx. 1000-2000 nests to the system total. More significantly, ground survey coverage for the WCAs was relatively limited this year and may underestimate the count for this area by up to 30% (see Simon et al., this issue). Adjusting for this underestimate increases the total number of nests in South Florida to approximately 70,000. Irrespective of how the total is estimated, 2006 represents a successful year for wading birds in terms of overall nest numbers and is comparable to historic nesting events in the 1940s.

In recent years, systematic nest survey coverage has been expanded to include the Kissimmee River floodplain and Lake Okeechobee. The Kissimmee River floodplain and surrounding wetlands supported large numbers of wading birds in 2006. Phase 1 of the Kissimmee restoration project was completed in 2001, and numbers of foraging wading birds continue to increase annually. This year's total was the highest recorded to date. 2006 was the first year since 1992 that systematic monthly nest counts were conducted at Lake Okeechobee (last year, a single count was conducted in June). As with other South Florida wetland systems, the lake and surrounding marshes exhibited a consistent and timely drydown throughout the nesting season and nest numbers were the highest recorded in over 30 years. The total number of nests at Lake Okeechobee and Kissimmee in 2006 was 11,447, which demonstrates the continued importance of these regions to South Florida wading birds. (Note that this total is not included in the system wide total.)

This year's large nesting effort occurred for the majority of species but the most noteworthy increases were for Snowy Egrets and Wood Storks. This is encouraging because these species have not enjoyed the general increase in nesting effort exhibited by some other wading bird species in recent years. Number of Tricolor Heron nests, however, declined relative to last year (down 44%) and continue to show the steady decline exhibited since 2001. Number of Roseate Spoonbill nests in Florida Bay was also slightly down on average.

Locations of wading bird colonies with ≥ 50 nests in South Florida, 2006.



INSIDE THIS ISSUE

3	Hydrology 2006
5	Regional Nesting Reports
32	Regional Bird Abundance
38	Population Recovery Status 2006
40	Special Topics

For all species, nesting success was generally high relative to recent years and the post-fledging environment was conducive to optimal foraging and high fledgling survival rates.

As usual for recent years, nesting effort in the Everglades was not uniformly distributed among regions. WCA-3 supported the largest number of nests (58%), whereas WCA-1 (21%) and ENP (21%) supported a similar nesting effort. Increasing the proportion of nests in ENP is a goal of CERP restoration efforts, and it is notable that ENP contributed considerably more nests in 2006 than it has done in recent years. It is also encouraging to note that this is the third successive season in which nesting has occurred and increased at the traditional "rookeries" in the southern, mainland estuaries downstream from Shark Slough. Indeed, these colonies contained approximately half the number of nests in ENP and 10% of total nests in the Everglades. The reasons for this are not clear at present but relative increases in the number of birds feeding along the coastal margins of ENP suggest that foraging conditions in the estuaries have improved. A trend in recent years has been for a large proportion of nests in South Florida to be concentrated in a single large colony (Alley North) located in northeast WCA-3A. While the 2006 breeding season followed a similar pattern, with 31% of all nests found in Alley North, the disparity was reduced relative to 2005 (57%) and 2004 (40%).

Systematic Reconnaissance Flight surveys (SRF) show that the temporal distribution of wading birds in 2006 differed from that of 2005. Last year record numbers of birds frequented the system from January through March, but numbers declined dramatically thereafter. This year overall bird abundance was consistently high from January through June. The system-wide total wading bird abundance in 2006 was higher than that of 2005.

Two of four species-groups (White Ibis and Great Egret) met the numeric nesting targets proposed by the South Florida Ecosystem Restoration Task Force. Two other targets for the Everglades restoration are an increase in the number of nesting wading birds in the coastal Everglades and a shift in the timing of Wood Stork nesting to earlier in the breeding season (Ogden, 1997). The 2006 nesting year showed no improvement in the timing of Wood Stork nesting but there was a general shift of colony locations.

Examining the annual breeding response of wading birds improves our understanding of how the Everglades and other South Florida ecosystems function. This year, at least some of the increased nesting effort and success may be attributed to favorable hydrologic and climatic conditions. The wet season prior to breeding was longer and wetter than average, which is considered to be favorable for aquatic prey production. Dry-season water depths and recession rates were classified as 'good' for wading birds and provided suitable foraging conditions throughout the system for much of the breeding season. Rainfall and reversal events were limited in frequency and magnitude, and induced only minimum nest failure. This pattern contrasts with that of 2005, when multiple heavy rain events through March and April resulted in a succession of reversals that left protracted high water levels, and thus poor foraging condition over much of the system. Hydrologic conditions, however, do not fully explain foraging and nesting patterns. Hydrologic conditions in February this year were similar to those reported in 2005, yet numbers of foraging wading birds in the WCAs in February this year were only half those of February 2005. This suggests that factors independent of recession rates and water depth such as the total prey available or foraging conditions beyond the Everglades may play a significant role in wading bird foraging decisions in South Florida. This observation also begs the question as to why numbers of pre-breeding foraging individuals do not relate directly to number of nests. The relatively low breeding effort in 2005 may be explained partly by the reversal events in March 2005 which undoubtedly limited the number of nests of later breeding species such as White Ibis which do not breed until late March. It does not, however, explain why the number of nests of earlier nesting species, such as Wood Stork and Great Egret, were lower in 2005 than they were in 2006. Finally, if environmental conditions this year were highly favorable for White Ibis and Wood Stork, why were they not suitable for Tricolor Herons?

The contributors to this Report are largely responsible for answering these and other critical questions. At the conception of the wading bird report in 1994 the contributors had the foresight to recognize that restoration requires a multi-agency approach that crosses jurisdictional boundaries and encompasses a system-wide assessment of wading bird ecology. Twelve years later this recognition, along with a free flow of information, have led to considerable improvements in our understanding of wading bird reproductive ecology and to some extent in our capacity to effectively manage the system. Indeed, during the past decade we have witnessed a rise in the reproductive effort of a number of species, and this may be attributed, at least partly, to increased input from ecologists into water management decisions. The road to a restored Everglades will be a long and challenging one but there is certainly cause for optimism. The contributors have laid the foundation for wading bird restoration and with continued dedication to good science and effective communication there remains hope that we can further restore and sustain South Florida's wading bird populations.

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HYDROLOGY 2006

The amount of rain in water-year 2006 (May 2005 – April 2006) was 11-12 inches greater than last year. The rainfall and associated stage readings for the 2006 water-year are shown in Table 1 below. Most of the rain fell during the month of June 2005. June totals ranged between 11 inches (in WCA-1) and 16 inches (in WCA-3A). For the rest of the year rainfall patterns were rather consistent across the Everglades Protection Area (EPA). That is, about 6 inches of rain per month from July '05 to November '05, then only 1-2 inches per month from November '05 until July '06. Rainfall was slightly below average in the northern part of the Everglades and slightly above average in the southern part of the system. As might be expected from an average rainfall water-year, the 2006 hydrologic stage conditions were also average throughout most of the system. Climatic events that had the potential to affect wading birds and/or their prey included Tropical Storm Katrina on August 25th, and Hurricane Wilma (Category 3) on Oct. 25th. However, neither were major rain-makers and as a result, none of the EPA hydrographs below indicate any stage impacts.

The following figures highlight the average stage changes in each of the Water Conservation Areas and Shark Slough, from January 2005 to July 2006, in relation to a simple categorical classification for wading bird habitat suitability during the nesting season (Figure 1). The dry-season recession rates are classified into three categories by the South Florida Water Management District to facilitate public discussion and operational decisions. These three are labeled Red, Yellow and Green. A Red label means poor conditions. This was due to a recession rate that was too fast (greater than 0.6 ft per week) or too slow (less 0.04 ft for more than two weeks). A Red label was also given when the average depth change for the week was positive rather than negative. A Yellow label means fair conditions. This was due to a slow recession rate of only 0.04 ft for a week or a rapid recession between 0.17 ft and 0.6 ft per week. A Green/Good label was given when water depth decreased between 0.05 ft and 0.16 ft per week. Although these labels are not meant to be indicative of an appropriate depth for foraging, they have been useful during high water conditions to highlight recession rates that can lead to poor foraging conditions during low water conditions, in April and May.

WCA-1

Last year, during the critical wading bird foraging and nesting period of March – April, dramatic reversals occurred and rainfall increased depths up to 1.5 ft. Despite the March '05 reversals, WCA-1 had the longest duration of good nesting and foraging periods of any region in the EPA during the dry season of 2005. This year, in terms of hydrology, good nesting and foraging periods were even better. Water levels in WCA-1 were below regulation most of the 2006 water year. As a result, recession rates were never too fast and minor reversals occurred only twice during the entire nesting season.

WCA-2A and 2B

In 2005, the return of the wet season in June of 2005 was very quick and ended any potential for delayed nesting and, in fact, was so intensive that it caused this region to exceed the upper flood tolerance for tree islands. This high water was not enough to cause 2006 nesting season recession rates to be too rapid and WCA-2A exhibited excellent foraging conditions from Feb. '06 until May '06. However, from May until July water levels went below ground (on average) in WCA-2A causing the wading birds to find other foraging locations. Fortunately, rainfall patterns and recession rates in WCA-2B were perfectly timed to create good foraging habitat just when they became bad in WCA-2A.

WCA-3A and 3B

On average, WCA-3A had good recession rates for the entire nesting season, and better foraging conditions (in terms of hydrology) compared to last year. There was a minor reversal during Feb. '06 that was more of an issue in the canals than it was in the marsh. Starting around March '06, wading birds were able to find good foraging habitats somewhere in WCA-3A. This was not the case in WCA-3B, where, despite good recession rates during the entire nesting season, the water depths did not go below 0.5 ft (optimum foraging depth) until May '06. Never-the-less, the two months of good foraging in WCA-3B in 2006, was a significant improvement over 2005 when numerous reversals in March, April and May caused foraging conditions to be poor to fair.

Table 1. Average, minimum, and maximum stage (ft NVGD), and total annual rainfall (inches) for water-year 2006 in comparison to historic[a] stage and rainfall. Subtract elevation from stage to calculate average depths.

Area	2005 Rainfall	Historic Rainfall	2005 Stage Mean (min;max)	Historic Stage Mean (min;max)	Elevation
WCA-1	47.96	51.96	16.18 (15.17; 16.87)	15.58 (10.0; 18.38)	15.1
WCA-2	47.96	51.96	12.62 (10.84; 14.27)	12.57 (9.33; 15.64)	11.2
WCA-3	53.39	51.37	10.58 (8.95; 11.72)	9.54 (4.78; 12.79)	8.2
ENP	57.27	55.22	6.65 (5.47; 7.59)	5.96 (2.01; 8.08)	5.1

[a]See Chapter 2 of the 2007 South Florida Environmental Report (Abtew et al.) for a more detailed description of rain, stage, inflows, outflows, and historic databases.)

Figure 1. Hydrographs for the WCAs and ENP for the 2006 water-year. See text for details on color-coded classification of wading bird habitat suitability.

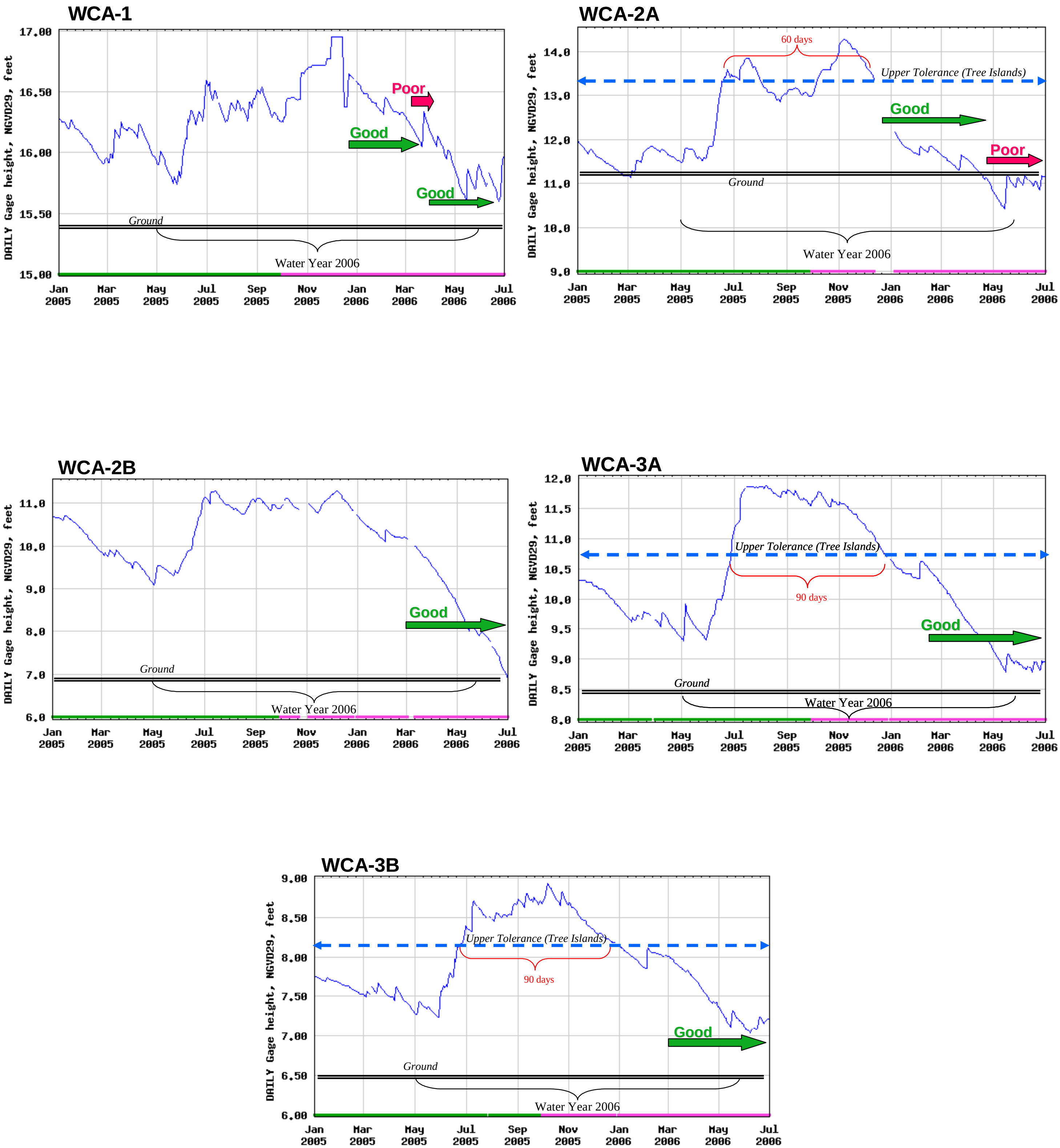
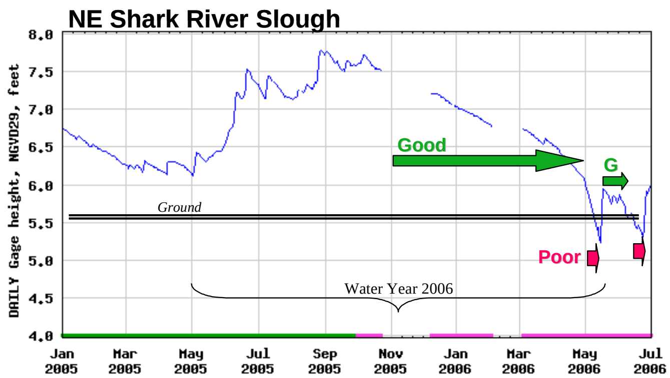


Figure 1 continued. Hydrograph for the WCAs and ENP for the 2006 water-year.



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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

The University of Florida continued its monitoring of wading bird nesting efforts in WCAs 2, 3 and Loxahatchee NWR throughout the 2006 breeding season. We conducted systematic 100% coverage aerial surveys over all study areas on a monthly basis between January and June, performed ground surveys within the most productive regions of WCA 3, and measured nesting success in five colonies: Alley North, Cypress City, Vulture, Vacation and Henry. Rena Borkhataria continued her monitoring of stork nests at Tamiami West and continued putting satellite telemetry devices on adults, in South Florida, Alabama and Georgia. In addition, we supported the efforts of Master's student Kate Willams in her work to quantify errors associated with the assessment of nest numbers and stage using aerial photography.

Methods

We conducted two types of systematic surveys in 2006, aerial and ground, to locate and quantify wading bird nesting attempts in the WCAs. In the middle of each month from February through June, we performed air surveys on established E-W transects, 1.6 nautical miles apart, over the whole of WCAs 1 (Lox), 2, and 3. Two observers, one on each side of a Cessna 172 flying 800 ft above ground level, searched for colonies, made visual count estimates (primarily of white waders), and took digital photographs for additional review. For most colonies, reported estimates were the peak count for each species as determined from these photographs. Because some nests within each colony were obscured by vegetation, the figures reported here are minimums. For those colonies where we established nest-check transects, estimates of dark-colored species were modified by on-site observations and by extrapolating from ratios of their nest numbers to the total counts of the more visible GREG nests.

As in 2005, we conducted ground surveys to better determine the distribution and numbers of less visible dark-colored waders (primarily GBHE, TRHE and LBHE) and anhingas. We again limited ground surveys to the one of the most consistently productive regions of WCA 3A, the area between Tamiami Trail and Alligator Alley from W80 40.3 to W80 49.6. From March 21 – 30, two observers on each of two airboats surveyed every other 0.3-degree-wide north/south running transect, covering half of the area within these boundaries. Smaller tree islands were approached closely enough to temporarily flush nesting birds, with nests either counted directly or estimated from the number of flushed birds.

To evaluate nest timing and success within colonies, we established transects in each of five tree islands noted above, marking nests and following them throughout the breeding season. Colonies were revisited during the cool morning or evening hours every 5 – 7 days. During these checks, the contents and fates of marked nests were recorded and newly active nests added to the sample. The length and width of transects were determined by the area that could be covered by researchers within the 1-hour time limit established to minimize nest failures. When possible, species identification for small herons (TRHE, SNEG, LBHE) was determined through the differentiation of older nestlings. Because failures early in the nesting cycle (egg or young nestlings) prevented our classification of certain nests, the nest success estimates for each species would be biased high. We have therefore lumped all small waders together in the results. We do not report most nest success figures here, but have used those ground-based surveys to grossly estimate the success of individual colonies.

The figures reported below are traditional percent success values to allow comparisons with last year's reported numbers. Nest success using the Mayfield method has not yet been determined.

Results

Total counts in the WCAs and Loxahatchee NWR: We estimate a total of 39,677 nests (excluding Anhingas, Double-crested Cormorants and Cattle Egrets) were initiated in 105 colonies between February and June 2006 (Table 1). This number represents a substantial 63% increase over the 2005 total of 24,248 obtained using the same methods. As stated above, this is a conservative estimate, especially considering that a sizeable upsurge in nesting took place at the Hidden colony where a large portion of birds were obscured by cypress cover.

Estimates for breeding seasons prior to 2005 are based on complete ground survey coverage (which we have not done in 2005 or 2006) and so truly direct comparisons of total numbers of nest starts of all species cannot be made. However, because ground surveys have historically contributed about 30% of the total numbers, we might speculate that a comparable wading bird total would be achieved by increasing this year's aerial survey numbers of 38,986, by 43% (70% x 1.43 =100%) yielding 55,750. However, this is a very rough estimate and should be used only to reinforce that the total numbers of nesting pairs in 2006 were similar to, if not slightly exceeding the averages of the past five years.

We can also directly compare years by comparing numbers of species that have always been counted primarily by aerial methods (White Ibises, Snowy Egrets, Great Egrets). Numbers of ibis nests in '06 were quite similar to the average of the previous five years (within 5%), and 45% greater than the average of the previous ten years. Great Egrets were also similar to the average of the previous five years, and considerably larger than the average of the last ten. Snowy Egrets were the real surprise, with 76% more nests than the average of the last five years, and nearly three times that of the last ten. This continues a trend of rapid increases in nesting numbers for Snowy Egrets in recent years, dominated Alley North and Hidden colonies.

Ground surveys (which ignore exclude larger, white-wader colonies visible from the air) yielded a total of 691 wading bird nests (169 locations averaging 4.1 nests per location) in the area surveyed. When Anhingas are included in the totals, we found 1121 nests (190 locations, 5.9 nests per location). These totals represent a 280% (wading birds only) and 108% increase (all nests including Anhingas) over the 2005 totals from the same area, respectively. The number of wading bird nesting locations this season in the ground surveys increased by nearly 66% over 2005 while all nesting (including ANHI) locations decreased slightly, about 6%. Average nests per location showed a modest increase of 16% over that of the 2005 figure of 5.1 nests per location.

Nesting Success: Nesting success was markedly higher in 2006 than in 2005. We marked a total of 275 Great Egret nests but, because limited access later in the season (due to a persistent and rapid dry-down) we were able to follow only 233 to the end of their nesting cycle. We found 81.5% were successful compared to 32% last year (apparent or traditional nest success measure), with an average number of young fledged per nest slightly over 2.5. Small heron nests (Snowy Egrets, Tricolored Herons, Little Blue Herons), were similarly successful, nearly 73%, with an average 3.2 fledged per nest.

We marked 213 White Ibis nests on northern Alley North, and several hundred more in Lox's New Colony 3, as part of Kate Williams' research. Due to the later initiation dates there, most could not be followed over the entire extent of their nest cycles. Still, based on our observations in the early and middle stages, we speculate that their nest success was quite high. We are in the middle of analysis both of marked nests, and of a much larger sample of nests individually identifiable on aerial surveys. Nest success was apparently high for White Ibises, and we saw large groups of fledged and fledging young at Alley North late in the season.

Wood Stork nests at Tamiami, Crossover and to some extent 3B Mud East were initiated in February. We monitored the fates of 90 marked nests at the Tamiami West colony, ENP, from 24 Feb—27 Apr 2006. Nests were visited weekly and eggs and chicks were counted using mirror poles. We used a maximum likelihood approach (Program MARK) to estimate the daily survival rates of eggs and chicks. The number of eggs per nest ranged from 1-5, with a mean number of 3.12 (SE 0.008). The daily survival rate of eggs in marked nests was 0.992 (SE 0.0026) and the probability of a nest hatching at least 1 chick was 0.799. The number of hatchlings per nest ranged from 1-4 with a mean of 2.66 (0.009). The daily survival rate of chicks from marked nests from hatching to up to 49 days of age was 0.998 (0.0009) and the probability of a nest with hatched young fledging at least 1 chick (age 55 days) was 0.896. The combined probability of any nest start fledging at least one young for the season was 0.7153. Researchers at Everglades National Park estimated that there were approximately 400 nests at the Tamiami West colony—with a nest success rate of 0.7153 and 2.58 chicks fledging per nest, we estimate that around 740 wood stork chicks fledged from the colony this year. This was the best year for wood storks at Tamiami West since 2002. Last year (2005) all marked nests (59) had failed by early April and it was estimated that only 20-25 of 200 nest starts were successful. In 2004, approximately 50 pairs initiated nests at Tamiami West, but all abandoned following heavy rains in early March. Although we did not follow marked nests at the 3B Mud East colony this year, aerial survey information suggests that this much smaller colony probably fledged about 1 chick per nest.

Table 1. Numbers of nests of aquatic birds found in WCAs 2, 3, and Loxahatchee NWR during systematic surveys, January through June of 2006.

Latitude	Longitude	WCA	Colony	GREG	WHIB	WOST	ANHI	GBHE	TRHE	BCNH	SNEG	LBHE	ROSP	YCNH	GLIB	Colony Total*
N26 32.168	W80 17.652	1	New Colony 3		4800					30	200				50	5080
N26 26.208	W80 23.454	1	Lox 99	1136							900					2036
N26 27.421	W80 14.441	1		437							1600					2037
N26 23.912	W80 14.955	1		73	200						140					413
N26 28.116	W80 22.376	1									397					397
N26 22.330	W80 15.612	1		108	194											302
N26 31.997	W80 16.539	1									177					177
N26 22.460	W80 18.680	1									100					100
N26 31.381	W80 15.983	1									81					81
N26 22.105	W80 15.197	1							30			50				80
N26 27.606	W80 25.379	1									60					60
N26 33.276	W80 15.904	1						3			50					53
N26 14.538	W80 21.043	2		57							85					142
N26 07.780	W80 40.740	2	2B Melaleuca	134												134
N26 14.944	W80 19.471	2		116												116
N26 12.130	W80 31.750	3	Alley North**	1193	13566		200	22	320	214	3000	470	40	20	190	19035
N25 46.360	W80 50.240	3	Hidden	300	1868											2168
N26 05.999	W80 27.365	3		215				5			694					914
N25 48.080	W80 29.400	3	3B Mud East	256	203	15					200					694
N26 01.331	W80 32.213	3	Vulture**	378				1			80					459
N26 02.655	W80 37.589	3	Big Mel	318							89					407
N26 00.738	W80 37.940	3		120				2			200					322
N25 55.510	W80 50.100	3	Crossover	140		175										315
N26 07.423	W80 32.544	3	6th Bridge Island	200				12								212
N25 48.344	W80 50.896	3		204												204
N26 07.468	W80 30.163	3	Cypress City**	173			60	8								181
N25 57.723	W80 34.344	3			16			4				157				177
N25 54.939	W80 37.813	3	Vacation**	120			45	6	10	5	35					176
N26 02.032	W80 40.442	3										138				138
N25 52.383	W80 39.208	3		114												114
N25 52.149	W80 48.359	3		8					50			55				113
N25 49.239	W80 40.616	3	Yonteau	113												113
N25 51.671	W80 50.234	3		85				2								87
N26 07.934	W80 42.127	3		81												81
N26 00.963	W80 47.652	3							80	1						81
N25 46.300	W80 41.590	3		80			80									80
N25 59.013	W80 48.761	3										80				80
N25 52.484	W80 39.262	3		70												70
N26 07.669	W80 43.464	3		65												65
N25 59.209	W80 41.718	3		62				2								64
N26 00.925	W80 33.811	3						2			60					62
N25 58.228	W80 41.994	3		61												61
N25 57.175	W80 39.176	3		56				4								60
N25 49.246	W80 50.469	3	Henry**	55			35	1								56
N25 55.296	W80 31.158	3		56												56
N26 06.621	W80 43.433	3		52												52
Total Nests for Colonies > 50				6636	20,847	190	420	74	490	250	8148	950	40	20	240	37,885*
Total Nests for Colonies < 50				861	45	0	430	257	101	69	137	312	0	8	2	1,792*
Grand Total				**7,497**	**20,892**	**190**	**850**	**331**	**591**	**319**	**8,285**	**1,262**	**40**	**28**	**242**	**39,677***

* Does not include ANHI
* Dark species estimated from ground visits and nest transect data

For all species, the timing of nesting was either typical or early, and nearly all fledged young during a time of year when the marshes were still drying, and food was highly available. This suggests that, unlike most years, young were fledged into an environment conducive to survival.

In conclusion, the 2006 nesting season was remarkably successful for nearly all species we monitored. Numbers of nesting attempts were as high or higher than most recent years, nest initiation was normal to early, nest success was apparently high or quite high, and the postfleding environment was remarkably conducive to foraging and high survival.

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EVERGLADES NATIONAL PARK

Methods

Aerial colony surveys were conducted monthly (February through July) by 1 or 2 observers using a Cessna 182 fixed-wing aircraft (~30 person hours). Survey dates were: 2 and 28 February, 22 and 28 March, 17 and 28 April, 26 May, 5 and 22 June, and 19 July.

Results

Wading bird nesting activity increased dramatically this season compared to previous seasons. There were more colonies seen within the park and more nests seen within many of the colonies. We observed a total of 10,140 nests within 39 active mainland colonies in Everglades National Park.

The initiation of nesting was late, but overall it appears that conditions were nearly perfect for successful nesting, despite vegetation damage within many colonies from hurricane Wilma and heavy rains occurring before young birds had fledged. We were concerned that the rainfall events occurring near the end of fledging would result in abandonment of nests, however it appears that birds were able to successfully fledge. We conducted several flights approximately 1-3 weeks after rain events, but were not able to see dead young or abandonment of nests within colonies. We also noted that juvenile birds continued to stand on nests and did not appear to be weak (unable to stand) so we assume the young were able to fledge. We later observed flapping young birds on and near nests and fledged young flying in and around the colonies.

Of the 39 colonies seen within the park, only 4 colonies failed and, for reasons unknown: 3 transient Great Egret colonies ("GREG 14, 16 and 17") and a new mixed species colony in lower Taylor Slough ("Madeira"). However the majority of colonies successfully fledged young.

An ominous discovery within one of the failed transient egret / night heron colonies ("GREG 14") was the sighting of an exotic 10' Burmese python. The python was seen, but not captured, by park research cooperators. At the time the python was seen, the colony was still active. We do not believe the python caused the abandonment of nests at this colony, however it was the first documented record of a Burmese python seen within an active wading bird colony. This colony may have failed due to its poor location within the East Everglades. The area around the colony completely dried down which would have forced the adult birds to travel long distances to find food for the young.

Colony summaries

Alligator Bay (previously called "2004 New Colony13")

This colony was much larger than in 2004 / 2005 and appeared to successfully fledge hundreds if not thousands of White Ibis and Snowy Egrets. We also noted approximately 200 Great Egret nests as well. In addition, we saw many Tri-colored heron young flying about the colony however the number of Tri-colored heron nests could not be estimated due to the thick vegetation. During one of the flights we followed flight lines of egrets and ibis flying from this colony to the west. Many birds landed among large feeding flocks of mixed waders and White Pelicans in mangrove creeks and flats.

Broad River (previously called "2004 New Colony7")

We've observed this colony increase each year since its initiation: from 80 nests in 2004 to 150 nests in 2005. This year we counted a total of 445 nests. Species nesting here included: Great Egrets, White Ibis, Snowy Egrets and Roseate Spoonbills. Tri-colored and Little Blue Herons also nested but we could not estimate numbers from the air.

Cuthbert Lake

This colony remained stable despite the severe damage to the island vegetation from Hurricane Wilma. The west half of the island's mangroves were toppled and killed. However there apparently was enough live vegetation and structure left to support nests and nest numbers were slightly higher than previous seasons.

Otter Creek (previously called "2004 New Colony8")

This colony increased in size rather dramatically from 600 nests in 2004, 450 nests in 2005, to 1400 nests this season. Like the previous seasons this colony contained a mix of species including: White Ibis, Snowy Egrets, Great Egrets, Roseate Spoonbills, and Tri-colored and Little Blue Herons. Wood Storks also nested in this colony during the 2004 season and were seen again this season. Twenty nests with incubating adults were seen (and photographed) but the nests were later abandoned for reasons unknown. The aforementioned species in this colony fledged young. Flapping and flying young were seen during later surveys.

Paurotis Pond

Nest numbers were up overall at this colony but most notable was an increase in Wood Stork nests compared to previous years. Previous stork nest numbers ranged from about 100-200 nests, however this year we counted approximately 500 stork nests. In previous years storks mostly nested on the mangroves at the far west side of the pond. This year they also nested on the center island.

Rodgers River Bay

Prior to this nesting season, this Wood Stork and Great Egret colony nested on a small exposed mangrove island in Rodgers River Bay. However after Hurricane Wilma damaged much of the island's vegetation, most of the colony appears to have moved north of the island to the nearest land peninsula. Total nest numbers were similar to previous years, however the colony was divided into the 2 nesting areas, island and peninsula.

Rookery Branch (renamed from "2004 New Colony9")

This colony has increased in size from a Great Egret colony of 60 nests in 2004 to a mixed species colony of 815 nests this season. We counted 310 Great Egret nests, 500 White Ibis nests, and 5 successful Wood Stork nests. Tri-colored Herons, Little Blue Herons and Black-Crowned Night Herons also nested but we could not estimate numbers for these species.

Peak numbers of wading bird nests found in Everglades National Park colonies from February through June 2006

COLONY NAME	Latitude WGS 84	Longitude WGS 84	Easting NAD83	Northing NAD83	GREG	WOST	WHIB	SNEG	CAEG	ROSP	TRHE	LBHE	BCNH	TOTAL
Alligator Bay	485234	2839257	25 40.259	-81 08.828	200	0	1500	1500	0	0	+	0	0	3200
Broad River	502573	2820638	25 30.176	-80 58.464	160	0	200	75	0	10	+	+	0	445
Cuthbert Lake	522666	2788146	25 12.560	-80 46.500	150	75	0	0	0	0	0	0	0	225
E of SV Tram Rd	526997	2846156	25 43.987	-80 43.851	15	0	0	0	0	0	0	0	0	15
East River Rookery	513306	2794697	25 16.116	-80 52.071	25	0	0	0	0	0	0	0	0	25
Grossman Ridge	535571.93	2834535.82	25 37.680	-80 38.740	130	0	0	0	120	0	0	0	+	250
Madeira (failed)	531800	2790118	25 13.618	-80 41.057	40	4	30	30	0	+	0	+	0	104
Madeira Ditches *	535662	2800779	25 19.390	-80 38.740	+	0	0	+	+	0	0	+	0	0
NE Grossman B	542646.05	2840868.89	25 41.100	-80 34.500	50	0	0	0	0	0	0	0	0	50
Otter Creek **	506261	2816750	25 28.068	-80 56.263	175	20*	1100	100	0	25	+	+	+	1400
Paurotis Pond	519834	2796133	25 16.890	-80 48.180	150	500	500	+	0	25	+	+	0	1175
Rodgers River Bay	492985	2826591	25 33.400	-81 04.190	230	140	0	0	0	0	0	0	0	370
Rookery Branch	514822	2816287	25 27.814	-80 51.153	310	5	500	0	0	0	+	+	+	815
Tamiami East-1	549338	2848934	25 45.457	-80 30.481	35	0	0	0	0	0	0	0	0	35
Tamiami East-2	547677	2849120	25 45.561	-80 31.474	15	0	0	0	0	0	0	0	0	15
Tamiami West	545627	2848902	25 45.447	-80 32.701	200	400	600	+	0	0	+	+	+	1200
GREG 01	541046	2843368	25 42.457	-80 35.452	50	0	0	0	0	0	0	0	0	50
GREG 02	518639	2828147	25 34.237	-80 48.865	45	0	0	0	0	0	0	0	0	45
GREG 03	515871	2826143	25 33.153	-80 50.520	55	0	0	0	0	0	0	0	0	55
GREG 04	522147	2824045	25 32.012	-80 46.773	35	0	0	0	0	0	0	0	0	35
GREG 05	515611	2822533	25 31.197	-80 50.678	25	0	0	0	0	0	0	0	0	25
GREG 06	506974	2840105	25 40.722	-80 55.830	35	0	0	0	0	0	0	0	0	35
GREG 11	521473	2820516	25 30.100	-80 47.180	10	0	0	0	0	0	0	0	0	10
GREG 14 (failed) ***	538673	2824172	25 32.060	-80 36.905	15	0	0	0	0	0	0	0	+	15
GREG 15	520119	2838040	25 39.596	-80 47.972	8	0	0	0	0	0	0	0	0	8
GREG 16 (failed)	523948	2838567	25 39.878	-80 45.682	15	0	0	0	0	0	0	0	0	15
GREG 17 (failed)	517123	2827912	25 34.111	-80 49.771	20	0	0	0	0	0	0	0	0	20

COLONY NAME	Latitude WGS 84	Longitude WGS 84	Easting NAD83	Northing NAD83	GREG	WOST	WHIB	SNEG	CAEG	ROSP	TRHE	LBHE	BCNH	TOTAL
GREG 19	516693	2833705	25 37.250	-80 50.024	25	0	0	0	0	0	0	0	0	**25**
GREG 20	522629	2822216	25 31.020	-80 46.488	4	0	0	0	0	0	0	0	0	**4**
GREG 21	524273	2832161	25 36.407	-80 45.495	2	0	0	0	0	0	0	0	0	**2**
GREG 22	530577	2839983	25 40.638	-80 41.718	35	0	0	0	0	0	0	0	0	**35**
GREG 23	523542.77	2822118.21	25 30.966	-80 45.942	4	0	0	0	0	0	0	0	0	**4**
UF1 GREG	519750	2818101	25 28.793	-80 48.211	6	0	0	0	0	0	2	0	0	**8**
UF2 GREG	520617	2827100	25 33.668	-80 47.685	50	0	0	0	0	0	0	0	0	**50**
UF3 SNEG	531882	2840997	25 41.186	-80 40.936	0	0	0	50	0	0	0	0	0	**50**
UF4 GREG	530587	2841291	25 41.347	-80 41.710	120	0	0	0	0	0	0	0	0	**120**
UF5 GREG	530027	2832484	25 36.576	-80 42.057	60	0	0	0	0	0	0	0	0	**60**
UF6 GREG	515994	2826507	25 33.350	-80 50.447	125	0	0	0	0	0.0%	0	0	0	**125**
Totals for mainland colonies					**2629**	**1124**	**4430**	**1755**	**120**	**60**	**2 +**		**+**	**10120**

+ Indicates species present but unable to determine numbers

Madeira Ditches *	Consists mostly of CAEG nesting June - Aug
Otter Creek **	20 Wood Storks incubating on nests March 28th, but nests empty and no storks seen when checked again on April 17th.
GREG/BCNH colony 14 ***	Park cooperators reported seeing a ~10' python at pond within same colony tree island. Python was not captured.

EVERGLADES NATIONAL PARK FLORIDA BAY

January – July 2006

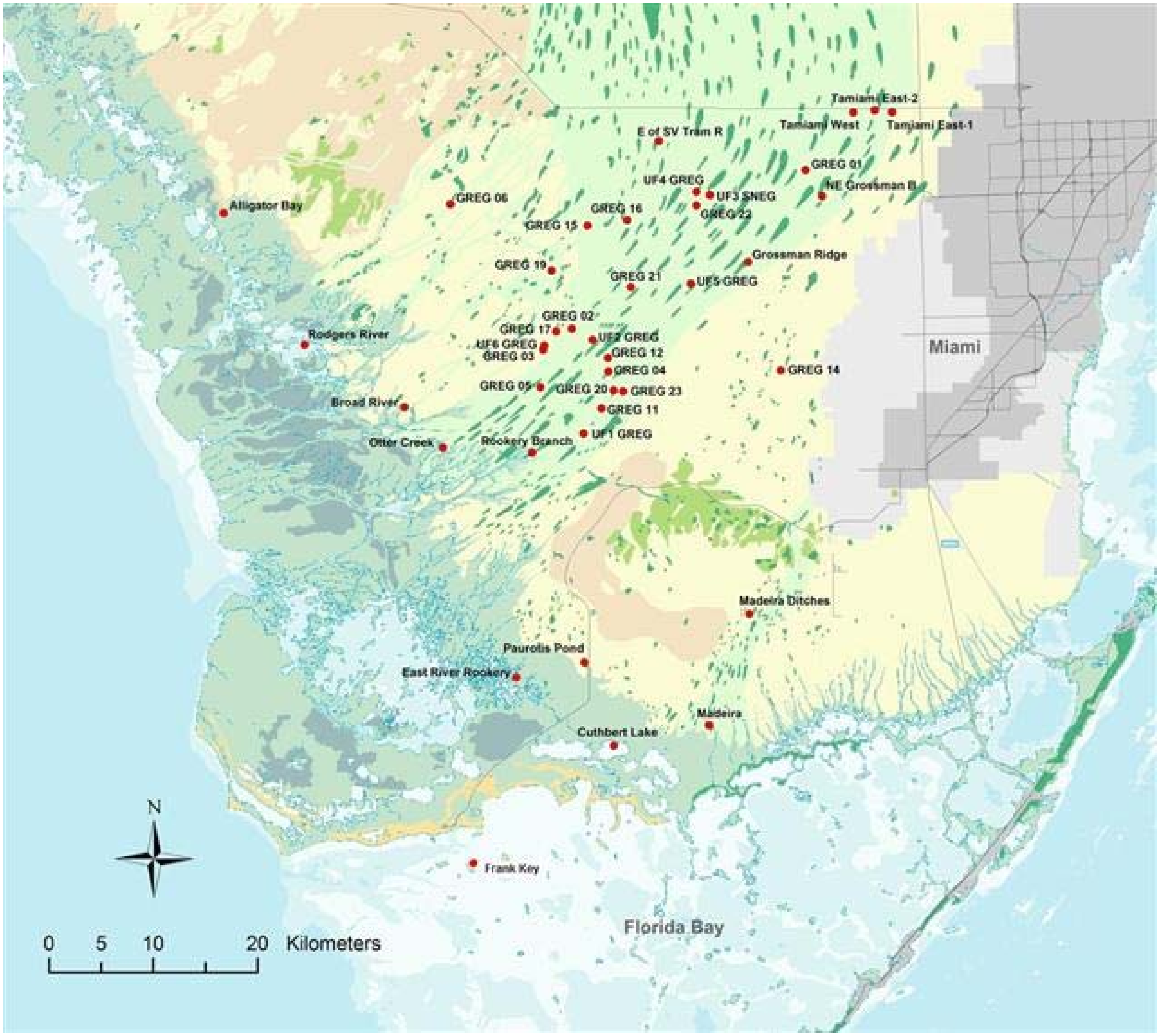
A formal wading bird aerial nesting survey was not conducted in Florida Bay, however we continue to monitor nesting activity at the large Frank Key colony.

Frank Key

The colony at Frank Key was active throughout the season, but their nests appear to have failed. During March through the end of May, we observed nesting Great Egrets (~100 nests), Snowy Egrets (~100 nests) and White Ibis (~200 nests). We saw birds incubating and brooding as well as some nests with eggs and small young. However, during subsequent checks in June and July, it appears they abandoned most nests. We observed a few Great Egrets incubating a second time in June, but by July they were gone. During the same July check, a few White Ibis still appeared to be sitting on nests. We did observe Brown Pelicans and Double-crested Cormorants with large young and appears they were able to fledge some young this season. We will check this colony again soon but it looks like most birds are finished.

The vegetation within this colony, like many others in the park, was damaged by Hurricane Wilma. Most of the mangroves and other vegetation on the island is thinned out and much of the vegetation within the colony nesting area appears to be toppled and dead. The nests were quite visible from the air and probably more exposed to both heat and predators. We observed vultures roosting within in the colony during several of the survey flights.

Everglades National Park Colonies, 2006



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WOOD STORK NESTING AT CORKSCREW SWAMP SANCTUARY

Location N 26° 22'30" W 081° 36'59"

Methods
Thirteen aerial surveys were conducted from December 1st 2005 to June 9th 2006 using fixed-wing aircraft. Jason Lauritsen (jlauritsen@audubon.org) 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 70-200 mm 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 500 ft during a single pass to assist in productivity estimates and stage of development.

Analysis
Photos of each aerial survey were projected on a whiteboard and analyzed. Photos from 1000 ft were used to identify the total number of possible wood stork nests. Slide photos taken from approximately 500 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. These values were used to extrapolate the final number of nest starts and successful nests for wood storks in the Corkscrew colony. Images taken on May 3rd from 500 ft were examined to determine colony and nest productivity.

Results
The Corkscrew colony had approximately 800 wood stork nest starts during the 2005 - 2006 nesting season. Approximately 650(+/- 40) of these nests were successful. The colony fledged approximately 1550 storks. The productivity per successful nest is 2.38. Productivity per nest start is 1.94. All wood stork nests had fledged by June 9th.

The 10 yr average of storks fledged from the Corkscrew Colony is 983 (1997-2006). This number is heavily influenced by the 2002 nesting season where nearly 3200 storks fledged from the Corkscrew colony, which was a 30 yr high. The 48 yr average for the Corkscrew colony is 1988 storks fledged.

Other wading birds were observed nesting among the storks at the Corkscrew colony. Prior to the leafing out of the bald cypress trees comprising the nesting substrate hundreds of great egret and white ibis nests, along with 4 or 5 roseate spoonbill nests were observed from the aerial slides. Other nesting locations sprung up along the pond cypress/marsh ecotone north of the Corkscrew colony after much of the bald cypress nesting effort had been obscured by foliage. The estimate of 93 other white waders recorded in Table 1 is only indicative of the number of nests visible from the aerial slide set examined on May 3rd. A minimum of 300 great egret nests are believed to have been initiated at Corkscrew Swamp Sanctuary this year. No estimate of white ibis numbers has been attempted.

Hydrology
Conditions in the vicinity of the nesting colony were wetter earlier and longer than average. This "wetter-than-average" wet-season was followed by a "drier-than-average" dry-season. Peak wet-season water levels reached 18.67 ft (NGVD29) at Corkscrew Swamp Sanctuary's B-staff gauge on July 15th. The 45-year mean wet-season peak water level for the B-staff gauge is 18.15 ft falling on October 1st. This is more than 6" above the average high for the season. Corkscrew records show a two day rainfall total of 2.7 in falling in early February. Over the next 16 ½ weeks (Feb. 5-May 31st) only 2.83 in of rainfall was recorded at Corkscrew's visitor center, which is over 8 in below the 45-year average for that timeframe. Hydrologic conditions at Corkscrew during the period discussed in this section appear to reflect regional hydrologic trends.

Other 2006 Wood Stork nesting colonies in Southwest Florida
Nest counts documented in Table 1 were derived from slide projected images shot during aerial surveys in a fixed wing Cessna using a SLR camera with a 70-200 mm zoom lens from altitudes varying from 500-1000 ft. Survey dates were April 24th for the Collier Hendry line colony and the Caloosahatchee river colonies, April 28th for the Charlotte and Sarasota County colonies. Only active nests were included in this tally.

Photos of the aerial survey for each colony were projected on a whiteboard and analyzed. Photos from 1000 ft were used to identify the total number of possible wood stork nests. Slide photos taken from approximately 500 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. These values were used to extrapolate the final number of active wood stork nests in the each colony.

Results
Tabulated in Table 1 below.

Table 1. Wood Stork nest totals for 2006.

County	Colony Name	Location (NAD 83)	Wood Stork Nests	Other white waders	**unknown**
Lee County	Caloosahatchee River West	26° 41'19"N 81° 49'48"W	420	214	152
Lee County	Caloosahatchee River East	26° 22'30"N 81° 47'41"W	50	50	18
Collier County	Corkscrew Swamp	81° 36'59"W 26° 22'30"N	650 +/- 40	93	80
Collier County	Collier/Hendry line	81° 16'25"W 26° 22"15"N	100	30	20
Charlotte County	Peace River	26° 58'28"N 81° 58'57"	18	12	31
Charlotte County	Morganton	27° 0'48"N 81° 58'40"W	53	25	119
Sarasota County	Black Burn Bay Island #1	27° 08'40"N 82° 28'23"W	0	59	NA
Sarasota County	Blackburn Bay Island #2	27° 08'40"N 82° 28'23"W	178	11	NA
Sarasota County	N. Port Charlotte -Myakka River	27° 02'03"N 82° 16'33"W	249	131	116

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SOLID WASTE AUTHORITY OF PALM BEACH COUNTY COLONY

Methods

From February – July 2006, 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 Grassy Waters (=Water Catchment Area), a 44 km^2 remnant of the Loxahatchee Slough.

Results

This report presents preliminary data for the 2006 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. 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 1442 which represents a 23% increase from the previous 2005 season. There was an overall increase in nest numbers from last year for most of the bird species as follows: Great Egret (>100%), Snowy Egret (>100%), Cattle Egret (6%), Wood Stork (>100%), and Anhinga (58%). The Wood Storks had a record high of 508 nests at the SWA Colony. The White Ibis numbers plummeted to an all time low of 159 nests. This is the second year in a row where the White Ibis nest numbers were below average for the site. Even though the site was impacted by Hurricane Wilma, the nesting habitat remained relatively intact, and there did not appear to be any change in the numbers of adult birds utilizing the colony. Throughout the season there appeared to be several attempts of small groups of "red-faced" Ibis but the number of nest starts is significantly less than previous years. It will be interesting to see what the 2007 Breeding Season brings, especially if this area is spared by Hurricanes. It should also be mentioned that there was at least one Roseate Spoonbill nest.

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Peak number of wading bird nests in SWA Rookery from February to July 2006

GREG	SNEG	CAEG	GBHE	LBHE	WOST	WHIB	ANHI	TRHE	Total Nests
167	48	315	2	41	508	159	357	75	1442

ROSEATE SPOONBILLS IN FLORIDA BAY

Spoonbill Colony Surveys
Thirty-five 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 regions (Table 1) based on each colony's primary foraging location (Figure 1, Lorenz et al. 2002). During the 2005-2006 nesting cycle (Nov-May), complete nest counts were performed in all five regions by entering the active colony and thoroughly searching for nests. Nesting success was estimated for the four active regions through mark and re-visit surveys of the most active colony within the 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 10d cycle to monitor chick development. Prey fish availability was estimated at six sites (TR, EC and WJ in the Taylor Slough Basin and JB, SB and HC in the C-111 Basin) in the coastal wetlands of northeastern Florida Bay (Figure 1) known to be spoonbill foraging locations for the Northeastern and Central 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 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.

Banding Program
The purpose of this 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 breeders 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

In Florida Bay, spoonbill nestlings were banded at 16 out of the 22 colonies at which spoonbills nested. In Tampa Bay, we banded spoonbills at the largest colony in the region, Alafia Bank, as well as the smaller colony of Washburn Junior. The 16 colonies in Florida Bay were distributed by region in the following way: 1 colony in the Northwest, 5 colonies in the Northeast, 4 colonies in the Central, and 6 colonies in Southeast Florida Bay. The Northwest region did have 5 active nesting colonies; however, 4 of them were heavily patrolled by fish crows, and we have seen nest predation in the past as a result of time spent banding nestlings in the colony. Due to that fact, we decided to abandon banding the other four colonies in that region. Although the Southwest region did have 1 nest, the nest was inaccessible to banding. Nestlings were banded any where between 5 days and 20 days of age. 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.

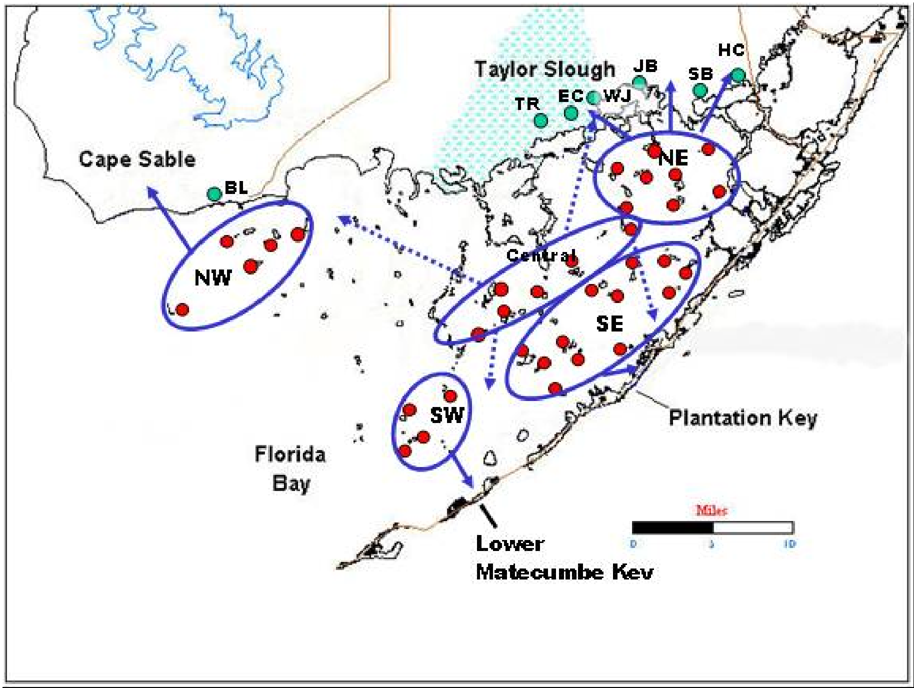
In Florida Bay, a total of 3 bands were placed on each nestling. A USGS band was placed on the tarsus, and a 2-digit alphanumeric band was placed on the opposite tibia. Florida Bay spoonbills received an additional colored celluloid band, placed above the alphanumeric band, to designate the region in which the bird was banded. Tampa Bay birds received a USGS band and a red alphanumeric band but did not receive an additional celluloid band. At the time of banding, we recorded the age and sibling rank of each chick and the number of siblings or eggs still in the nest.

Spoonbill Monitoring Results
Northwestern Region: Sandy Key
All five colonies in the Northwestern region were surveyed for nesting activity in 2005-06 (Table 1). A total of 262 nests were counted in this region, which is slightly above average for this region compared to the last twenty years of survey data. Nesting success surveys were conducted at Sandy Key on Nov 11, 26, Dec 5, 15, 22, 29, Jan 4, 13, 20, Feb 2, 10, 16, 28, and Mar 27. Individual nest attempts were asynchronous compared to this colony's historical nesting record; however, in the last few years, nest attempts have typically been asynchronous. We estimate that the first nest to lay eggs was on Nov 13 while the last nest did not lay eggs until Dec 7. Usually, all nests are initiated within 14 to 21 days of each other. The mean egg laying date was Nov 26, and mean hatch date was Dec 16 (based on previous years, the average nest initiation date is Nov 18). The 120 nests counted were slightly below average (166 nests since 1984). Fifty-seven nests were marked for revisitation. Of these, 61% were successful at raising chicks to at least 3 weeks old (the time when they first leave the nest) with the average of 1.33 chicks per nest attempt (c/n; Table 2). The fledging rate was above average (1.25 chicks/attempt since 1984; Table 2) and is considered 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 160 chicks fledged (slightly lower than last year's 167 chicks fledged).

The results of the colony surveys were supported by results from the banding program. One-hundred fifty-nine nestlings from 58 nests were banded at the Sandy Key colony (Table 3). Chicks were banded between Dec 15 and Dec 29. Although 18% of these chicks were found dead before leaving their nest, approximately 50% of the banded chicks were observed post-fledging on the fringes of the colony. Based on band resightings, nesting success was estimated to 1.31 c/n.

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 region was successful. 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. Water levels at the BL site peaked at >60cm following landfall of Hurricane Wilma on Oct 24, 2005. Within days, the water level receded rapidly to 20cm followed by a period characterized by a more gradual recession rate that was typical of November draw downs. Water levels

Figure 1. Map of Florida Bay Indicating spoonbill colony locations (red circles) and nesting regions (blue circles). Arrows indicate the primary foraging area for each region. The dashed lines from the central region are speculative. Approximate location of fish sampling sites are represented by green circles.



reached the fish concentration threshold (FCT) of 12.5 cm on Nov 16 and remained below the FCT for the entire nesting cycle. By the mean hatch date (Dec 16) water was -3cm indicating that the prey base was highly concentrated into the remaining wetted areas on the foraging ground. At this time available fish biomass was estimated to be at its highest point of the year for this location. During the critical 21 days post hatch period, water levels remained below 0cm suggesting ideal foraging conditions. By 42d post hatch (early Feb), water levels had dropped to their lowest level of the year (-15cm) and our data indicates that fish continued to remain highly available to wading birds. Fish samples collected in Mar and Apr indicated fish continued to remain highly available, although there was a steady decline from Feb to Apr. Overall, conditions were ideal for fledging chicks from the Northwestern colonies, which occurred between in Mar and early Apr.

Northeastern Region: Tern Key

A new spoonbill nesting colony was discovered on Deer Key bringing the number of colonies in the northeastern region to eight, and the total number of nests to 127 (Table 1). Nest counts were made at all eight colonies, however; only five were active with one of the active colonies having only one nest (Table 1). The 127 total nests in the region is not the lowest nesting effort in terms of the number of active colonies (2002-03 count was 101), but is still well below the average nesting effort of this region. Spoonbill nesting success surveys were conducted at Tern Key on Nov 3, 21, Dec 2, 9, 19, 27, Jan 3, 10, 17, 24, 31, Feb 7, 14, 23, Mar 9, 16, 23, 28, April 10, 19, 26, and May 12. As has been the norm for the last several decades, there were two distinct nesting cycles at Tern Key during the 2005-06 breeding cycle. During the first nesting, the first egg was laid on Nov 22 and the last nest initiated on Dec 18 with the mean laying date estimated at Nov 28.

The mean hatching date was Dec 18. As at Sandy Key, the nesting was asynchronous. The mean initiation date was slightly later than that of Sandy Key. As has been the trend in recent years, the first nesting effort was alarmingly small: only 106 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 spite of this low nesting effort, the success rate was very good. On average, each nest attempt produced 1.61 c/n, well above the average of 0.79 since 1984 and only marginally lower than the pre-1980 average of 2.0 chicks/nest (Table 2). Of the 106 nests, 51 were marked for revisitation. Of these, an encouraging 63% were successful at raising chicks to at least 3 weeks old. This is a remarkable improvement from last year's nesting season (3% successful with 0.1 chicks per nest). Total production for the colony was estimated at 170 chicks.

In the northeastern region, 118 nestlings from 33 nests within 5 colonies (Tern, South Nest, North Nest, North Park, and Deer Keys) were banded (Table 3). Chicks were banded between Dec 19 and April 26. Unlike most other colonies where fledges roost conspicuously on the fringing trees prior to leaving the colony, fledges at the Northeastern colonies prefer to roost around myriad ponds and salt flats within the colony where they are harder to spot. Only 26% of the banded chicks were observed post-fledging but before they abandoned their natal colony for an estimated production of 0.97c/n, well below that estimated by the colony surveys. However, during visits to the colony, observers noted up to 100 unbanded fledglings around the

Table 1. Number of ROSP nests in Florida Bay Nov 2005 – May 2006. An asterisk (*) indicates colony with nesting success surveys (see Table 2).

Sub-region	Colony	2005-06	Summary since 1984		
			Min	Mean	Max
Northwest	Sandy*	120	62	160	250
	Frank	93	0	54	125
	Clive	38	11	22	38
	Palm	2	0	6.87	45
	Oyster	9	9	16.67	21
	Subtotal	**262**	**65**	**211.24**	**325**
Northeast	Tern*	106	60	111.48	184
	N. Nest	1	0	0.14	1
	S. Nest	10	0	18.13	59
	Porjoe	0	0	31.17	118
	N Park	8	0	19.44	50
	Duck	0	0	2.13	13
	Pass	0	0	0.57	4
	Deer	2	2	2	2
	Subtotal	**127**	**101**	**190.88**	**333**
Cental	Calusa*	17	0	9.8	15
	E. Bob Allen	2	0	16.4	35
	Manatee	0	0	0	0
	Jimmie Channel	25	6	20.67	47
	Little Pollach	0	0	3.67	13
	S. Park	23	0	11	39
	Subtotal	**67**	**15**	**53.87**	**96**
Southwest	E. Buchanon	0	0	7	27
	W. Buchanon	0	0	3.92	9
	Barnes	0	0	0.08	1
	Twin	1	0	1.85	8
	Subtotal	**1**	**0**	**11.38**	**35**
Southeast	M. Butternut*	14	7	23.6	66
	Bottle	10	0	11.29	40
	Stake	13	0	3.85	19
	Cowpens	0	0	3.58	15
	Cotton	0	0	0	0
	West	0	0	3.58	9
	Low	0	0	0	0
	Pigeon	26	0	8.15	56
	Crab	0	0	2	8
	East	5	0	3.71	12
	Crane	21	8	13.77	27
	E. Butternut	1	4	4.25	11
	Subtotal	**90**	**39**	**82.54**	**117**
	Total	**547**	**429**	**565**	**880**

island, which would support the high estimate for chick production. Furthermore, only 7% of the banded chicks were found dead before leaving their nest, further supporting the colony count estimate of 1.61 c/n.

As occurred at BL, water levels on the Northeastern foraging grounds receded rapidly immediately after Hurricane Wilma then more gradually after Nov 1. Three water level recorders in the C-111 basin indicated that water levels reached the FCT just prior to the mean nest initiation date of Nov 28. Three additional water level recorders in the Taylor Slough basin indicated that the FCT was reached just before the mean hatch date of Dec 18. Cumulatively, these recorders documented a drying front that moved from the northeast to the southwest sequentially drying wetlands on the foraging grounds. This creates ideal conditions for nesting spoonbills as the drying front moves closer to the colonies as the energetic demands of the chicks increase. Fish collections made at all six sites indicate highly concentrated prey throughout the nesting period. The prey became available in the C-111 Basin in Nov and dropped in Feb. In the Taylor Slough Basin fish became highly available in Dec and increased to a peak in Mar. The nearly ideal water recession resulted in a temporally and spatially picture-perfect scenario in making prey available to nesting spoonbills, thereby explaining the highest nesting success that had occurred in the Northeastern region since 1992.

The ideal water level recession that occurred at BL suggested that conditions should be excellent in the Northeastern region given minimal impact of water management practices. Water management can affect the recession rate in several ways (Lorenz 2006). For example, reversals in the recession rate release the concentration effect that low water has on the prey base. Maintaining artificially high water levels throughout the nesting cycle may also prevent fish concentrations from forming. Finally a too rapid recession rate tends to strand the prey base before they can seek out refugia from the drying front. This results in prey mass mortality and poor foraging conditions later in the nesting cycle. Given the low rainfall conditions following Hurricane Wilma, this was the main consideration that could cause failure during the 2005-2006 nesting cycle. Weekly conversations between the first author and Paul Linton, hydrologist for the SFWMD, were designed to prevent practices that may have endangered the nesting activities in Northeastern Florida Bay. The result of these conversations was a gradual scaling back of water releases into the Taylor Slough headwaters. Establishing whether there was a causal relationship between this practice and near perfect recession rates observed at six locations within the C-111 and Taylor Slough basins will be the subject of a future report.

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

			Summary since 1984			
Sub-region	**Colony**	**2005-2006**	**Min**	**Mean**	**Max**	**% of Yrs Succssful**
Northwest	Sandy	1.33 (61%)	0	1.25	2.5	60%
Northeast	Tern	1.61 (63%)	0	0.79	2.2	35%
Central	Calusa	1.71 (86%)	0	0.82	1.71	33%
Southeast	M. Butternut	.86 (36%)	0.14	0.97	2.09	30%

Table 3. Number of ROSP banded in Florida Bay Dec 2005-April 2006, and in Tampa Bay, April 2006. "Number of ROSP Resighted Alive" indicates the number of birds resighted after the age of 21+ days.

Estuary	Sub-region	Colonies where Roseate Spoonbills were Banded	Number of Nests Banded	Number of Chicks Banded	Number of ROSP Resighted Alive	Number of ROSP Resighted Dead	Number of ROSP where Fate is Unknown
Florida Bay	**Northwest**	Sandy	58	159	80 (50%)	28 (18%)	51 (32%)
	Northeast	Tern	22	58	14 (24%)	6 (10%)	38 (66%)
		S. Nest	8	17	10 (59%)		7 (41%)
		N. Nest	1	3	3 (100%)		
		N. Park	1	4	1 (25%)	2 (50%)	1 (25%)
		Deer	1	3	3 (100%)		
	Central	Calusa	9	19	18 (95%)	1 (5%)	
		Jimmie Channel	22	54	30 (56%)	1 (1%)	23 (43%)
		E. Bob Allen	1	1			1 (100%)
		S. Park	18	43	17 (40%)	3 (7%)	23 (53%)
	Southeast	M. Butternut	9	24	6 (25%)	1 (4%)	17 (71%)
		Stake	3	6	2 (33%)	1 (17%)	3 (50%)
		Pigeon	13	34	14 (41%)		20 (59%)
		East	3	9	3 (33.3%)	4 (44.4%)	2 (22.2%)
		Crane	17	37	9 (24%)	13 (35%)	15 (41%)
		Bottle	1	1			1 (100%)
		Florida Bay Total	**187**	**472**	**210 (44%)**	**60 (13%)**	**202 (43%)**
Tampa Bay		Alafia Bank	97	230	196 (85%)	4 (2%)	30 (13%)
		Washburn Junior	11	34	29 (85%)		5 (15%)
		Tampa Bay Total	**108**	**264**	**225 (85%)**	**4 (2%)**	**35 (13%)**

The second wave of nesting at Tern Key was not as successful as the first nesting attempt. The nesting began in mid-March but still exhibited somewhat asynchronous timing of nest initiation. The first eggs were laid on Mar 14 and the last nest initiated on April 1 with the mean laying date of Mar 22. The mean hatch date was Apr 11. This effort was much smaller than the first nesting (about 20 nests). The small number of nests during the second nesting supports the hypothesis that second nesting is populated by birds that failed to produce young in the primary nesting. Since the phenomena began in the mid-1980s the second nesting at Tern Key is larger than the primary nesting when there is bay-wide failure of the primary nesting. Likewise, in years when the primary nesting is successful (as was the case this year), the second nesting is typically small.

In 2006, the second nesting yielded only one successful nest with an average of 0.05 chicks reaching 21d post-hatching per nest attempt. We estimate that only 1 chick fledged during the second nesting. In early April, just before the mean hatch date, water levels increased to well above the FCT in the Taylor Slough Basin and in the C-111 basin, water levels periodically exceed the FCT for periods of several days. Although no fish data were collected during this period, Lorenz (2000) demonstrated that under these conditions, prey dispersed and become unavailable, thereby likely explaining the failure of the second nest attempt.

Southeastern 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 4, 28, Dec 6, 12, 23, 29, Jan 6, 12, 19, 27, Feb 3, 10, 17, Mar 4, and 22. The first egg was laid on approximately Nov 19, with a mean lay date of Nov 26. The mean hatch date was estimated to be Dec 16. Only 17 nests were initiated on the island, which is slightly better than the previous years' nest attempts (average of 8 nests). On average, each nest attempt produced 0.86 c/n; a marginal success rate. In the Southeastern region, we banded 111 nestlings from 46 nests within 5 colonies (M. Butternut, Stake, Pigeon, East, Crane, and Bottle Keys, Table 3). Chicks were banded between Dec 14 and Jan 9. More than 17% of these chicks were found dead before leaving their nests and approximately 31% of the banded chicks were observed post-fledging but before they abandoned their natal colony. Based on the banding effort, the success rate in the Southeastern region was 0.74, supporting the marginal success rate that was found at Middle Butternut Key.

The success rate observed via nest surveys is lower than last year's successful year of 1.11 chicks/nest attempt, and is slightly below the average 0.97 c/n since 1984. 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 region generally faired poorly: 3 of 10 years surveyed were failures (Table 2). Based on these observations it appears that conditions during the 2005-06 nesting were typically poor in the Southeastern region. However, based on previous work (Lorenz et al. 2002) it appears that the quality of the Southeastern region for nesting spoonbills is marginal, at best, thereby explaining the low overall effort. This is in stark contrast to the period prior to the Keys land boom when spoonbills nesting in the Southeastern region successfully fledged young every year with an average production of >2 chicks per nest (Lorenz et al. 2002).

Central Region: Calusa Key

Previous nest success surveys in this region were conducted on East Bob Allen Key (EBA). This year, the astonishingly low overall effort of nest production at EBA confirmed our need to begin surveying another, more representative colony in this region. Calusa Key will continue to be monitored as the focal colony for this region indefinitely.

All six colonies in the Central region were surveyed in 2005-06 (Table 1). Nesting success surveys at Calusa Key were performed on Nov 9, 23, 30, Dec 8, 14, 21, 28, Jan 5, 11, 19, 26, Feb 1, 9, 16, 25, and Mar 27. Seventeen nests were found on Calusa, which is well above average (9.8 nests since 1984). The first egg was laid on Nov 7, and the last nest initiated on Dec 7 with the mean laying date estimated at Nov 21. The mean hatching date was Dec 11. This nesting effort was a complete success with 1.71 chicks per nest attempt, and 86% of the nests were successful at raising chicks to at least 3 weeks of age. Total production for the colony was estimated at 24 chicks, and this estimate was confirmed with the observation of 18 fledglings outside the colony (Table 3). Eighteen of the 19 chicks banded from 9 nests on Calusa Key confirming the high nest production estimated by nesting surveys.

We banded 117 nestlings from 50 nests within 4 colonies (E. Bob Allen, Jimmie, Calusa, and South Park Keys, Table 3) in the Central region. Chicks were banded between Dec 8 and Jan 5. Approximately 56% of the banded chicks were observed post-fledging but before they abandoned their natal colony. The banding effort estimate for production was 1.31 c/n, well below the survey estimate. However, several of these colonies are similar to those of the Northeastern region where fledges are not as conspicuous before they leave the colony. That only 4% of these chicks were found dead before leaving their nest suggests that the resighting technique may result in undercounts of the total number of banded birds that were successful.

Significant nesting in the Central 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 regions. Spoonbills nesting in the Central region have reasonable access to the entire mosaic of foraging habitats found in the other four 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 regions become compromised, the spoonbills of the Central region would also be deleteriously affected. This year, fixed wing aircraft followed one adult spoonbill from the Central region to its foraging grounds over 10 miles and 30 minutes away. If these foraging grounds do not support abundant and concentrated prey, such a long flight may be too energetically demanding for a spoonbill to make, resulting in lower nest success. However, based on a flight-line count and fixed-wing aircraft observations, it appeared that the birds from the Central region were flying over the Russell and Black Betsy Keys to the Taylor Slough area, where they were met with quality foraging habitat. This would support their exceptional nest success (Table 2).

Southwestern Region: Buchanon Keys

All keys in the southwestern region were surveyed multiple times in 2005-06 but only 1 nest was found on Twin Key (Table 1). This is the first time since 1998 that a spoonbill has nested at Twin Key. This nest did produce young, and one chick was observed post 21day hatching. This is a promising find for the Southwest region, whose historic record high was 153 nests in 1979. Historically, the Northeastern region was the most productive region of the bay (Lorenz et al. 2002). Since 1982, this region has been heavily impacted by major water control structures that lie immediately upstream from the foraging grounds (Lorenz 2000).

Bay-wide Synthesis

Bay-wide Roseate Spoonbills nest numbers were below average, indicating a continued downward spiral that began with completion of these major water management structures in the early 1980s. This year, the success rate at Tern Key was the highest it has been in 14 years and well above the 0.79 c/n average since 1982.

The success of nesting attempts in the Northwestern region indicated that conditions should have been good for spoonbills nesting in the Northeastern region in the absence of adverse water management practices. The coordination between ecologists and water managers may have been beneficial through avoiding adverse management practices. Regardless, conditions were excellent on the Northeastern foraging grounds and the lack of adverse management practices resulted in a highly successful nesting in that region. Repeating such cooperation between ecologists and managers in the upcoming years will reveal how successful such communications are in providing the appropriate conditions for all fauna that utilize this wetland during the draw down process.

Based on a flight-line count and fixed-wing aircraft observations, it appeared that the birds from the Central region were flying over the Russell and Black Betsy Keys to the Taylor Slough area, where they were met with quality foraging habitat. This would support their exceptional nest success (Table 2).

In all, 472 chicks were banded from 187 nests across Florida Bay. Of these 13% were observed dead either before leaving the nest or outside the colony and 44% were observed alive post-fledging. Outside of their natal colonies, there has been one resighting of a bird banded at Sandy Key in December observed foraging at Lake Ingraham, Everglades National Park, in March.

Comparison to Tampa Bay Nesting Population

We began banding spoonbill nestlings at Alafia Bank, Tampa Bay in 2003 as part of a pilot study for the banding program. The goals of this program were two-fold: 1) to determine the movements of spoonbills within the state and the region and 2) to get estimates of nesting success to compare to Florida Bay. Reports of spoonbills producing greater than 2 c/n in Florida Bay were regularly reported throughout Florida Bay as late as the early 1970s. Following the destruction of wetlands in the Keys and water diversion in the northeastern part of Florida Bay, the average dropped below 1 c/n on average. Tampa colonies provided an opportunity to see how productive spoonbills were in another part of the state to assess if this decline was unique to Florida Bay or a more regional response in general. Answering this question is critical to demonstrating the causal relationships between Everglades management and the observed decline in Florida Bay.

Spoonbills nested in 11 colonies in the greater Tampa Bay area this year. The largest colony in the region is the Richard T. Paul Alafia Bank Bird Sanctuary in Hillsborough Bay, with 360 pairs. The colony of Washburn Junior was the second largest with 53 pairs. A total of 294 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 the Alafia Bank and Washburn Junior colonies. We banded nestlings on April 5, 11, 12, 13, 18, 19, 20, and 24. At Alafia, we banded 230 nestlings from 97 nests (Table 3) during 6 banding sessions (April 12, 13, 18, 19, 20, and 24). Out of the 230 nestlings banded, we have resighted 196 of them alive in 12 resighting surveys of the colony. One bird was observed dead in the colony, and one bird was found dead after being hit by a car in Flagler County (~150 miles away) only 2 months after it was banded at Alafia. Only 30 of the total birds banded have not been resighted at all. Based on our estimation of 2.02 fledged birds/nest (196 resighted nestlings/97 nests), we expect about 730 spoonbills (360 pairs X 2.02 birds/nest) fledged from Alafia Bank. At Washburn Junior, we banded 34 nestlings from 11 nests. Out of the 34 nestlings banded, we have resighted 29 of them alive in 8 resighting surveys. We do not have any band recoveries for dead birds, and 5 of the total birds banded have not been resighted at all. Based on our estimation of 2.64 fledged birds/nest (29 resighted nestlings/11 nests), we expect about 140 spoonbills (53 pairs X 2.64 birds/nest) fledged from Washburn Junior. Using an average production rate for the two colonies and applying it to the total number of nests in the Tampa region yields a total production of more than 1300 fledglings from Tampa Bay compared to 745 fledged from Florida Bay even though the number of nests was nearly identical (565 in Florida Bay, 566 in Tampa Bay). This comparison is telling in that, based on recent history, the 2005-06 nesting in Florida Bay was one of the best since 1982 and the nesting success in Tampa Bay was a little below average for this region.

We banded 164 birds in April 2003, 233 birds in 2004, and 105 birds in 2005. Since then we have received resight reports for over 90 of those birds. These birds were resighted in Brevard, Duval, Hendry, Hillsborough, Lee, Nassau, Palm Beach, Pasco, Pinellas, Polk, Sarasota, St. John's, and Taylor Counties. Banded birds have frequently been observed at Merritt Island, Ding Darling and Loxahatchee National Wildlife Refuges. Of those resighted birds, 5 birds were observed in Georgia. Three birds were observed in the same location in both 2004 and 2005. Three birds were observed in two different locations within the same year. Of the 110 resighting reported from across the state, 103 were birds banded in Tampa Bay and only 7 were banded in Florida Bay. This further suggests that Florida Bay's productivity is greatly diminished, however, migrations from Florida Bay southward to Cuba and the Yucatan Peninsula can not be discounted as a cause for the low resightings from Florida Bay.

Clearly, Florida Bay has been, and continues to be, impacted by anthropogenic forces that render production be less than that of healthy spoonbill nesting areas including the highly industrialized habitats of Tampa Bay. It is also interesting to note that rapid growth of spoonbill numbers 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 a pseudo-control for Florida Bay, as well as a 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

Systematic wading bird surveys were not done in Big Cypress in 2006. During the course of other aerial work, 8 wood stork nests with eggs were observed in the Deep Lake Unit in April, but failed within a month. Three other stork nests in the Deep Lake Unit fledged 8 young. A great egret rookery of approximately 28 nests with eggs was documented on August 1 in the Loop Unit.

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HOLEY LAND AND ROTENBERGER WMAs

Systematic wading bird surveys were not conducted this year, but some searching was performed during other routine aerial surveys from April to June, 2006. While conducting these searches, no wading bird nests were observed in Holey Land or Rotenberger WMAs.

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UPCOMING MEETINGS

Waterbird Society: 31st annual meeting: Barcelona, Spain (for more information visit: http://www.waterbirds.org)

Florida Chapter of The Wildlife Society: September 22-26, 2007, Tuscon, AZ (for more information visit: http://fltws.org)

125th Stated Meeting of the American Ornithologists' Union: 8 - 11, 2007, University of Wyoming, Laramie, Wyoming (for more information visit: http://www.aou.org)

SOUTHWEST COAST

After hurricane Wilma devastated the mangroves in Southwest Florida and impacted some of the waders in the area (see Special Topics), I felt that all bets were off for this year's wader nesting season; again coastal waterbirds proved me wrong. Of the six colonies monitored over the last years, one was totally destroyed and not censused this year (Chokoloskee Pass). Two lost at least half of the vegetative mass (Marco and Rookery Bay), one lost over 75% of the vegetative mass (Smokehouse Key) and two were hardly damaged at all (East River and Chokoloskee Bay). For the three heavily impacted colonies the storm broke down much of the mangrove on the islands and piled it underneath, this eliminated nesting structure in the over-story and destroyed the understory. In all three of these colonies most of the large birds were forced to nest on the compacted debris near the ground, which just about excluded the smaller birds from nesting (Snowy, Little Blue and Tricolored Herons, Cattle Egrets and White Ibis). As for both of the unaffected colonies, one (East River) had average nesting and the other (Chokoloskee Bay) inexplicably had a considerable increase in Great Egret nests. One would have thought that this amount of devastation would have precluded any nesting on the altered colonies but despite human logic all five of the colonies had some success.

Hydrology: The transitional ponds at Rookery Bay Research Reserve reflected the slightly unusual rainfall pattern for the first six months of the year. Twice as much rain as usual in February caused a slight spike in water level in the system that was already high from an unusually high last half of 2005. But almost immediately the coastal wetlands reverted to the seasonal 20 year pattern of spring dry-down and summer build up, by July water levels were slightly above the mean. What all this means to wader nesting on the coast I have no idea as I have never been able to correlate wader nesting and any particular phenomenon.

Note: For the Rookery Bay, Marco and Smokehouse colonies, which were usually censused by walking through the colonies, no ground censusing was attempted; all of these islands were so destroyed that it was possible to observe from a boat. Also we felt that trying to penetrate the tangled mangrove would have caused too much disturbance to justify the endeavor.

Location and Methods

Rookery Bay (RB): 26°01'51"N 81°44'43"W. Two Red Mangrove islands, 0.22 ha. Nest census conducted 6/8, boat, 2 observers 0.5 hour. Again this year all the wader nests were on the southern island, this is the fifth year in a row 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 4/12, two observers, boat two hours.

Smokehouse Key: (Note: This colony formerly miss named Henry Key (now named for the closest body of water), 25°54'51"(.476)N-81°42'52"(.838)W. One island in Caxambas Pass, 0.8579 ha (Red Mangrove; a little terrestrial vegetation on sand ridge in center). 6/23, boat, one hour, two observers.

East River (ER): 25°55'39"N 81°26'35"W. Three Red Mangrove islands, 0.25 ha (about). Nest census conducted 6/6, canoe, complete coverage, two observers, one hour.

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, 4/15, two people, one hour.

Note: All censuses are conducted during peak nesting and this varies according to species and timing, which accounts for the spread and differences of the dates.

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

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

Species Accounts:

Great Egret (GREG): Even with the disruption of Wilma these birds that nest in any numbers at just two of the colonies had a promising year (Table #1). At both RB and SK they had the same small number of nests as last year. For the ABCs they were 25% above the 24 year mean and at CHOK the highest ever, number of nests; 70% above the 12 year mean. Although it is not possible to get a good idea of how many chicks fledge there have been plenty of young GREG around. The numbers coming into the night roosts are about as high as they have been for the last eight years which have been the highest for the projects.

Table 1. Number of wading bird nests in coastal Southwest Florida during 2006.

Colony	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	WHIB	GLIB	Total
Rookery Bay	0	13	10	4	14	1	35	0	0	77
Marco (ABC)	8	191	10	0	8	2	31	2	1	253
Smokehouse Key*	0	12	12	1	5	2	1	41	0	74
East River	0	0	53	2	167	0	0	0	0	222
Chokoloskee Bay	1	211	4	0	0	0	0	0	0	216
Total	**9**	**427**	**89**	**7**	**194**	**5**	**67**	**43**	**1**	**842**
Mean (24 year)	**12**	**222**	**287**	**58**	**474**	**5**	**408**	**51**	**40**	**1557**

*Misnamed Henry Key; now referred to as Smokehouse Key

Snowy Egret (SNEG): As mentioned above, small waders did not due well except at ER where SNEG and TRHE had an average number of nests. At both night roosts small waders were down quite a bit; it appears that they must have left the area, as not many were killed by Wilma.
Little Blue Heron (LBHE: See SNEG (above).
Tricolored Heron (TRHE): See SNEG (above).
Reddish Egret (REEG): Although not numerous in the area censused (m = 1.89, for 32 years) this bird has slowly increased. Last year there was a phenomenal 12 nests this year it is back down to the 24 year mean of five. They did not decline in numbers in the project area in 2005, or so far this year. Appears the condition of the nesting islands may have affected reproduction; we have only recorded them nesting on ABC, RB and SK the most heavily storm damaged islands.
Cattle Egret (CAEG): See SNEG (above). This species continues to decline considerably in the area.
White Ibis (WHIB): As usual in this area WHIB didn't start to nest until July and they had the same problems as the other small waders (see SNEG, above). The few nests they have haven't started to bring young off yet. As for the numbers coming in to roost they were about average for RBSD but dropped off some after Wilma on the ABCSD; by the beginning of August, 2006 total numbers had rebounded to 10552 just 160 individuals lower than the 20 year mean (sometimes the numbers are scary). The numbers of first year birds arriving in both July and August were 14% of the total and the mean for 20 years is 12%; it appears they had a decent breeding year inland (where I think they breed).
Glossy Ibis (GLIB): With only one confirmed nest at the ABCs they obviously had the same problem as the other small waders. In the sundown censuses the numbers have been very erratic; difficult to guess what is going on.

So much storm damage in the area made for a unusual and interesting year. That there was any nesting at all, in such heavily impacted colonies seems almost miraculous. It is not hard to understand why the larger birds, by shifting to what was left of the downed mangrove in the storm impacted colonies, were able to nest successfully this year. It was obvious that in those same colonies small waders had nowhere to nest. The sundown censusing indicated that at least some of the small waders stayed in the area; did they nest somewhere else that we couldn't find or did they just take the year off? Although a different year most certainly the breeding season was not a bust, but what about next year? A lot of the storm debris will have decomposed and the trees that are still alive (questionable) will not have enough structure for nests. As there is almost nothing green on Smokehouse Key it could be predicted that there will be no nesting at all next year (but they may fool us again) anyway it should another interesting year.

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WADING BIRD COLONY LOCATION AND SIZE AT LAKE OKEECHOBEE

Introduction

The importance of Lake Okeechobee to South Florida wading bird populations has been recognized since National Audubon Society wardens began patrolling the area during the early 20th century (David 1994). The earliest systematic aerial surveys were conducted at Okeechobee from 1957 to 1960, and then again during the early 1970s, as part of regional and statewide efforts to monitor wading birds (David 1994). Nest counts reached a high point of 10,400 in 1974 during this period in the history of known surveys (Ogden 1974, David 1994). In response to concerns about the effect of proposed management increases in lake levels on wading birds, the South Florida Water Management District (SFWMD) began in 1977, monthly surveys of nesting birds throughout the breeding season that ran annually until 1992 (David 1994, Smith and Collopy 1995). During this period, the overall presence of breeding wading birds on Lake Okeechobee declined by 60%, with Glossy and White Ibises declining by 83% and 74%, respectively (David 1994). There were no other surveys on the Lake until 2005, when Florida Atlantic University (FAU) conducted a single survey at the end of the nesting season. Then in 2006, FAU initiated monthly aerial surveys to determine the size and location of wading bird colonies on Lake Okeechobee as part of the Monitoring and Assessment Plan of the Comprehensive Everglades Restoration Plan. Herein, we report the results of the 2006 surveys, discuss their historical significance, and then attempt to link our findings to regional hydrologic conditions.

Methods

From January through June 2006, two observers surveyed wading bird nests along aerial transects flown in a Cessna 172 at an altitude of 244 m (800 ft) and a speed of 185 km/hr (100 knots). One transect was flown parallel to the eastern rim of the lake from Eagle Bay to Ritta Islands. Remaining transects were oriented East-West, spaced at an interval of 3 km (1.6 nm), and traversed the littoral zone. Observers searched for colonies on each side of the plane. Colonies were defined as any assemblage of at least 2 nests separated by at least 200 m (Erwin et al. 1981, Smith and Collopy 1995). When a colony was located, we lowered to 91 m (300 ft), and the colony was circled several times until a nest count was completed. One observer counted while the other recorded data. We also recorded photographs and geographic coordinates with each visit and then mapped colonies to specific stands of vegetation or islands onto 1-m resolution digital orthophotoquarterquadrangles (DOQQs). We calculated intercolony distances using ArcGIS. To maintain consistency with past wading bird reports for Lake Okeechobee, we counted all birds sighted and categorized them as "nesting" if nests were visible or known assemblages of nests existed for a species (David 1994, Smith and Collopy 1995). At the largest, most diverse, and accessible colonies, we followed aerial surveys with ground surveys to improve count accuracy (Frederick et al. 1996). Even with combined ground surveys and photographs, however, small dark-colored wading birds were difficult to census, and therefore we likely underrepresented the presence of dark-colored wading birds in our counts. We also compared 2006 colony locations to published maps of past wading bird colony survey results (David 1994, Smith and Collopy 1995) to determine whether a site was a new colony or had historical significance.

Figure 1. Weekly precipitation totals (in) and average stage levels (feet NGVD29) for Lake Okeechobee, FL, USA during the 2006 wading bird breeding season. Suitability of wading bird foraging recession rates were depicted in colored arrows. Good foraging conditions (green) existed when average lake stage decreased between 0.05 ft and 0.16 ft per week, fair foraging conditions (yellow) when stage decreased between 0.17 ft and 0.6 ft or decreased only 0.04 ft per week, and poor foraging conditions (red) when stage levels increased or if decreases were > 0.6 ft per week.

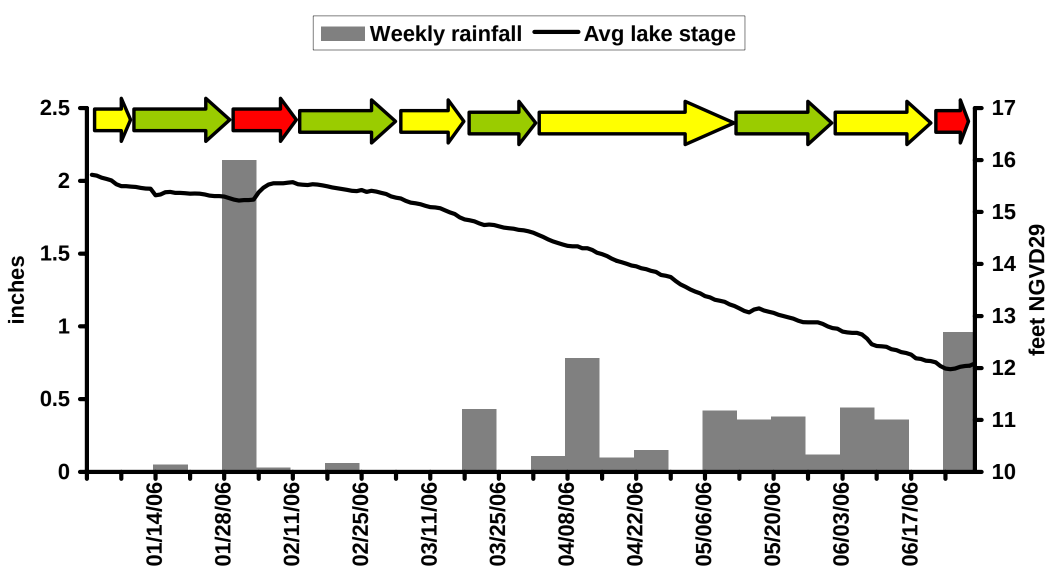
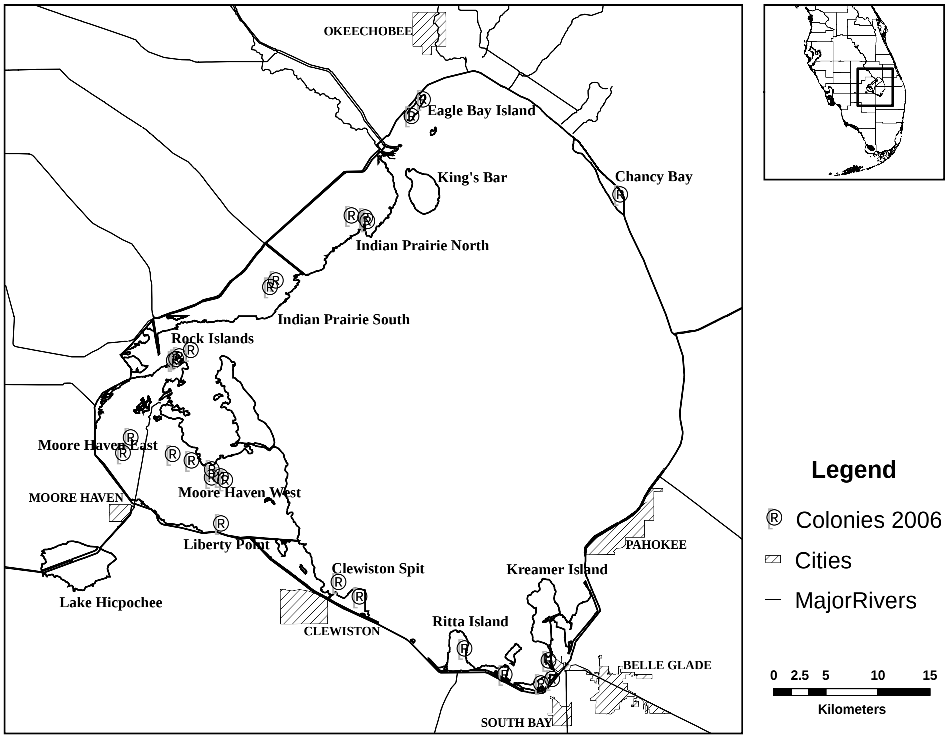


Figure 2. Map of wading bird colonies observed at Lake Okeechobee, Florida, USA, from January to June 2006.



Hydrology

Lake stages and recession rates reported herein were based on average stage readings from six principal gauges at Lake Okeechobee. Four are located in the pelagic zone throughout the lake (L001, L002, LAKEOKEE, LZ40), one near Moonshine Bay (L005), and one in the littoral zone near Liberty Point (L_OKEE.M_G). Lake stage receded steadily throughout the breeding season following a brief reversal due to heavy rains early in February (Fig. 1). All water levels and lake stages are reported as feet National Geodetic Vertical Datum 1927 (NGVD27). Foraging surveys suggested that as the average lake stage dropped below 15 ft in March, water depths in the marsh became shallow enough that large aggregations of wading birds (including small ardeids and ibis) were beginning to forage on the lake (unpublished data). We used the recession rate index from Sklar (2005) to assess the suitability of wading bird foraging conditions. The index was based on weekly changes in lake stage once water levels in the marsh became shallow enough for wading birds to forage successfully. Data suggested that recession rates were good to fair for more than three months from March 11 until June 30 when lake levels began to increase again following initiation of the rainy season (Fig. 1).

Results and Discussion

Historical significance and colony size

In contrast to historical nesting reports, we did not observe any activity at either King's Bar, Okeetantie, Harney Pond/Twin Palms, or Observation Island. Moreover, we observed no breeding activity at either Lake Hicpochee or in Cowpen Marsh, two former colony sites outside of the lake levee. Whether these historical sites will be reoccupied in response to shifting hydrological conditions as environmental circumstances change or as lake management strategies evolve remains to be seen. Even so, several perennial sites were occupied in 2006, and data suggested that wading birds at Lake Okeechobee initiated a substantial number of nests this year in comparison to past reports. The five most prominent colonies during 2006 were Moore Haven West 1 (A19), Moore Haven East 4 (A21), Indian Prairie South 1 (A32), Eagle Bay Island (A1), and Liberty Point (A14), respectively (Table 2). These five colonies accounted for 83% of the overall peak nest effort (refer to Fig. 2 for colony locations).

Colony A19 was a traditional colony site whose location was similar to colonies reported as "Moore Haven A" by David (1994) and "North Moore Haven" by Smith and Collopy (1995). Colony A19 was this year's largest colony, harboring 40% of the total nests with all principal wading bird species breeding there at some point during the season. At colony A21, we recorded 2,440 nests in May, 50% of which were White Ibises and 37% of which were Snowy Egrets. No previous record existed for the Indian Prairie South colonies, suggesting that breeding birds moved to new sites northeast of the traditional Harney Pond and Twin Palms sites (David 1994, Smith and Collopy 1995). Colony A14 near Liberty Point was likely the oldest and most perennial site of all the active colonies located during 2006. Nests attempts were initiated here during 80% of the breeding seasons from 1977–1992. Colony A1 at Eagle Bay Island is not mentioned by David (1994), but was active during Smith and Collopy's (1995) surveys, suggesting that birds that traditionally nested at King's Bar eventually relocated to Eagle Bay Island as the King's Bar colony gradually disbanded during the modern era. Colony A1 and Colony A14 were active and multispecific throughout the entire breeding season with May peaks of 1, 525 and 1, 157 nests, respectively.

Table 1. Timing and nest effort for species breeding in wading bird colonies during 2006 at Lake Okeechobee, Florida, USA . Italics denote peak nest effort for species included in grand total.

Date	ANHI	GREG	SNEG	TRHE	LBHE	GBHE	CAEG	GLIB	WHIB	Peak nest effort [1]
January	---	50	---	---	---	34	---	---	--- [2]	**84**
February	105	480	---	---	---	*98*	---	---	---	**578**
March	471	*1,796*	203	63	25	72	---	80	400	**2,639**
April	243	1,782	2,393	*234*	*182*	55	650	435	*5,800*	**10,881**
May	200	1,067	*2,580*	137	158	22	1,530	*620*	2,980	**7,564**
June	59	655	1,764	83	82	15	1,215	305	170	**3,074**

[1] Monthly totals excluded Cattle Egrets and Anhingas

[2] Species undetected during the survey

Timing and peak nest effort

Large ardeids began nesting in early December 2005 before surveys began, and small ardeids began nesting during the third week of March. Ibises began nesting the first week of April. Several colonies remained active until the last week of June when the last surveys were conducted. We observed 11, 310 wading bird nests spread across 27 colonies. This total summed the peak nest effort for each species within the 2006 breeding season, but excluded Cattle Egrets and Anhingas (see Table 1, the grand total is the sum of the italicized totals). We expect this was the most accurate estimate of total nest effort for the year because different species exhibited peak nest effort during different periods of the nesting season. However, to put this number in its proper historical context, we also summed a separate nest effort for just White and Glossy Ibises, Great Blue Herons, Great Egrets, and Snowy Egrets, which were the five species totaled in the historical nest count summary provided by David (1994). That partial count was 10, 868 nests in 2006. This number of nests makes 2006 the largest nesting year since 1974. However, these early surveys (1957–1975) were sporadic between years and typically occurred only once during the breeding season, making it possible that peak nest effort was underestimated and some good years were missed.

Environmental conditions

One might expect that January's high water levels in the marsh would act to reduce on-lake habitat and prey availability for wading birds. Yet Eagle Bay Island had active colonies during the first aerial survey in January. Furthermore, many of those early nests already had chicks by February 8, at the time of our first monitoring visits, suggesting that courtship and nest construction at Eagle Bay Island began in December when lake levels were still relatively high from Hurricane Wilma in October 2005. If habitat and prey availability are critical factors influencing the initiation of nesting in wading birds (Powell 1983, 1987; Strong et al. 1997, Gawlik 2002), then what environmental conditions could have stimulated early nesting given that water levels in the marsh were essentially still too deep to maximize foraging potential? Data suggested that an above average rainy season may have increased the availability of foraging habitats off-lake in the surrounding landscape proximal to Eagle Bay Island (see Fig. 2). Surveys for foraging birds conducted simultaneously on- and off-lake during January and February showed that most birds within 15 km of Lake Okeechobee were feeding at flooded depressional marshes within rangelands (i.e. short-hydroperiod wetlands) northwest of Lake Okeechobee (Marx and Gawlik unpublished data). More importantly, we expect that the availability of such habitats could enhance post-breeding juvenile survival and eventual recruitment as wetlands are reflooded following initiation of the wet season. If indeed short-hydroperiod wetlands in the surrounding landscape provide primary foraging habitats while lake levels are high, then the protection and management of these wetlands could be an important complementary component of conservation efforts to restore and sustain wading bird populations that breed on the lake.

This year's nesting data also gave some guidance for the hydrologic conditions that might increase wading bird presence on-lake. We expect the circumstances that produced this year's superior nest effort were related to water management that reduced average lake stage, followed by a steady recession. As managers reduced the lake stage enough to sufficiently lower water levels in the littoral zone, marsh habitats became increasingly suitable for successful foraging which stimulated breeding (Powell 1983, 1987, Gawlik 2002). In fact, once the average lake stage fell below 15 ft, there was a marked increase in wading bird use of the lake, especially with regard to smaller ardeids and ibises that require shallow waters to maximize their foraging potential (Marx and Gawlik unpublished data). Thereafter, a steady protracted recession with no major reversals in the receding water pattern provided good to fair foraging conditions for several months during the breeding season, which allowed wading birds to complete their nest cycle (Fig. 1). Despite the wide variety of environmental stressors that threaten

Table 2. Geographic coordinates (NAD83) and species-specific peak nest effort for colonies during the 2006 breeding season at Lake Okeechobee, Florida,

Colony name	ID	Geographic Location		Peak nesting month	ANHI	GREG	SNEG	TRHE	LBHE	GBHE	CAEG	WHIB	GLIB	Totals[1]
		Latitude	Longitude											
Chancy Bay [3]	A29	80° 39' 58"W	27° 06' 14"N	MAY 2006	5	0	0	0	2	3	220	0	0	**230**
Clewiston [4]	A12	80° 53' 29"W	26° 45' 48"N	FEB 2006	0	0	0	0	0	5	0	0	0	**5**
Clewiston Spit [4]	A13	80° 54' 33"W	26° 46' 33"N	APR 2006	0	220	0	1	0	2	0	0	0	**223**
Eagle Bay Island North	A1	80° 50' 11"W	27° 11' 04"N	MAY 2006	20	55	180	40	20	0	480	480	250	**1,525**
Eagle Bay Island South	A2	80° 50' 47"W	27° 10' 14"N	MAR 2006	6	80	0	0	0	12	0	0	0	**98**
Indian Prairie North 1 [3]	A5	80° 53' 53"W	27° 05' 11"N	FEB 2006	0	0	0	0	0	6	0	0	0	**6**
Indian Prairie North 2 [4]	A18	80° 53' 10"W	27° 05' 05"N	MAR 2006	30	95	0	0	0	1	0	0	0	**126**
Indian Prairie North 3 [4]	A30	80° 53' 04"W	27° 04' 55"N	MAR 2006	23	68	0	0	0	3	0	0	0	**94**
Indian Prairie South 1	A32	80° 57' 47"W	27° 01' 53"N	APR 2006	0	160	800	80	80	2	480	0	0	**1,602**
Indian Prairie South 2	A35	80° 58' 06"W	27° 01' 33"N	MAR 2006	0	37	0	0	0	4	0	0	0	**41**
Torrey Island	A6	80° 45' 58"W	26° 41' 51"N	FEB 2006	0	0	0	0	0	7	0	0	0	**7**
Ritta Island [4]	A7	80° 48' 02"W	26° 43' 10"N	FEB 2006	0	2	0	0	0	8	0	0	0	**10**
Liberty Point [3]	A14	81° 00' 38"W	26° 49' 32"N	MAY 2006	83	260	550	2	12	0	0	150	100	**1,157**
Moore Haven East 1 [3]	A3	81° 00' 25"W	26° 51' 44"N	APR 2006	22	170	0	0	0	4	0	0	0	**196**
Moore Haven East 2 [3]	A4	81° 00' 39"W	26° 51' 55"N	MAR 2006	8	0	0	0	0	3	0	0	0	**11**
Moore Haven East 3 [3]	A20	81° 03' 08"W	26° 53' 02"N	APR 2006	70	300	200	2	20	0	0	150	5	**747**
Moore Haven East 4 [3]	A21	81° 02' 10"W	26° 52' 43"N	MAY 2006	0	100	900	30	60	0	0	1,200	150	**2,440**
Moore Haven East 5 [3]	A27	81° 01' 06"W	26° 52' 17"N	MAR 2006	15	46	0	0	0	2	0	0	0	**63**
Moore Haven West 1 [3]	A19	81° 05' 18"W	26° 53' 53"N	APR 2006	60	300	850	30	18	4	20	5,000	40	**6,325**
Moore Haven West 2 [3]	A28	81° 05' 42"W	26° 53' 06"N	MAR 2006	0	90	0	0	0	1	0	0	0	**91**
Rock Islands 1 [3]	A15	81° 03' 04"W	26° 57' 48"N	APR 2006	8	70	130	2	1	1	50	0	0	**262**
Rock Islands 2 [3]	A33	81° 02' 48"W	26° 58' 01"N	APR 2006	6	30	90	16	0	0	20	0	0	**162**
Rock Islands 3 [3]	A38	81° 02' 57"W	26° 57' 54"N	APR 2006	0	0	0	0	0	0	35	0	0	**45**
Rock Islands 4 [3]	A40	81° 02' 12"W	26° 58' 20"N	MAY 2006	0	0	0	0	0	0	140	0	0	**140**
South Bay 1	A23	80° 43' 30"W	26° 41' 37"N	MAR 2006	0	0	0	0	0	2	0	0	0	**2**
South Bay 2	A24	80° 44' 05"W	26° 41' 23"N	MAY 2006	0	26	0	0	1	1	0	0	0	**28**
South Bay 3	A39	80° 43' 41"W	26° 42' 33"N	MAY 2006	0	8	0	0	0	0	40	0	0	**48**

[1] Colony total included all species present

[2] Species listed in descending rank order based on nest abundance at time of peak nesting

[3] Reported in David 1994 and Smith and Collopy 1995

[4] Reported in Smith and Collopy 1995

Lake Okeechobee's ecological integrity (Havens and Gawlik 2005), the 2006 season demonstrated that the lake still serves as critical breeding ground for South Florida wading birds (David 1994). Future work will be aimed at developing a habitat suitability model for wading birds that formalizes the relationship between hydrologic conditions and wading bird use of Lake Okeechobee.

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KISSIMMEE RIVER

Introduction/Background

Prior to its channelization, the Kissimmee River, its 1 – 3 km wide floodplain, and surrounding wetland/upland complex supported substantial numbers of foraging and nesting wading birds (National Audubon Society, 1936 – 1959). Between 1962 and 1971, the Kissimmee River was channelized and its headwater lakes regulated, resulting in the drainage of the majority of its floodplain wetlands and a substantial reduction in the number of wading birds (excluding cattle egrets) using the system (Williams and Melvin, 2005). The Kissimmee River Restoration Project, which was authorized in 1992, seeks to restore ecological integrity to the middle portion of the original river system via 1) reconstruction of the physical form of the river (i.e., canal backfilling, removal of water control structures, and recarving/reconnecting river channels); and 2) reestablishment of historical (pre-channelization) hydrologic (i.e., discharge and stage) characteristics through modifications to regulation schedules of headwater lakes. When completed, the project will restore approximately 104 km^2 of river-floodplain ecosystem, including 70 km of continuous river channel. The restored area is expected to experience seasonal flood pulses and recessions that are favorable for wading bird reproduction. To date, approximately one third of project construction has been completed. All construction is scheduled for completion by the end of 2012; new regulation schedules for headwater lakes will be implemented in 2010. Wading bird responses to the restoration project will be monitored through 2017.

Methods

As part of the Kissimmee River Restoration Project evaluation program, we performed systematic aerial surveys (Feb 28, Apr 5, May 19) to search for wading bird nesting colonies within the floodplain and surrounding wetland/upland complex of the Kissimmee River. Surveys began at the S65 structure at Lake Kissimmee and proceeded southward to the S65-D structure (Fig 1). Observers were placed on both sides of a helicopter flying at an altitude of 244 m along east-west transects spaced 2 km apart. Each transect spanned the 100 yr flood line of the river plus an additional 3 km east and west of the flood line. In addition to dedicated flights for colony surveys, nesting colonies were also monitored, when encountered, during separate aerial surveys of foraging wading birds. These surveys (Feb 17, Mar 15, Apr 28, May 26, Jun 28) were flown at a lower altitude (30 m) and were limited to the area within the 100 yr flood line of the river between S65 and S65-D. Once a colony was located, nesting species and the number of active nests were visually estimated by both observers. The number of nests reported for each colony represents the maximum number of nests for each species. Nesting success was not monitored and no ground surveys were conducted.

Results

Five colonies containing an estimated 657 nests were observed during the 2006 season, including 133 GREG, 4 GBHE, 500 CAEG, and 20 ANHI (Figure 1). All colonies were first encountered during the Feb 28 survey except C38 Caracara Run, which was first discovered on June 28. GREG was the most widely distributed nesting species, occurring in four of five

Table 1. Peak numbers of wading bird nesting colonies inside or within 3 km of the Kissimmee River 100 yr flood line between the S65 and S65-D structures. Surveys were conducted Mar – June, 2004; Mar – Jun, 2005; and Feb – Jun, 2006.

Latitude	Longitude	Colony Name	Year	ANHI	CAEG	GBHE	GREG	Colony
			2004	-	-	-	-	**-**
			2005	-	-	-	-	**-**
81 13.2196	27 42.946	42W	2006	-	-	-	8	**-**
			2004	-	-	-	-	**-**
			2005	-	-	-	-	**-**
81 04.466	27 22.853	C38 Caracara Run	2006	-	500	-	-	**500**
			2004	-	-	-	-	**-**
			2005	-	-	-	21	**21**
81 16.527	27 32.088	Cypress West	2006	-	-	-	25	**25**
			2004	-	-	-	-	**-**
			2005	-	-	-	-	**-**
81 00.380	27 22.620	New Chandler Slough	2006	-	-	-	40	**40**
			2004	-	-	-	-	**-**
			2005	30	-	5	60	**95**
81 04.649	27 21.076	Orange Grove	2006	20	-	4	60	**84**
			2004	-	-	-	-	**-**
			2005	-	400	-	-	**400**
81 06.442	27 37.791	Pine Island	2006	-	-	-	-	**-**
			2004	**0**	**0**	**0**	**0**	**0**
			2005	**30**	**400**	**5**	**81**	**516**
Total Nests			**2006**	**20**	**500**	**4**	**133**	**657**

colonies. Three of five 2006 colonies were absent from 2004 and 2005 surveys, including 42W, New Chandler Slough, and C38 Caracara Run (Table 1). The other two colonies, Orange Grove and Cypress West, had species composition and number of nests that were similar to 2005. Pine Island colony, which contained 400 CAEG nests in 2005, was inactive in 2006. As in 2005, the majority of nests occurred in a single CAEG colony.

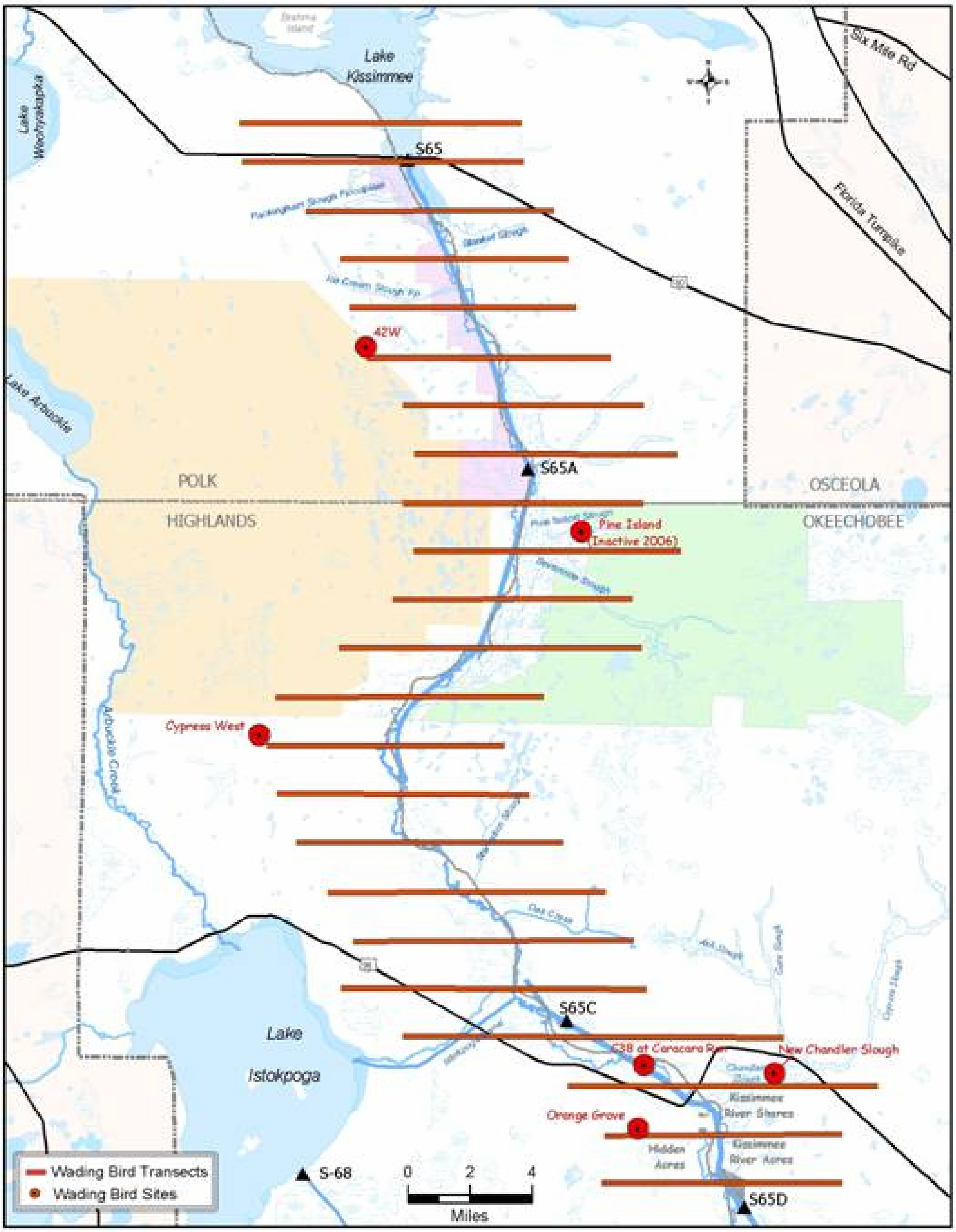

Figure 1. Transect layout and locations of nesting colonies within the Kissimmee River floodplain and surrounding wetland/upland complex.

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Channelized Kissimmee River, Florida. In: S.G. Bousquin, D.H. Anderson, G.E. Williams and D.J. Colangelo (eds) *Establishing a Baseline: Pre-Restoration Studies of the Kissimmee River.* Technical Publication ERA 432, South Florida Water Management District, West Palm Beach, FL.

KISSIMMEE RIVER FORAGING DENSITIES

Aerial surveys were used to measure the densities of wading birds. Surveys were conducted approximately monthly during the baseline period (pre-restoration; 1996–1998) and have continued after Phase I of the restoration project was completed in 2001. Restoration is expected to bring increased use of the floodplain by long-legged wading birds (excluding cattle egrets). Furthermore, mixed species wading bird rookeries are anticipated to regularly form on and near the floodplain and tributary sloughs once abundant food resources and appropriate hydrology have been reestablished.

To investigate densities of wading birds on the floodplain, east-west aerial transects (n = 218) were established at 200 m intervals beginning at the S-65 structure and ending at the S-65D structure (see Figure 11-1 for structure locations). Each month, transects were randomly selected for counts until a minimum of 15 percent of the 100-year floodplain was surveyed in both the Phase I and unrestored portion of the river/floodplain. Surveys were conducted via helicopter flying at an altitude of 30.5 m and a speed of 130 km/hr. A single observer counted all wading birds and waterfowl within 200 m of one side of the transect line. Because it is not always possible to distinguish tricolored herons (*Egretta tricolor*) from adult little blue herons (*E. caerulea*) during aerial surveys (Bancroft et al., 1990), the two are lumped into the category, small dark herons. Likewise, snowy egrets (*E. thula*) and immature little blue herons were classified as small white herons (Bancroft et al,. 1990). Densities of wading birds were calculated separately for restored and unrestored areas.

Because no quantitative data are available for densities or relative abundances of long-legged wading birds of the pre-channelized Kissimmee River, restoration expectations for responses by wading birds to the KRRP are based on reference data from aerial surveys of a flow-through marsh in Pool B that was built as part of the Kissimmee River Demonstration Project and for floodplain areas along Paradise Run, a portion of the Kissimmee River near Lake Okeechobee that still retains some channel flow and periodic floodplain inundation (Toland, 1990; Perrin et al., 1982). The 3.5 km² flow-through marsh was constructed just south of the S65-A tieback levee during 1984–1985 and was manipulated to simulate inundation and overland flow that were typical of the pre-channelized Kissimmee River floodplain (Toth, 1991). Based on these reference data, it is expected that annual dry season (December–May) densities of long-legged wading bird (excluding cattle egrets) will be ≥ 30.6 birds/km².

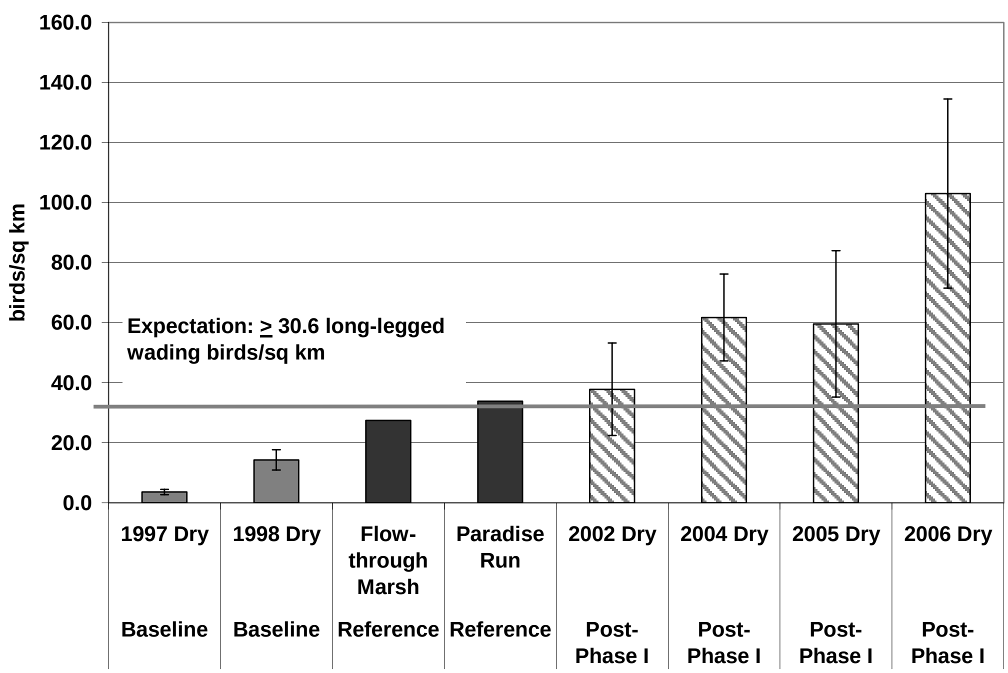

Figure 11-27. Baseline, reference, and post-Phase I densities (± SE) of long-legged wading birds (excluding cattle egrets) within the 100-year flood line of the Kissimmee River. Baseline densities were measured in the Phase I area prior to restoration. Post-restoration densities were measured beginning approximately 10 months following completion of Phase I.

Prior to Phase I construction (baseline period), mean annual dry season densities of long-legged wading birds in the Phase I area averaged (± SE) 3.6 ± 0.9 birds/ km^2 in 1997 and 14.3 ± 3.4 birds/ km^2 in 1998. Since completion of Phase I, densities of long-legged wading birds have exceeded the restoration expectation of 30.6 birds/km^2 each year, averaging 37.8 ± 15.4 birds/ km^2, 61.7 ± 14.5 birds/ km^2, 59.6 ± 24.4 birds/ km^2, and 103.0 ± 31.5 birds/km^2 in the dry seasons of 2002, 2004, 2005, and 2006 respectively (2003 data were not collected; Figure 11-27). Furthermore, the lower limit of the 95 percent confidence interval (95% C.I.) has exceeded the expectation in three of four years. White ibis was the most common species in all 2006 dry season surveys, with great egret, small white heron (snowy egret and immature little blue heron), glossy ibis, wood stork, and great blue heron also commonly encountered

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WADING BIRD ABUNDANCE (FORAGING AND NESTING)

EVERGLADES NATIONAL PARK AREA

Methods

Systematic reconnaissance flights (SRF's) were performed monthly between Dec 2005 and May 2006. Flights were conducted over 3 to 4 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 2Km (Figure 1). Wading birds were counted, identified and geographically located using GPS units. Changes in surface water patterns (hydro patterns) were also recorded. Five categories were used to describe the hydro patterns: 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 December 1984, December 1987 and January 1998. Missing data for those months were estimated using years with complete sets of data. From those years, it was calculated the overall percentage of increase or decrease from month to month in order to estimate missing values. In some years, due to personnel constraints, only one observer was used to collect those data. This situation occurred during the surveys of April 1990, May 1990 and from January 1991 to May 1991. Finally, some transects were missing for one observer during April 2004 and May 2005. Densities of birds were estimated using a 2X2 Km grid. The number of birds counted during the SRF inside the 300m width surveyed stripe were extrapolated to the rest of the 4Km^2 cell dividing the number of birds observed by 0.15 for surveys were data from two observers were available. In cases were only data from one observer were available the number of birds inside the 150m stripe were extrapolate to the rest of the cell by dividing the birds observed by 0.075.

Results

During the survey period (December 2005 – May 2006) an increase of eighteen-percent in the abundance of wading birds was observed, for all species combined, in comparison to the previous year (Figure 2). This increase in the number of birds observed in 2006 ads more positive slope to the overall increasing trend observed from 1985 to the present, when a linear regression model is used to fit those data.

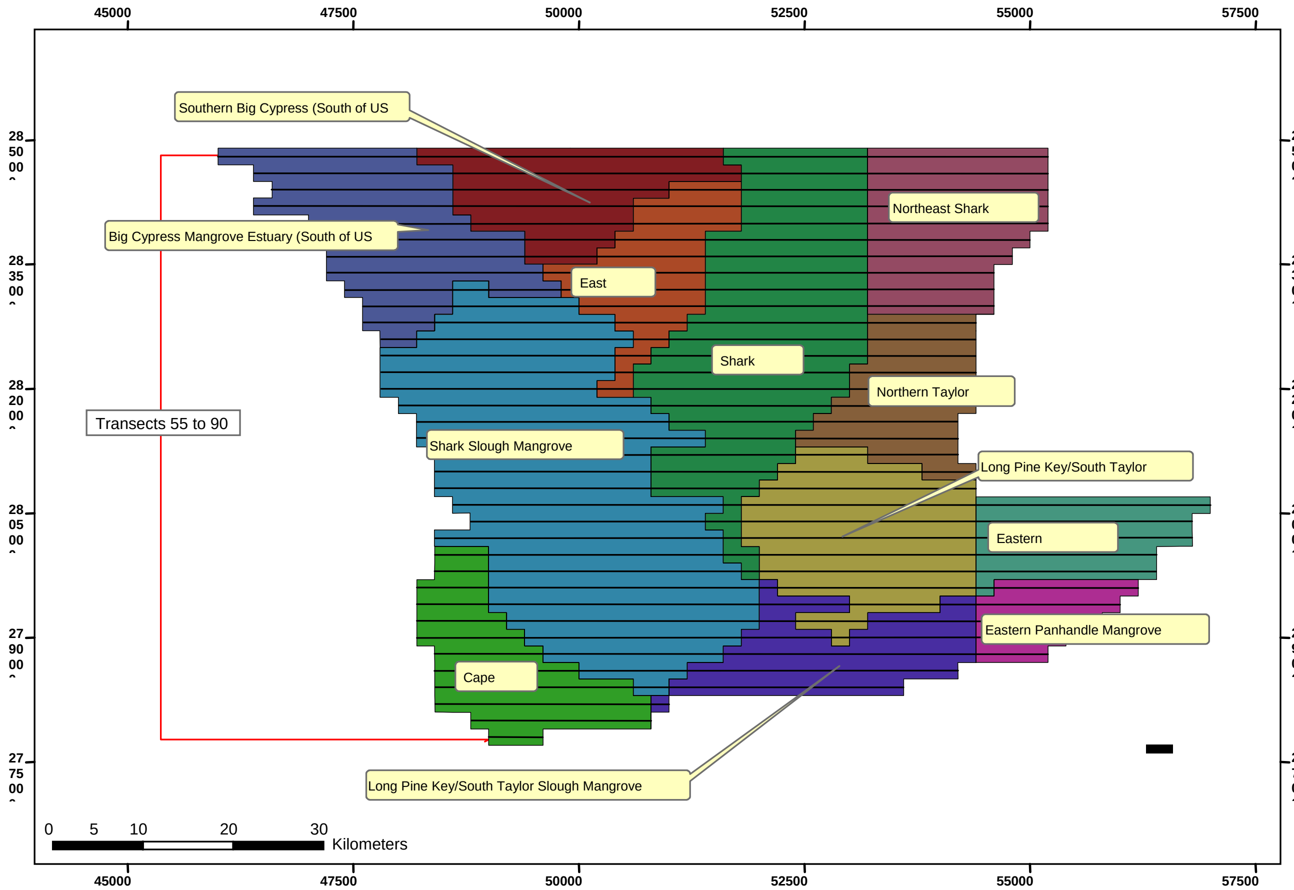

Figure 1. Map of ENP and southern Big Cypress National Preserve with sampling transects and drainage basins.

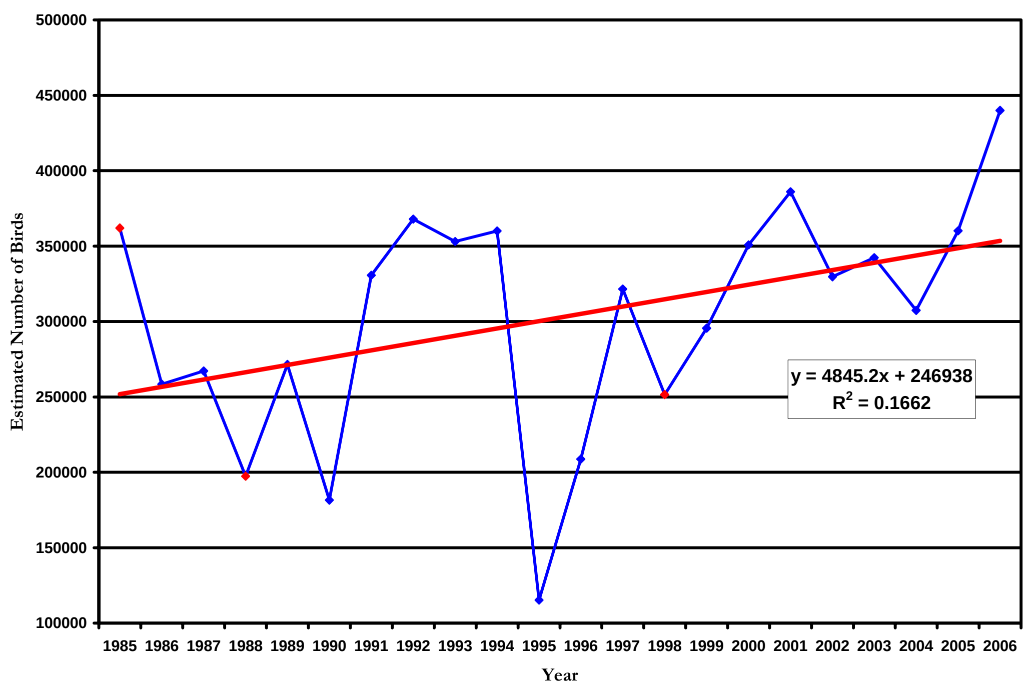

Figure 2. Estimated number of wading birds (all species pooled) observed from the months of Dec-May from 1985 to 2006. Red marks represent years with estimated missing data for one month.

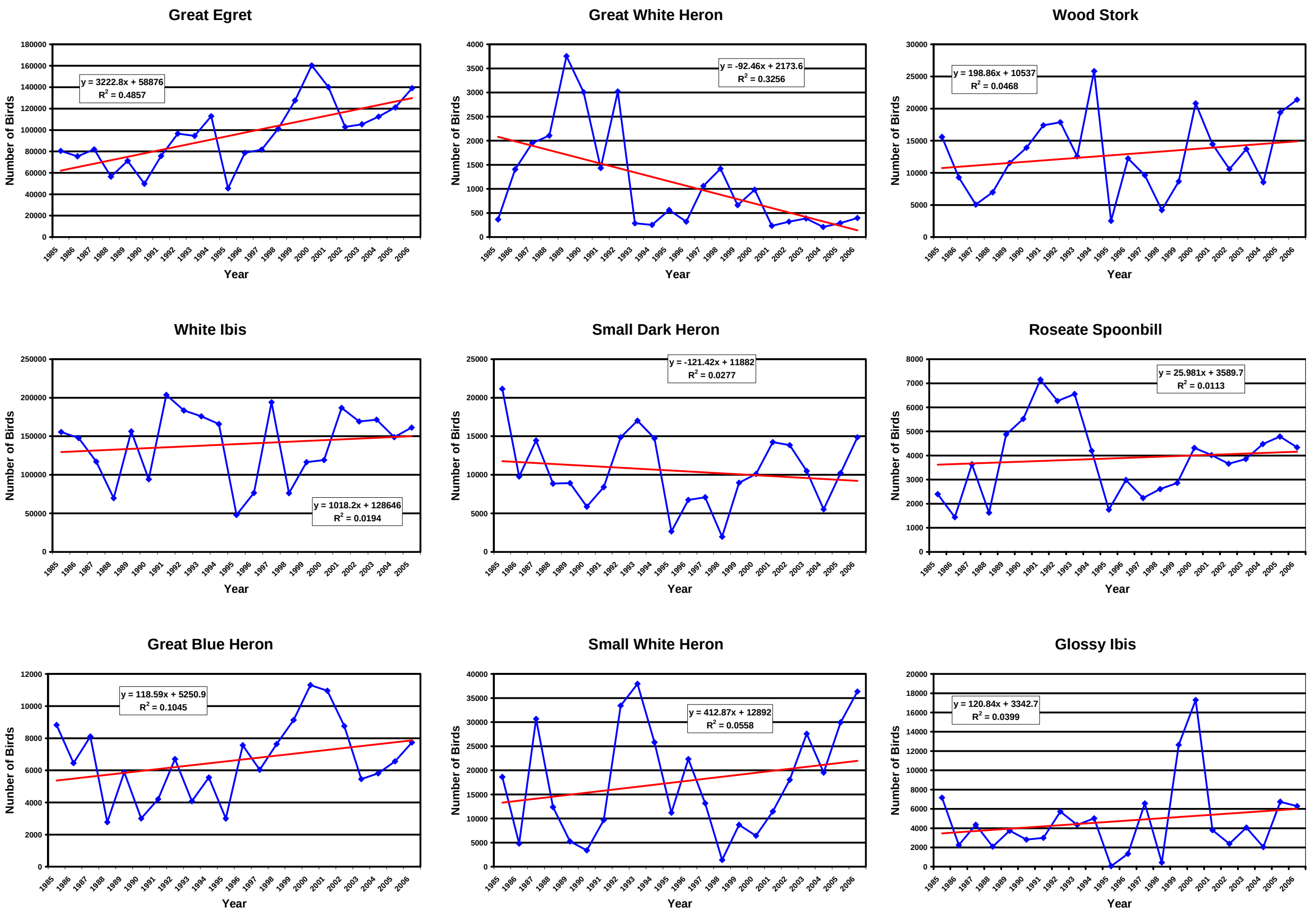

Figure 3. General trends in wading bird populations based on the total number of birds estimated during the surveys performed each year in the Everglades National Park from 1985 to the present.

Figure 3 shows that seven of the nine species of birds increased their numbers in relation to those observed in 2005. Small dark herons (SMDH) increase 31%, great white heron (GWHE) 27%, white ibis (WHIB) 23%, small white heron (SMWH) 18%, great blue herons (GBHE) 15%, great egrets (GREG) 13%, and wood stork (WOST) with a 9%, increase. Roseate spoonbill (ROSP) decreased 9% and glossy ibis (GLIB) 7%. Figure 3 also shows the annual estimates of the number of birds by species from 1985 to the present. Once again, linear regression models were use to determine the general trend for each species. A tendency to increase in the number of birds estimated for GREG, GBHE, SMWH, WOST, and GLIB was observed. Some species such as ROSP, and WHIB showed a stable trend; while only two species SMDH and GWHE, showed tendencies to decrease. Although this type of analysis can provide some idea of the general trends in the number of individuals observed for each species or groups of birds through those years, additional studies and more data analysis will be necessary in order to evaluate the significance of these observations and its relevance to the wading bird populations occurring in Everglades National Park.

The maximum density of birds occurred this year during the month of January (see Table 1). During January the highest numbers of GREG, WHIB, GBHE, and WOST were observed. Other species such as SMWH and GLIB reached their maximum numbers in December and April respectively, while ROSP, SMDH and GWHE peaked in the month of May. The months of March and April were the months with the least number of birds observed. It was during these months that the lower numbers of birds occurred for all the species but for GLIB and GWHE which showed the minimum numbers of birds during December.

Table 2 shows the distribution and abundance of wading birds in the different drainage basins. The Shark Slough (SS) basin contained the highest number of wading birds (25%), followed by Shark Slough Mangrove Estuary (SSME) with 20% and East Slough (ES) with 12%. These three basins combined, made up 57% of the total number of birds observed during the entire season. In contrast; the basins with the lowest number of birds were Eastern Panhandle Mangrove Estuary (EPME) with 1%, Northern Taylor Slough (NTS) and Eastern Panhandle with 2% each. Most birds were concentrated in SSME and Southern Big Cypress (SBC) during December. By January, most birds still concentrated in SSME. However, as the water receded, a great increase in the number of wading birds was observed in Big Cypress Mangrove Estuary (BCME) and East Slough (ES). As water levels declined during February, SS became the basin with

Table 1. Estimated abundance of wading birds in the Everglades National Park and adjacent areas, Dec 2004- May 2005.

Species	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Total
GREG	24,349	24,836	24,332	20,580	21,936	23,075	139,108
GBHE	1,147	1,676	1,540	813	1,187	1,375	7,738
SMDH	2,517	3,119	2,199	1,915	1,635	3,482	14,867
SMWH	9,315	4,869	6,373	3,806	4,304	7,674	36,341
WHIB	32,749	42,943	34,473	36,617	29,040	33,749	209,571
GLIB	67	855	968	976	3,006	406	6,278
WOST	4,357	4,615	4,591	1,842	2,778	3,197	21,380
ROSP	721	590	537	222	574	1,694	4,338
GWHE	0	28	63	63	88	156	398
Abundance	75,222	83,531	75,076	66,834	64,548	74,808	440,019

Table 2. Estimated abundance of wading birds (all species combined) for the different drainage basins in the Everglades National Park, Dec 2004 – May 2005.

Month	SBC	BCME	SS	NESS	ES	SSME	NTS	LPK/STS	EP	CS	LPK/STS M	EPME	Total
4-Dec	7,804	4,284	3,469	1,120	2,879	10,213	462	2,720	4,025	13,717	2,128	684	53,505
5-Jan	3,660	6,340	15,340	1,843	15,411	19,394	338	2,746	1,316	5,886	3,873	2,660	78,807
5-Feb	8,219	11,739	21,753	3,310	13,178	8,336	1,483	3,734	801	3,194	3,903	1,073	80,723
5-Mar	7,340	5,214	26,246	7,474	7,716	19,145	91	2,503	1,152	1,971	2,814	1,070	82,736
5-Apr	1,236	991	12,345	1,732	2,132	3,014	14	1,662	797	1,846	3,301	243	29,313
5-May	1,305	2,553	19,546	1,794	2,737	793	0	1,766	163	1,438	2,906	87	35,088
Total	**29,564**	**31,121**	**98,699**	**17,273**	**44,053**	**60,895**	**2,388**	**15,131**	**8,254**	**28,052**	**18,925**	**5,817**	**360,172**

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

the larger number of birds followed by SSME. SS continues with this increasingly trend from March until the end of the season, followed by ES.

Considerable changes in hydro-patterns and birds distribution were observed throughout the season as shown in Figure 4. The greatest changes in the area covered by the different hydro patterns took place at the extreme categories. From December to May, the original extend of the area covered by WW was reduced from 45% to only 12% (1,596 Km²) by the end of the season, while DD area experienced an increase from 3% to 33% (1,452 Km²). Despite the magnitude of these changes, they occurred gradually from month to month. Intermediate categories such as WT and WD showed moderated changes, with a change from 35% to 22% (632Km²) decrease and from 6% to 17% (576 Km²) increase respectively. Finally, fairly small fluctuations occurred in the middle category, DT.

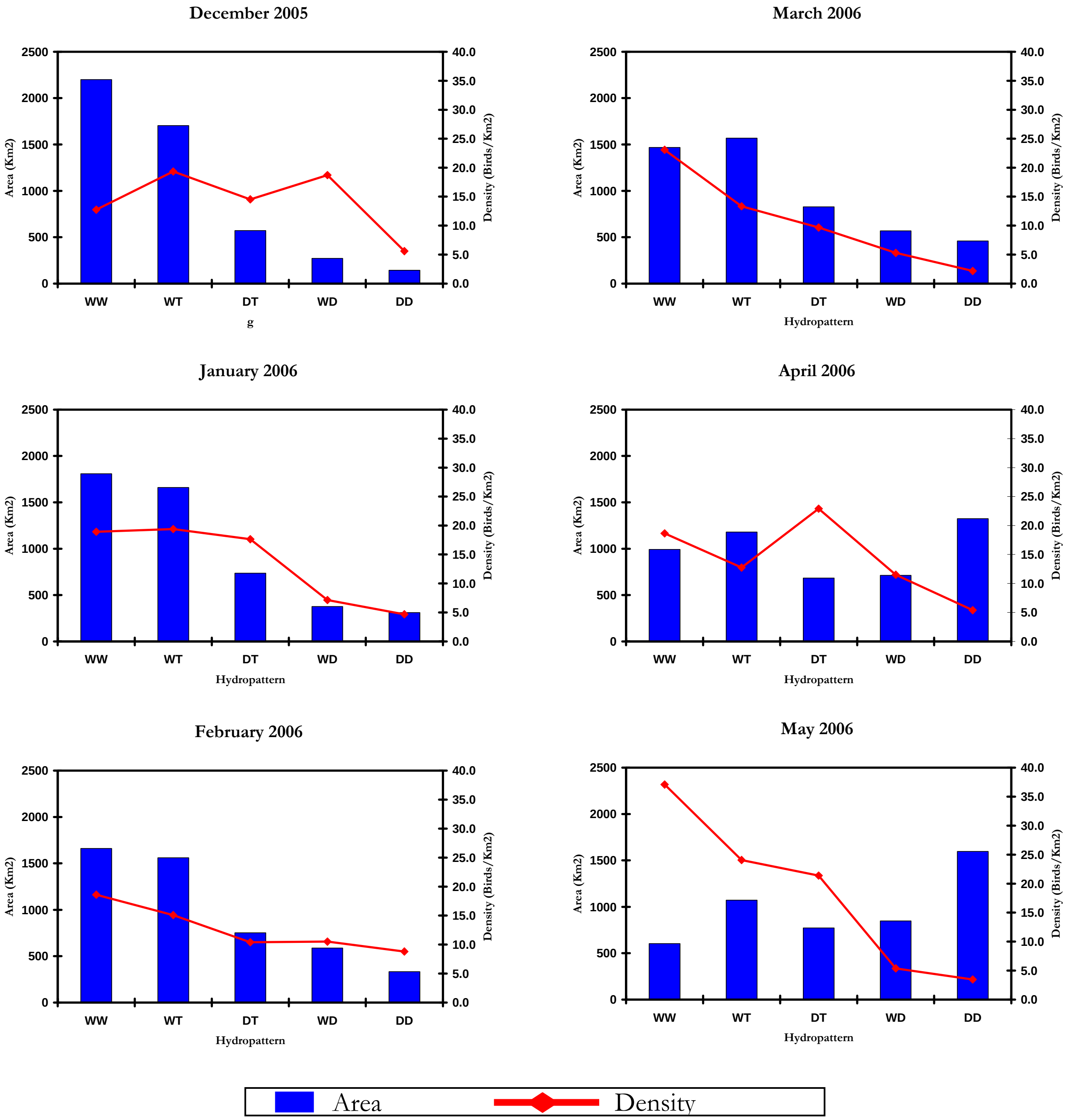

Figure 4. The areal extent and density of wading birds (all species pooled) in each surface water category. WW = continuous surface water; WT = mostly wet with scattered dry areas; DT = mostly dry with small scattered pools of water; WD = dry with water only in solution holes; DD = dry surface.

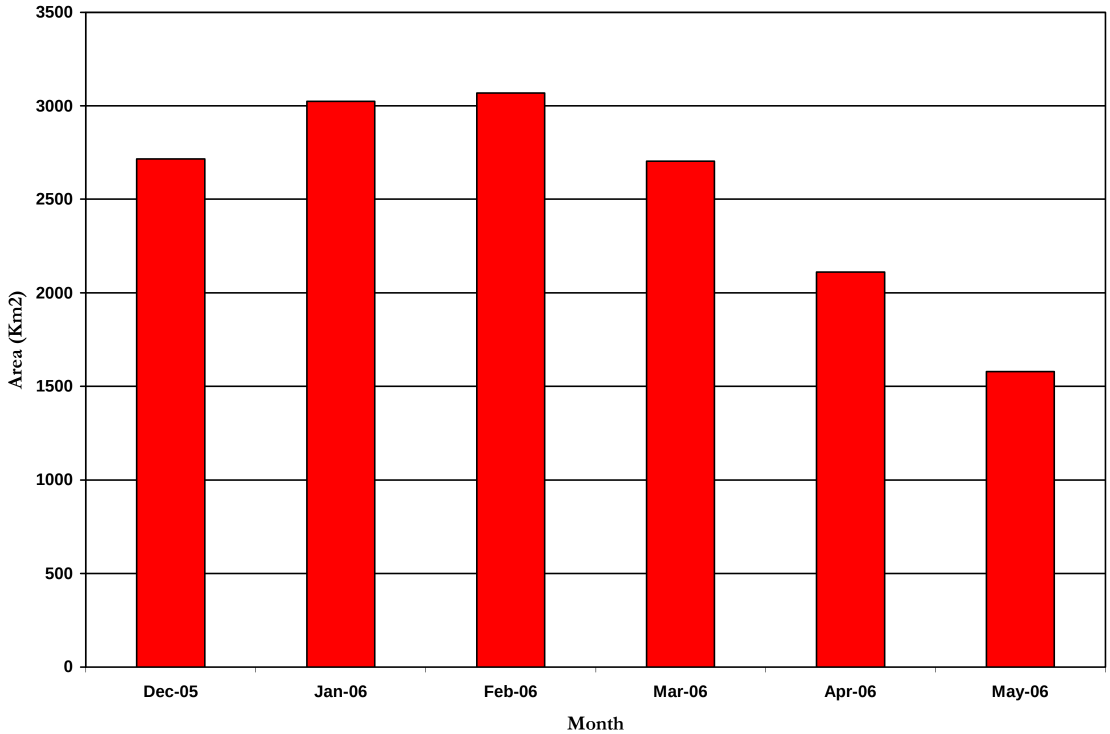

Figure 5. Monthly changes in wading bird areal utilization in the Everglades National Park from Dec-2005 to May-2006

During the month of December, the highest densities of birds were observed mainly in the WT and WD categories respectively. By January, as water receded, some of the birds began foraging in WW areas; making this hydro-pattern as well as WT and WD contain the highest densities of birds. As water depth continued to decrease during the following months, densities at the WW, WT and DT continued increasing. Despite that WW area was covered completely by water, overall low water levels made these new territories accessible to foraging birds.

Birds were found foraging in 56% of the study area during the month of December (see Figure 5). By January the birds were more widely distributed, occupying 62% of the total available area; reaching a peak in February with 63% of the area. After February, the area utilized by birds started declining from March with 55% to May were all the birds were concentrated in only 32% of the total surveyed area.

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WADING BIRD SURVEYS FOR WATER CONSERVATION AREAS, BIG CYPRESS NATIONAL PRESERVE, AND HOLEY LAND WMA

Methods
Wading bird surveys 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 2005. Wading birds were identified to species when possible, enumerated, their locations recorded, their data entered into a database, and summarized into tables. Densities of each species were separated into 4-km^2 cells and plotted onto maps. Data were recorded using HP720 palm top computers linked to GPS. The data were downloaded into a computer spreadsheet, edited for errors, and compiled using a program written in Dephi programing language.

Results
In the Water Conservation Areas, monthly wading birds abundance was higher during 2005 than 2006 from February to March. It should be noted that the wading bird abundances in May 2006, June 2006 and July 2006 were much greater than the respective months in 2005. The higher 2006 wading bird abundances during these months is likely due to the "pooling" of water thus concentrating prey species and the presence of greater number of nesting of birds then observed during these months in previous years. During 2006 in the Water Conservation Areas, the wading bird monthly relative abundance generally increased from February to March, decreased in April, increased to a high in May then decreased in June in July. In the Big Cypress National Preserve, monthly wading bird abundance was generally higher in 2006 than 2005 for the months of February, March and April but abundance was generally lower in 2006 than 2005 for the months of May, June and July. In the Big Cypress National Preserve, monthly wading bird abundance peaked in February 2006 then declined until June 2006 then increased with the increase in rain in July 2006. In the Holey Land Wildlife Management Area, wading bird monthly relative abundance remained low for much of the survey period. Final reports from 1996 to 2005 are currently available.

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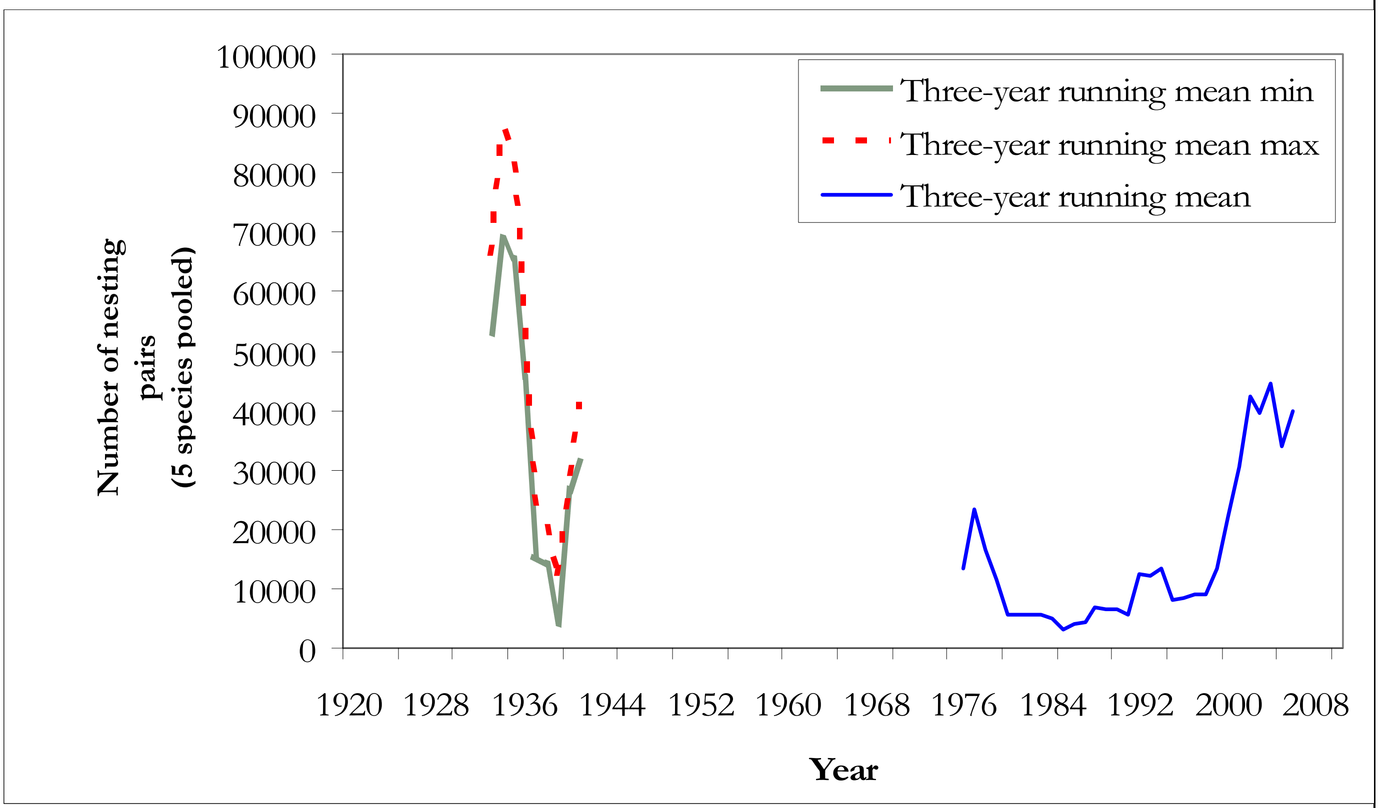
STATUS OF WADING BIRD RECOVERY – 2006

Annually since 1996 the South Florida Wading Bird Report has included a summarization of nesting patterns for five species of wading birds in the Everglades, for the set of parameters that are being used by the multi-agency RECOVER team to measure wading bird responses to the Comprehensive Everglades Restoration Plan (CERP). These annual summaries thus far are valuable for characterizing pre-CERP nesting patterns. The five species are, Great Egret, Snowy Egret, Tricolored Heron, White Ibis and Wood Stork. The key parameters are, number of nesting pairs, location of nesting colonies, timing of nesting (storks), and occurrence and frequency of "super colonies." The reporting area has been the true Everglades and downstream mainland estuaries in Water Conservation Areas 1 -3 and Everglades National Park. Please see earlier volumes of the SFWBR for additional details on the restoration objectives for these five species, and the methods used to survey and report the key parameters of nesting patterns.

Results
Numbers of Pairs: The most consistent parameter reported each year has been estimates of number of nesting pairs for each of the five species (with the exception of the dark plumaged Tricolored Heron, which is difficult to detect from aerial surveys). In 2006, the species totals for the four white species were 10,150 nesting pairs of Great Egrets, 10,040 pairs of Snowy Egrets, 24,180 pairs of White Ibis, and 1,315 pairs of Wood Storks, for a four-species total of 45,685 nesting pairs. These numbers show an increase from 2005 when high water conditions substantially disrupted nesting throughout the region. The 2006 numbers are more similar to those recorded in several years immediately prior to 2005. The exception is the Snowy Egret, which showed a fascinating spurt in nesting effort in 2006 similar to what occurred in 2002 (10,000 pairs in 2006 compared to 15,000 in 2002; the next highest numbers were 5,000+ pairs in both 2001 and 2004). The table included in this 2006 report adds the most recent 3-year running average of estimated nesting pairs (2004 – 2006 data).
Colony Locations: For the first time since 1996, the percentage of wading birds nesting in the mainland estuaries in southern Everglades National Park was over 10 percent of the Everglades total; in 2006 it was approximately 16.7 percent. The increase in the southern estuaries was impressive in that it occurred at multiple colony sites and among three key species: Snowy Egrets, White Ibis and Wood Storks. Eight colony sites in the southern estuaries were active this year, including at least five sites that were historically important "rookeries": Broad River headwaters, Rookery Branch, Otter Creek, East River, and Cuthbert Lake. The return of nesting birds to several of these sites was first detected in 2004, but numbers of nesting birds substantially increased in 2006.
Timing of Stork Nesting: Storks have initiated nesting relatively late (January – February) over the past decade, and nesting in 2006 followed a similar pattern. While the survey reports do not provide specific dates for colony formations, personal communications with stork researchers suggest that no colonies were initiated before February.

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	2003 -05	2004 -06
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	7,829	8,296
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	4,085	6,410
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	20,993	24,926
WOST	175	255	276	276	294	250	277	130	343	283	228	279	863	1,538	1,868	1,596	1,191	742	800



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

Discussion

The U.S. Fish and Wildlife Service has set somewhat different recovery goals for Wood Storks in south Florida than has been set by RECOVER for CERP. The FWS goals are for a running average of 2,500 nesting pairs per year and a nest production that averages at least 1.5 young per active nest (including the Everglades and Big Cypress and Corkscrew Swamp colonies). Newly initiated (or about to be) actions by both the FWS and RECOVER to review the status of the stork, and to review CERP performance measures, respectively, provide an opportunity to bring consistency to Wood Stork recovery and restoration goals in south Florida. The FWS will initiate a formal status review for the stork in the Fall of 2006, a process that requires about one year. Preliminary reports from stork colony surveys in the four states where storks are known to nest (including GA, SC and NC) show close to 11,000 nesting pairs in 81 colonies in 2006. Both the number of pairs and number of colonies are all time highs since coordinated multi-state surveys began in the early 1980s.

When increases in numbers of nesting pairs of wading birds in the Everglades basin were detected during the 1990s (see accompanying table of running averages), a question was raised as to whether the higher numbers of nesting birds would be sustained. With each passing year, it appears the answer is "yes". In general, the running averages suggest that Great Egrets began to increase in the early 1990s, White Ibis in the late 1990s, and Snowy Egrets/Tricolored Herons and Wood Storks around 1999/2000. As we add more years to the record, it also appears that after a period of substantial increase, the numbers of nesting pairs have leveled since about 2001 - 2002. Looking at the running averages table, it appears that for these five species in the WCAs and mainland ENP the numbers ranged from approximately 6,000 to 12,000 nesting pairs during the late 1980s-early 1990s, and from 34,000 to 43,000 pairs since about 2000. Understanding why this pattern of nesting has occurred may provide essential insights to the RECOVER team that will be issuing annual assessment reports on conditions in the greater Everglades, in the context of the goals of CERP. At this point the reasons for the changes in nesting numbers are not obvious, although a closer review of water management operational decisions in the WCAs may provide clues.

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SPECIAL TOPICS

COASTAL WATERBIRDS AND HURRICANE WILMA

This Class III hurricane was the first major tropical cyclone to hit the Southwest Coast of Florida since Donna in 1960. Having sat out these two severe storms in Naples, I can honestly say that they were quite different but both created considerable damage to structures and vegetation. In this document I do not intend to comment about the affects of Wilma on the area other than to address what has or has not happened to the coastal waterbirds that we (my wife Ginnie and I) have studied for the last 32 years. After an event like this several questions about birds are common: What happens to the birds, were birds forewarned and able to adjust and how the birds deal with the storm? The following tries to address these questions.

Having such a large database for coastal waterbirds taken over a long period of time, allows for an in-depth analysis of specific events not only both before and after but also comparison to normal conditions to determine how and if the birds were affected. Unlike the birds, humans had advance warning of the hurricane and therefore we were able to census several areas before and after, to try and determine the immediate results. Even with such disruption to the coast, regular field work was conducted and a number of additional censuses of Sand Dollar Spit and Naples Beach were added. A number of colony/roosts (Rookery Bay, ABC Islands, Henry Key) were examined to determine the amount of damage and bird mortality. The coast was also inspected and photographed from Gordon Pass to Lostmans River (85 km., 53 miles) both by boat and small airplane. The following comments are derived from the above.

The most pronounced effect observed was the destruction to the coastal vegetation especially mangroves. Much of the mangrove has turned brown, many of the small islands have suffered extensive damage with both uprooted trees and a lot of broken braches that made the bird islands almost impenetrable. It was possible to work through the colony/roosts and look for dead birds and this is where most of the initial effects of Wilma on coastal birds were noted. In all 418 dead birds were recorded; ABC Islands 99, Henry Key 95, Sand Dollar Spit 18.

Note: In an article in the Palm Beach Post 10/29/05 a local resident of Chokoloskee was quoted as saying that thousands of dead birds were observed along miles of the Chokoloskee Causeway. This prompted my wife and I to survey the 1.5 miles of causeway, we recorded 206 birds not thousands; *this shows what is often a problem between trained and untrained observers*.

All but two of the birds recorded in the colony/roosts and along the causeway were waders (herons, egrets and ibis) almost all were killed by either being blown into or being crushed by vegetation (10 just off the causeway appeared to have been killed by cars, most likely dazed and staggering around on the road). There was no oblivious cause of death for the Sand Dollar birds but this is a lot for one census (the average is three).

The censuses before and after the storm at both Sand Dollar and Naples Beach actually showed a small increase in the coastal waterbirds using the sites. A good but small example; Piping Plovers at Sand Dollar before Wilma 21 were recorded; two days after 30 were recorded; on both of these censuses the same color-banded individual was observed indicating that this bird made it. Conversely the regular censuses right after the hurricane at the colony/roosts showed a slight decline in the waders coming in at sundown. In a way this is surprising as these patterns are what occur in a normal year and apparently the storm did not immediately alter normal seasonal trends. In October-November many winter residents are arriving into the area, this did not change which was demonstrated on the beaches and sandbars; thus the increase in some of the birds (shorebirds, gulls and terns). The waders using the colony/roosts peak in late August and then slowly decline until the next year; this accounts for the slight continuing down turn.

To answer the three questions from the first paragraph (noting that the answers apply to this storm and the immediate effects):

1. The above relates what apparently happened to the coastal waterbirds at least in the near term. That less than one percent of the birds in the area were killed and comparison to the long term data has not shown any effects on their numbers; it appears that hurricane Wilma had little effect on the overall population of coastal waterbirds. It should be noted that although we recorded 418 dead birds most likely many more also died but were not found.
2. All of the evidence indicates that, at least coastal waterbirds have no idea that a hurricane (or bad weather) is coming. Often before approaching storm, birds can be observed going about their normal actives as they were for Wilma.
3. There is some information as to what birds do in really bad weather, but not a lot. One example; there are some reports that right after the peak of a hurricane, small land birds appear at feeders. At our house we have a feeder in-between the house and a dense Fishtail Palm, during the storm sparrows, Cardinals and Blue Jays sheltered in the palm and were out on the feeder before Wilma's winds dropped to 40 mph. and the doves were feeding on the ground at the same time. It is safe to assume that the majority of land birds take shelter in heavy vegetation of some sort. For beach and sandbar birds there is little direct evidence but very few dead ones were found; it would be logical to suppose that they find cover in the lee of something nearby (debris, plants, small depressions in the sand, sand dunes etc.) unfortunately one cannot be out there to document it. Walking through the colony/roost islands told the story; the waders had gone to roost at sundown as usual. Wilma hit in the early morning before first light catching the birds roosting; trees up-rooted, branches broke and a few of the birds were caught in the falling wreckage and killed. This is what was found both north and south of Marco Island. The species most affected were White Ibis (55% of the dead birds at the ABC islands) then Great Egrets (26% same location); it is easy to understand why the ibis as they are the most numerous species that roost at night throughout the year and for October are 73% of the total birds. But why were there so many Great Egrets when this bird is only 2% of the total birds spending the night in October?

The questions go on and on and on, for instance: There were (and are) many more Brown Pelicans in the area than usual for October; only two dead pelicans were recorded (Chokoloskee Causeway) how in the world did they manage? In the weeks following the storm large numbers of Great and Snowy Egrets (the most ever for November in 27 years) have been counted coming in at sundown at Rookery Bay, what is going on?

Wilma has shed some light on coastal waterbirds and hurricanes but like most things in the natural world, more questions are generated than answers.

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SEASONAL WADING BIRD PREY CONCENTRATIONS IN THE EVERGLADES

The belief that hydrology, prey populations, and wading bird populations are linked is one of the primary hypotheses underlying Everglades restoration. The aquatic fauna concentration project monitors prey concentrations throughout the Everglades during the dry season and attempts to provide a quantitative link between wading bird nesting and prey availability within the landscape. This section provides a comparison of prey data that were collected during the dry seasons of 2005 and 2006, two years with disparate hydrological cycles and large differences in the numbers of successful wading bird nests.

We sampled during the dry seasons from January until May using a multi-stage sampling design (Cochran 1977) to define our sampling space. See the 2004 South Florida Wading Bird Report for details on sampling. We arrived at our sampling locations via helicopter and then used a 1 m^2 throw trap to sample aquatic fauna (Kushlan 1974). We took 1 or 2 throw trap samples, depending on the size of the site. We compared prey densities between random sites and sites where large foraging flocks (> 30 birds) of mixed species wading birds were seen feeding.

Results and Discussion

In 2005, we collected 95 throw-trap samples at 69 random sites and 53 throw-trap samples at 27 foraging sites. Random samples were distributed across 12 landscape units and foraging samples were distributed across 8 landscape units (Fig. 1). In 2006, we collected 90 throw-trap samples at 59 random sites and 26 throw-trap samples at 13 foraging sites. Random samples were distributed across 7 landscape units and foraging samples were distributed across 6 landscape units (Fig. 1). We captured 47 and 41 species of aquatic fauna in 2005 and 2006 respectively. In both years, 6 species accounted for over 90% of all individuals captured. In descending order of frequency, these were mosquito fish (*Gambusia holbrooki)*, grass shrimp (*Palaemonetes paludosus*), flag fish (*Jordanella floridae*), crayfish (*Procambarus spp.)*, least killifish (*Heterandria formosa*), and bluefin killifish (*Lucania goodei*). These 6 most common species were similar to the dominant species sampled when water levels were higher (Trexler et al. 2002).

Hydrologic conditions and wading bird nesting success differed considerably between 2005 and 2006. Water levels at the start of the 2005 dry season experienced a steady and rapid drying rate through the end of February, which likely triggered the initiation of nesting by wading birds. Several rainfall events in early March resulted in the reversal of the seasonal water recession (Fig. 3) and produced widespread nest failure by most wading bird species (Cook and Call 2005). Hydrologic conditions in the 2006 dry season were close to optimal for wading bird nesting as suggested by Gawlik (2002). Water levels were well above average at the start of the dry season, unimpeded by major reversals, and receded steadily throughout the season. Furthermore, the late onset of the wet season in 2006 continued to provide ample foraging patches for fledging birds late in the season.

The striking negative effect of a water level reversal on prey concentrations was seen during a two-day sampling event in May 2006. On 15 May 2006, we sampled an area in WCA-2A that was ideal for wading bird foraging due to low water levels that had concentrated prey in small microtopographic depressions. Prey density in a single random throw-trap sample was 939 prey/m^2. Later that day, water levels in WCA-2A rose by 14.6 cm following a rain event. The next day we returned to an adjacent slough, and found that prey density had declined to 89 prey/m^2. The flooding of the sloughs allowed prey to disperse from isolated holes and resulted in a 10-fold decrease in prey density (Fig.4). There could be no better illustration of the challenge facing wading birds foraging in a wetland with increasing water levels.

The hydrological and wading bird nesting differences between these two years corresponded with differences in prey concentrations. Averaged across the entire landscape, prey density and biomass at random sites tended to be higher in 2006 than in 2005 (Table 1, Fig. 2). We may have detected a difference in prey densities between foraging and random sites that is intriguing, although inferences are tentative because we only have two years to compare. Mean prey density was higher at foraging sites than at random sites in 2005, but 95% confidence intervals overlapped slightly, suggesting that differences were not consistantly great. Nevertheless, mean prey densities at foraging and random sites seemed to be more similar in 2006 than in 2005. We speculate that the foraging sites birds used in 2005 were atypical and probably uncommon compared to characteristics of the average sites available in the landscape. In 2006, the birds were using sites that were similar to the average conditions produced in the landscape.

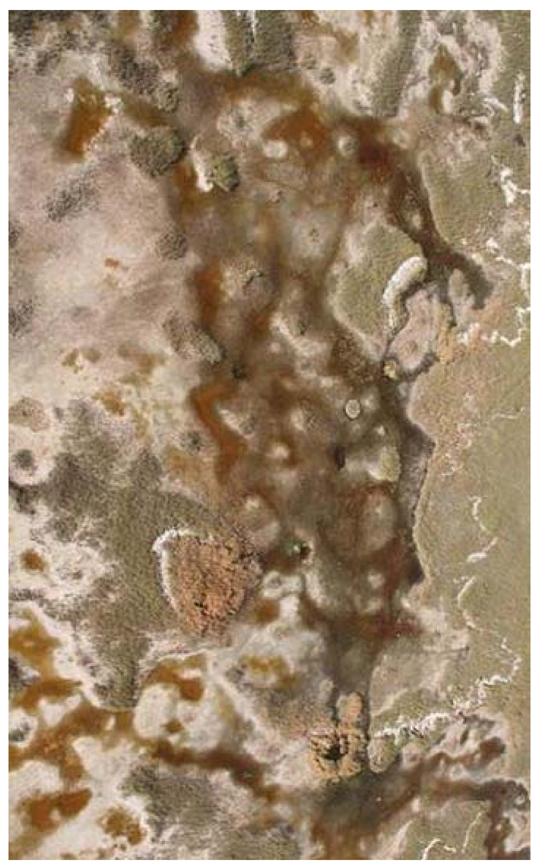

Table 1. Mean prey density, mean biomass, and the mean number of large prey found within 1 m² throw traps for random and foraging sites throughout the Florida Everglades in the dry seasons of 2005 and 2006. Standard error is listed as ± the mean.

Sample Type	Mean Prey Density (range)		Mean Prey Biomass		Mean Prey Denstiy (≥2 cm)	
	2005	**2006**	**2005**	**2006**	**2005**	**2006**
Random	81 ± 14 (0 - 798)	142 ± 36 (1 - 3198)	32 ± 5	48 ± 12	58 ± 12	106 ± 32
Forage	184 ± 98 (1 - 4124)	126 ± 34 (4 - 832)	25 ± 12	31 ± 8	107± 58	68 ± 12

Until estimates of prey densities are available during the wet season, it will not be known whether the higher mean prey density in 2006 was a result of more prey produced during the wet season or a particular pattern of drydown in the landscape. One hypothesis about fish communities in the Everglades is that large aquatic prey populations are produced by high water levels with infrequent dry-downs (Loftus and Eklund 1994). This is a result of fish having more inundated marsh area which provides additional three dimensional space for growth and reproduction. The early onset of rising water levels in March of 2005 did produce a longer than usual period of rising water, about 8 months instead of 6, in which fish could grow and become subject to the 2006 dry down (Fig. 3). In contrast, in 2004, water levels did not begin to rise until mid June and began declining in mid October, producing increasing or stable water levels for only about 4 months (Fig. 3). However, the differences in the drydown pattern between the two years allowed for differences in the way that prey became concentrated, which may have also contributed to higher prey densities in 2006.

One pattern that was consistent between 2005 and 2006 was that we captured a higher proportion of large prey (> 2cm) than small prey (Table 1, Fig. 2). This pattern is different from what is typically seen during the wet season when small fish are more abundant (Loftus and Eklund 1994, Trexler et al. 2002). Wood Storks are known to select foraging sites with large fish (Ogden et al. 1976) and fish size may be a limiting factor in a wetland comprised of so many small fish. Therefore, the seasonal water recession in the Everglades may be a mechanism that not only produces high concentrations of prey, but also produces a high proportion of larger fishes, which are preferred by wading birds.

We offer three hypotheses to explain the high proportion of large fish (> 2 cm) in our samples. First, it is possible that aquatic predators are eating the small fishes and thus increasing the proportion of large fishes in samples. We noted that the density of small prey in our samples were still high relative to wet season fish samples, but that does not exclude the possibility that a large proportion of the small prey had been removed prior to our sampling. A second hypothesis is that we are sampling dry season refuges, which are responsible for fish at those sites surviving longer and getting larger. In other words, we are selectively sampling large fish habitat. The third hypothesis is that large fish are better able than small fish to disperse from drying marshes into deeper refuges as the drying season progresses. Identifying prey concentration patterns throughout the landscape is a critical component to monitor from the perspective of wading bird habitat suitability and is an important first step in the generation and investigation of new hypotheses. Additional sampling will allow for refinement of hypotheses and for focusing other intensive ecological studies on these new questions.

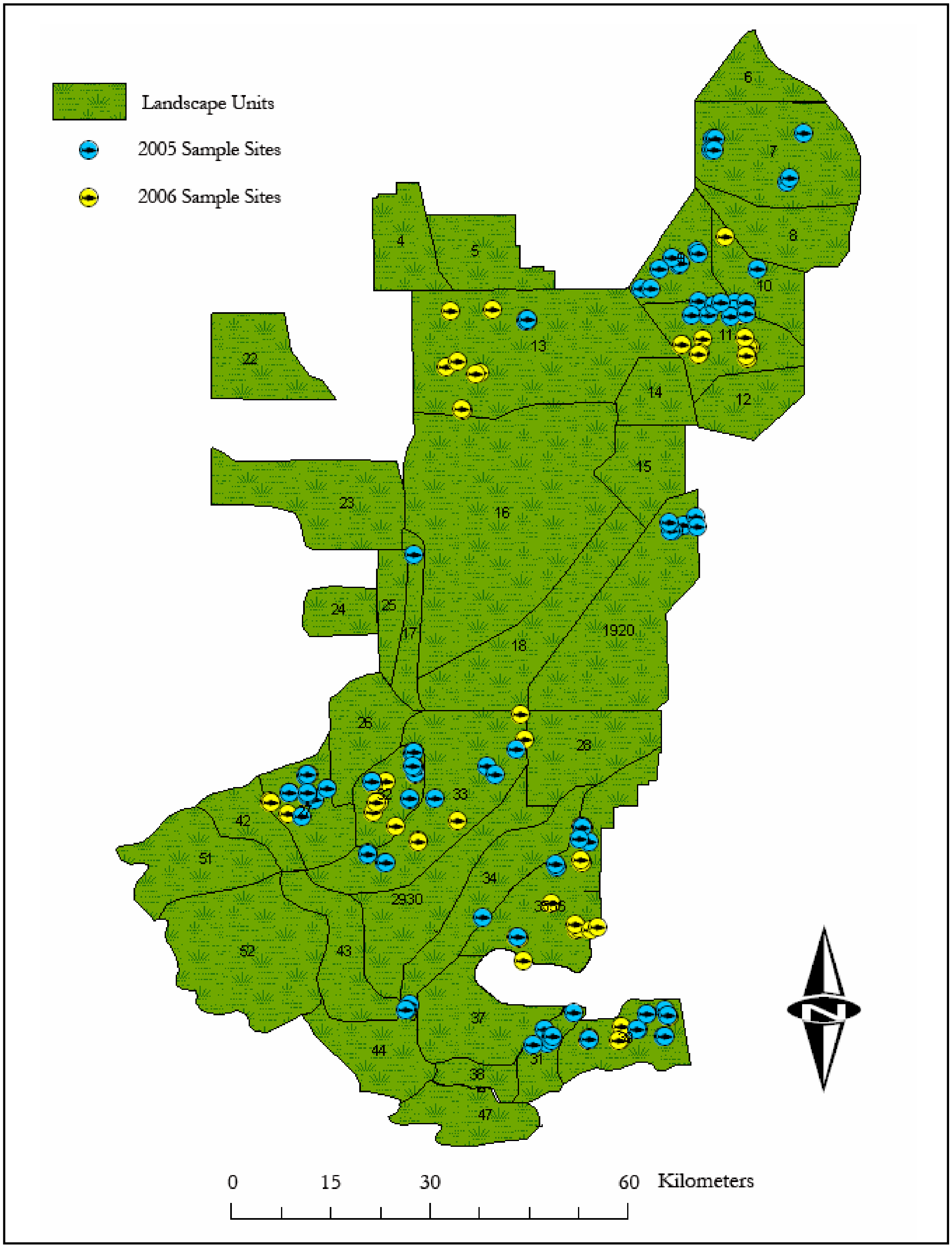

Figure 1. Map of landscape units and sites sampled during the 2005 and 2006 dry seasons.

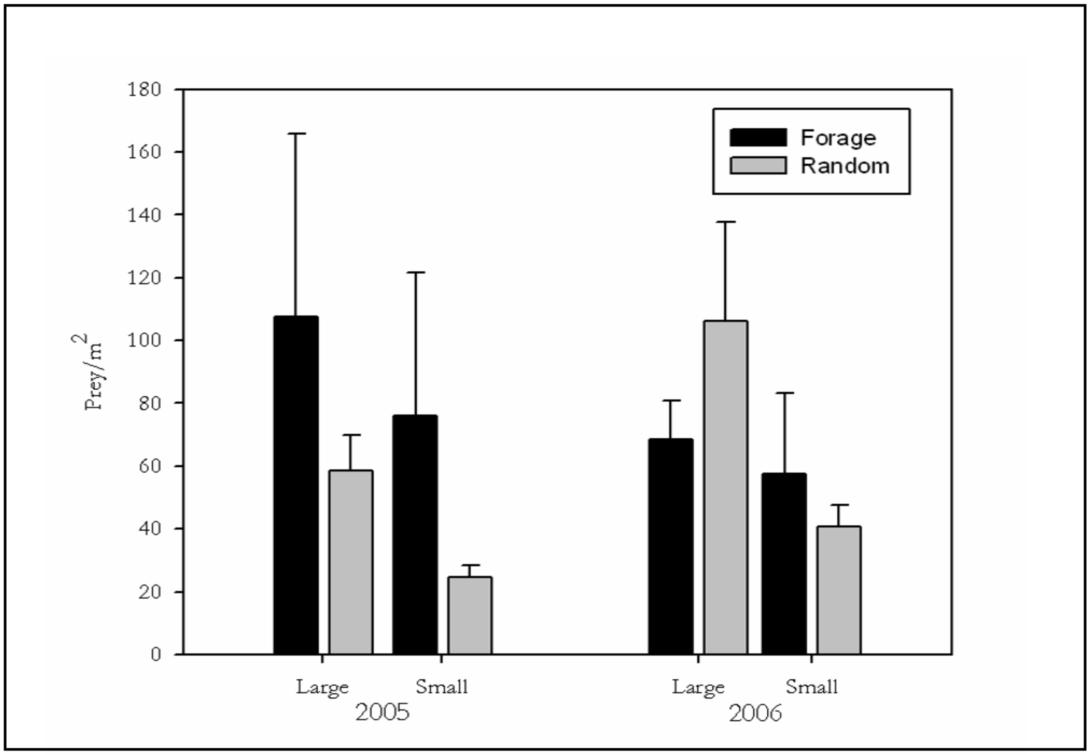

Figure 2. Mean density of all prey items in 1-m² throw traps at random sites and wading bird foraging sites throughout the Florida everglades in the dry seasons of 2005 and 2006. Error bars are + 1 SE.

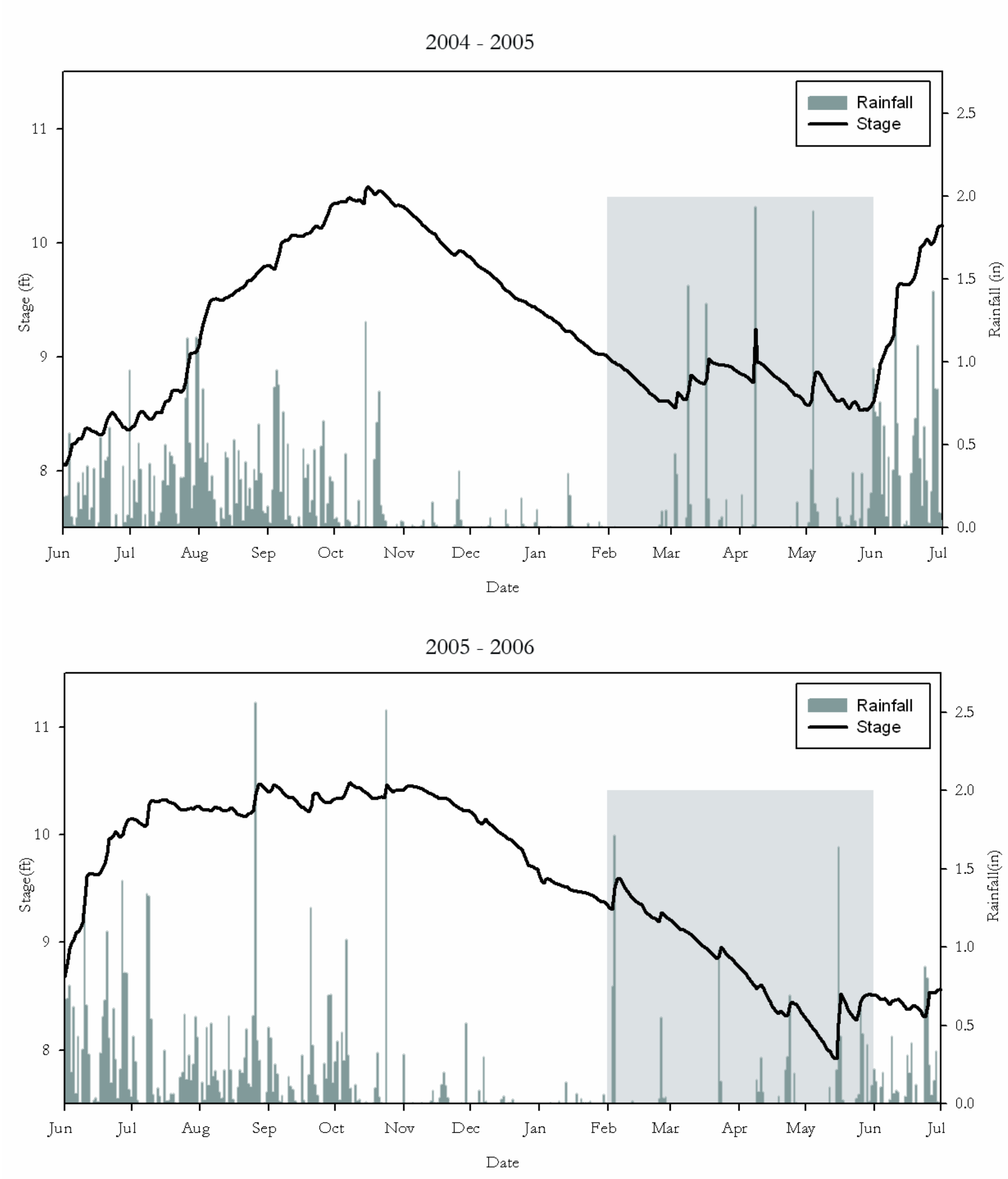

Figure 3. Mean rainfall and stage level throughout the Florida Everglades from June 2004 to July 2005 and from June 2005 to July 2006. Stage values represent the mean of 8 gauges. Rainfall is reported as the mean of 6 gauges. Stage values were taken from gauges 1-9, 2-17, 3ANE, 3AS, 3AS3W1, NESRS4, NESRS1, RUTZKE and BCA20. Rainfall values were from gauges WCA1ME, 3ANE, 3AS, 3AS3W3, HOMES.FS, BCA20. Shaded areas represent approximate wading bird nesting season.

Figure 4. Two photos of adjacent sloughs in WCA-2A taken in a 24 hour period. The left photo represents suitable wading bird foraging habitat on 15 May 2006 and shows a small refuge with less than 33% of the slough covered with water. Mean prey density was 939 prey/m^2. The right photo, taken on 16 May 2006 shows a slough inundated with water after 2.2 cm of rainfall. Mean prey density was 89 prey/m^2.

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THE DISPERSAL RESPONSE OF CRAYFISH TO WATER RECESSION: IMPLICATIONS FOR WADING BIRD PREY AVAILABILITY

Prey availability has long been considered an important causal factor in structuring animal communities, and has significant implications for the conservation and management of threatened predator populations (e.g., Hutchinson 1959). It is considered a key factor limiting the distribution and nesting success of wading birds, and may be particularly relevant in the oligotrophic Everglades ecosystem (Hoffman *et al.* 1994). However, the mechanisms governing prey availability have received only modest empirical scrutiny and are poorly understood for most wading bird species.

Availability of prey depends not only on the absolute number and density of prey present in a habitat, but also on the localized distribution of the prey and it's vulnerability to predation. Prey distribution and vulnerability, in turn, are a function of dynamic interactions between environment, predator and prey (Heck and Crowder 1991). A first step in elucidating the linkages between ecosystem processes and wading bird populations is to quantify the environmental and biological mechanisms that affect the distributions of aquatic fauna and to determine how those distributions subsequently influence their vulnerability to foraging wading birds.

In the hydrologically fluctuating Everglades, patterns of habitat use by aquatic fauna are controlled by local processes such as differences in the risk of predation and food availability. When water is sufficiently deep, aquatic animals tend to inhabit structurally complex, relatively high elevation habitats, such as densely vegetated sawgrass ridges where predatory fish and wading birds cannot forage efficiently and food levels are relatively high. However, as water levels seasonally decline many aquatic prey species are physiologically constrained to follow the receding water and move from the protection of the ridges to the less vegetated, lower elevation wet prairies and sloughs. Here, as water levels continue to drop, prey become increasingly concentrated in drying, shallow depressions. Wading bird foraging is constrained by an upper threshold water depth (approximately 20 cm) and becomes increasingly efficient as water depth and vegetation density decline. Thus, as water level drops, prey density and vulnerability increase and prey become progressively more available to wading birds. Anthropogenic changes to natural hydrologic patterns in the Everglades are believed to have reduced the frequency, magnitude and distribution of these concentration events, which in turn has caused the dramatic decline in the number of breeding wading birds (e.g., Frederick and Spalding 1994).

Research on the availability of wading bird prey in the Everglades has focused largely on fish as a prey source, yet another essential prey component are the crayfish. Crayfish are ubiquitous in the system, can reach high densities and are a critical food source for a number of wading bird species, particularly the white ibis. Because crayfish can breathe air, disperse within a terrestrial environment and burrow or hide in damp vegetation in response to drought, the process by which they respond to declining water levels and how they become available to wading birds may be markedly different from that of fish prey. Understanding how crayfish respond to seasonal changes in hydrology is therefore essential for the successful restoration of Everglades wading bird populations. Here we present preliminary results of an experiment designed to examine how crayfish become available to wading birds by measuring their dispersal within the ridge and slough landscape in response to declining water levels.

Methods

The experiment was conducted at the Loxahatchee Impoundment Landscape Assessment (LILA) research facility situated in the Arthur R. Marshall Loxahatchee Wildlife Refuge. LILA consists of four identical 400 x 200 m macrocosms containing key landscape features of the Everglades (ridges, sloughs, tree islands, and alligator holes) and a naturalized population of the slough crayfish (*Procambarus fallax*). We examined the distribution and dispersal of this crayfish species across the ridge and slough landscape in response to three successively declining water levels (depth 1: water 50 cm above the ridge; depth 2: water 5 cm above the ridge and; depth 3: water off the ridge and 5 cm above the slough (Fig. 1)) in two randomly selected macrocosms. In a transect across the ridge and slough, we placed a group of four baited minnow-traps each on the narrow ridge, in the slough or alligator hole, and on the wide ridge, and repeated this set-up for a total of ten transects spaced approximately 30 m apart within each macrocosm (Fig.1).

Water levels were lowered slowly over a period of several days to reach each target water depth and each depth was attained at least one day prior to setting traps. We checked traps after 24 h and examined crayfish dispersal response in terms of the relative change in density within a habitat and the recapture of marked individuals between habitats. We repeated this set-up in the two remaining macrocosms, but kept water levels constant at 50 cm above the ridge to control for any crayfish movements unrelated to water depth.

We used two-way ANOVA with Tukey post-hoc tests to examine change in crayfish relative abundance in each habitat relative to treatment and water depth, and chi-square to examine movement of 170 marked individuals between ridge and slough habitats from depths 1 to 3. The null hypothesis was that crayfish in each habitat remain in situ in response to declining water levels.

Preliminary Results

Water level had a considerable influence on the distribution of crayfish across the ridge and slough landscape (see Fig. 2, Table 1). When water levels were high across the ridge and slough landscape (depth 1), crayfish were distributed among all habitats but relative abundance tended to be highest on the ridges and lowest in the sloughs/gator holes. As water levels declined to depth 2 (5 cm above the ridges) crayfish abundance on the ridges slightly increased, and then significantly decreased when the ridges became dry (depth 3). In the sloughs, initial crayfish abundances were low and changed little while water remained above the ridges (depth 1 and 2) but increased considerably once the ridges dried (depth 3). A similar increase was evident in the alligator holes once water levels declined to 5 cm in the sloughs (depth 2 to depth 3). Thus a decrease in crayfish on the ridges was reflected by an increase in the sloughs, suggesting that crayfish followed the water as it dried on the ridges. By contrast, no change in relative abundance was evident within habitats in control macrocosms where water levels remained constant at 50 cm above the ridges.

Mark-recapture data reveal a similar dispersal pattern. At depth 1, all crayfish in the experimental treatment (n =170) were uniquely marked according to habitat type, and the distribution pattern (ridges: n = 145 crayfish; sloughs: n = 25 crayfish) reflects the preference by crayfish for ridge habitat at this water depth. No change in distribution was evident at depth 2 but by depth 3 the distribution pattern of crayfish had significantly changed: only one crayfish was re-caught on a ridge whereas 10 were re-caught in the sloughs (χ^2 = 51.5, d.f. = 1, p < 0.001). This pattern strongly suggests that crayfish tend to move from the ridges to the sloughs during the drydown.

These preliminary analyses suggest that crayfish respond to the seasonal drawdown by remaining on the densely vegetated ridges and potentially safe from avian predators until water levels become extremely low (i.e., below 5 cm). As water levels continue to decline, crayfish move into the less vegetated sloughs where they subsequently become more available to foraging wading birds. Analyses are ongoing.

Table 1. ANOVA table summarizing the effects of water depth (depths 1-3) and treatment (experiment and control macrocosm) on the mean number of crayfish caught in each habitat.

Habitat	Source	d.f.	MS	F	P-value
Gator hole	water depth	2	76.38	5.83	0.011
	treatment	1	104.17	7.95	0.011
	water depth*treatment	2	75.76	5.78	0.012
	error	18	13.1		
Slough	water depth	2	165.75	48.84	<0.001
	treatment	1	259.78	76.55	<0.001
	water depth*treatment	2	166.88	49.17	<0.001
	error	90	3.39		
Narrow Ridge	water depth	2	2.33	2.35	0.100
	treatment	1	8.54	8.61	0.004
	water depth*treatment	2	3.33	3.36	0.038
	error	113	0.99		
Wide Ridge	water depth	2	8.44	7.41	0.001
	treatment	1	19.78	17.36	<0.001
	water depth*treatment	2	12.94	11.36	<0.001
	error	114	1.14		

Figure 1. Diagram of the experimental set-up at LILA. Panel A: Section of a macrocosm showing trap transects across ridges, sloughs and gator holes. Panel B: Cross section of a ridge and slough transect showing the relative depth of treatments 1-3.

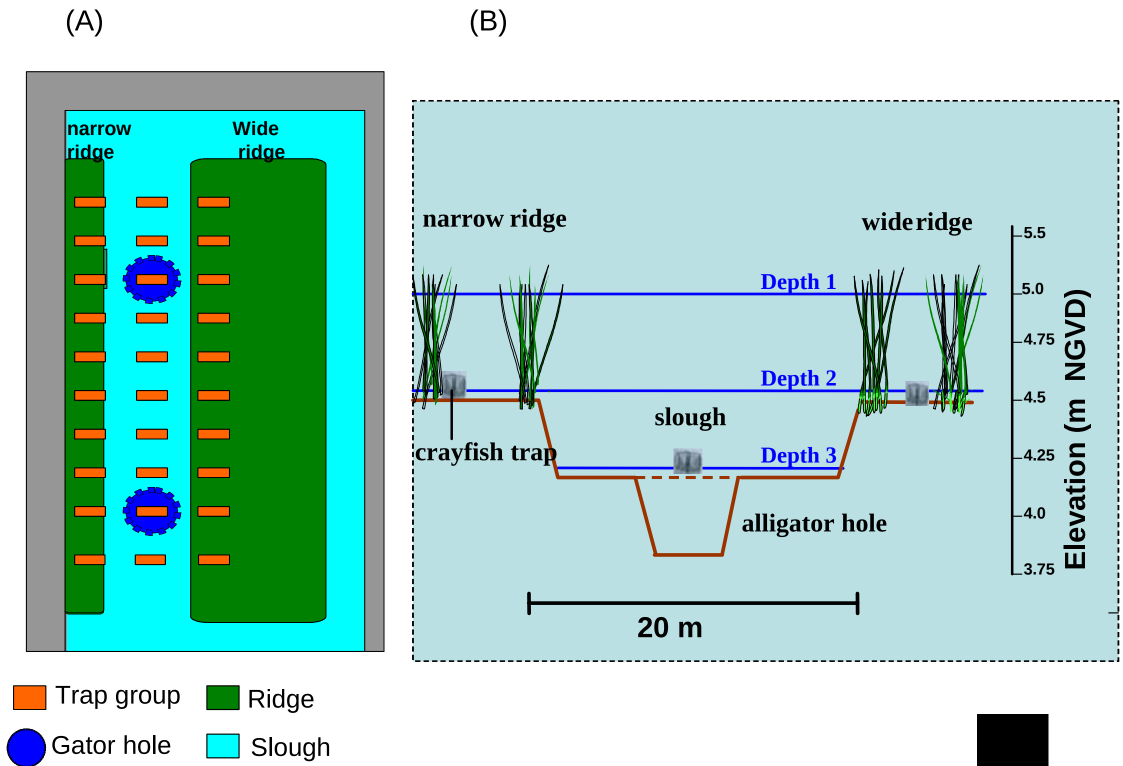
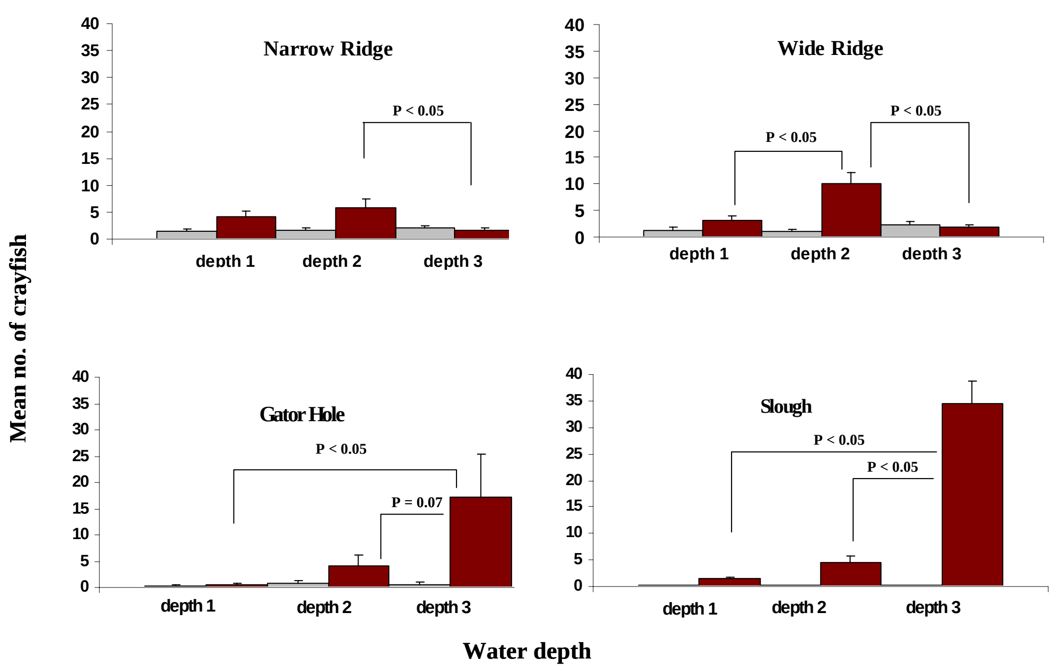


Figure 2. Mean (± S.E.) number of crayfish caught within the control (grey bars) and experimental (red bars) macrocosms for each habitat: narrow ridge (n = 20), wide ridge (n = 20), alligator hole (n = 4), slough (n = 16). Significant differences between experimental treatments are displayed (Tukey post-hoc test).



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