SOUTH FLORIDA WADING BIRD REPORT

Volume 18 Mark I. Cook and Mac Kobza, Editors December 2012

SYSTEM-WIDE SUMMARY

An estimated 26,395 wading bird nests were initiated throughout south Florida during the 2012 nesting season. This estimate is comparable to those of 2011 (26,452) and 2010 (21,885) and is the third consecutive year of relatively poor nesting effort in south Florida. The 2012 estimate represents a 39% decline relative to the decadal average, and a 66% decline relative to the 77,505 nests for 2009, which was the best nesting year on record in south Florida since the 1940s. All species of wading birds suffered reduced nest numbers relative to the past ten years, but the extent of the decrease varied among species. Great Egrets exhibited a relatively minor decline (9%) in nest numbers relative to their ten year average, while Wood Storks (44%), White Ibises (39%) and Snowy Egrets (56%) suffered greater declines. Of particular note was the limited nesting by Little Blue Herons and Tricolored Herons (only 89 and 412 nests, respectively), which continues a steep and steady decline in nesting activity for these two species during the past eight years. By contrast, Roseate Spoonbill nesting effort (348 nests) in Florida Bay improved relative to recent years, although it remains lower than the decadal average and the historical period. Note also that the dramatic increase in spoonbill nesting activity observed in WCA 3A during 2011 was evident again in 2012. This year there were 176 spoonbill nests in the WCAs, a 260% increase on the average for the past ten years.

The majority of wading bird nesting in south Florida occurs in the Greater Everglades. In 2012 an estimated 24,191 nests (92% of all south Florida nests) were initiated either in the Water Conservation Areas (WCAs) or Everglades National Park (ENP). This estimate is 40% lower than the decadal average and 66% lower than in 2009 when a record high of 73,096 nests was recorded. Most other regions of south Florida experienced similar declines in nest numbers during 2012. Of particular note is the reduction in wood stork nests at Corkscrew Swamp Sanctuary. Wood Storks have historically nested annually in Corkscrew in relatively large numbers, yet the 2012 nesting season was the fifth year of the past six when storks failed to breed there. Such an unprecedented decline in nesting activity may reflect a serious reduction in the extent and/or quality of wood stork foraging habitat in south west Florida during recent years. Spatial coverage of system-wide nest surveys was expanded to include Lake Okeechobee and Kissimmee River floodplain in 2005, and Estero Bay Aquatic Preserve in 2008. The marshes around Lake Okeechobee supported 3079 wading bird nests in 2012, which represents a decline in nesting effort relative to recent years (5,636 and 6737 nests in 2011 and 2010) but is a marked improvement on 2008 when only 39 nests were recorded around the lake. On the recently restored section of the Kissimmee River floodplain wading birds are not yet nesting in significant numbers, and this year only 148 nests were recorded. However, nesting effort is not expected to improve until hydrologic conditions are restored in 2015. Note that for comparative purposes with prior years, nest counts for these three regions are not included in the above system-wide total.

ENP historically supported the largest number of nests in the Greater Everglades, but in recent decades the majority of nesting has occurred further inland in the WCAs. CERP's goal is to restore the hydrologic conditions that will re-establish prey production and availability across the landscape that, in turn, will

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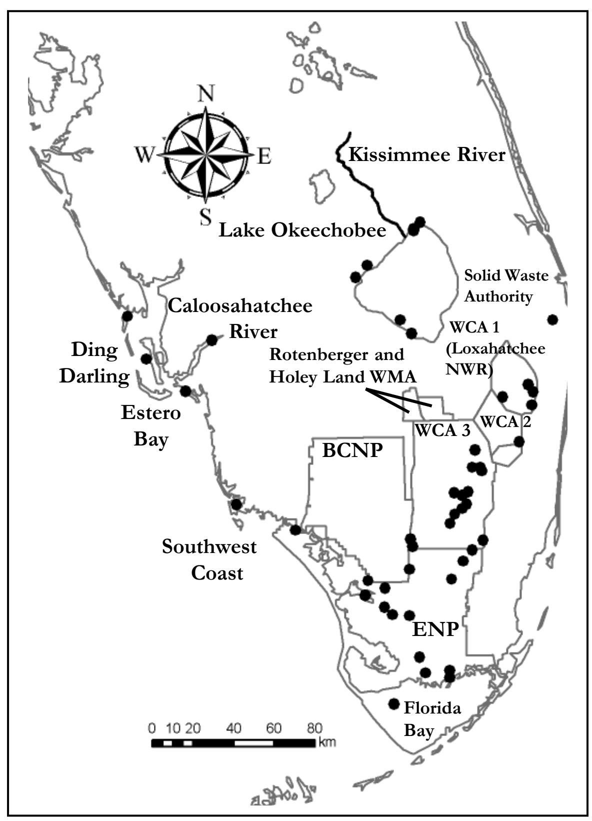
Locations of wading bird colonies with ≥ 50 nests in South Florida, 2012.



support the return of large successful wading bird colonies to the traditional estuarine rookeries downstream of Shark Slough. In 2012, ENP supported a relatively large proportion of nests (40%), while WCA-3 and WCA-1 supported 51% and 9%, respectively. This spatial distribution of nests contrasts with the general pattern over the past decade when nesting was concentrated in WCA-1 and WCA-3A, while ENP was relatively unattractive for nesting (an average of 16% of nests over the past decade). Nonetheless, ENP has become more attractive to nesting birds in recent years, with the proportion of nests increasing to 20% and 21% in 2006 and 2009, and then jumping to over 40% in 2010. However, 2012's increase remains below the 50% CERP target and may be due to declines in nesting conditions in the WCAs rather than a marked improvement in habitat conditions along the marsh-mangrove ecotone.

Of note in 2012 was the late start to nesting for most species. Wood Storks, which in recent decades have typically initiated nesting in January – February, did not start nesting until early- to mid-March. Late starting dates were also noted for great egrets and, to a lesser extent, white ibises. Moreover, nest success was generally depressed for most species in 2012 relative to previous years. This was certainly the case in the WCAs, where overall nest success (the probability of fledging at least one young) was low for all species studied. In ENP, nest success varied considerably by species. The federally Endangered Wood Stork fared particularly poorly and it is thought that all 820 nests failed or were abandoned. By contrast, anecdotal observations suggested that Great Egrets, Snowy Egrets and White ibises in ENP were relatively successful. Another region that experienced poor nesting success was Lake Okeechobee where most colonies experienced complete or extensive nest failure. The exception to this general pattern was Roseate Spoonbill nesting in Florida Bay where many colonies fledged on average >1 chick/nest.

Wading bird breeding patterns in south Florida are driven largely by hydrology through its influence on the production of prey and their vulnerability to predation. The 2012 breeding season was preceded by drought conditions in the WY2011 dry season followed by a relatively dry WY2012 wet season. Such conditions generally limit the production of small fishes but possibly promote the production of crayfish, which can burrow and physiologically tolerate loss of surface water. Indeed, preliminary reports from annual monitoring studies of prey production and concentration events in the Everglades suggest that WY2012 experienced reduced fish production but elevated crayfish production relative to recent years (N. Dorn, D. Gawlik & J. Trexler, personal communication). A reduction in fish production would certainly account for this year's reduced nesting effort, late dates of nest initiation, small clutch sizes, and reduced nest success experienced by piscivorous species such as the Wood Stork and Great Egret, but it is unclear why the crayfish specializing White Ibis suffered similar, although less extreme, breeding responses. With regard to prey vulnerability, recession rates and water depths were generally conducive to wading bird foraging from January through mid-April in WY2012 but several heavy rain events in late April and May promoted large scale water-level reversals, dispersing concentrated prey. This was followed by extensive nest failure and abandonment in many colonies in the Everglades.

To restore and manage for wading bird populations in the Everglades we need to provide the right amount of water at the right time and the right place to optimize the availability of aquatic prey species (small fishes and crayfish). The long-term monitoring programs in this report (both avian and prey related) are critical to this end. We need to know what's happening, why it's happening and what's working if restoration efforts are to be targeted effectively. These programs have made considerable advancements in our knowledge of wading bird ecology in recent years, although much still remains to be learnt about getting the water right for the birds.

Mark I. Cook
Everglades Systems Assessment Section
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406
561-686-8800 ext. 4539
mcook@sfwmd.gov

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), Magnificent Frigatebird (MAFR), Fish Crow (FICR), small dark herons (SML DRK), and small white herons (SML WHT).

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).

HYDROLOGIC PATTERNS FOR WATER YEAR 2012

The amount of rain in the Everglades Protection Area (EPA) for Water Year 2012 (WY12) (May 1, 2011 through April 30, 2012) was substantially more than last year and similar to average historic conditions. This year (WY12) rainfall amounts were slightly above average for all the Water Conservation Areas (WCAs) as shown in **Table 1** below. However, in Everglades National Park (the Park), the rainfall was 1.4 inches less (10.7%) than the historical average, but still 1.4 inches more (3.0%) than last year. In Water Conservation Areas WCA-1 and WCA-2 the rainfall was only 2.0 inches more (3.9%) than the historical average, but was 10.1 inches more (23.1%) than last year. Like last year, Water Conservation Area WCA-3 experienced the most dramatic deviations from the year before of any region. The rainfall in WCA-3 was 3.7 inches more (7.2%) than the historical average and was 14.2 inches more (34.7%) than last year.

One would expect from these above average precipitation values that regional water depths would be greater than last year (a drought year). However, the 2012 average stage data were, on average for WCA-1, WCA-3 and the ENP, 0.25 ft <u>lower</u> than 2011 stages and were similar to the historic averages (**Table 1**). Higher rainfall than last year "resulting" in lower than average water depth than last year could be due to three reasons: 1) lag times associated with hydrologic responses to the very low stages in WY11 (a buffering characteristic at the landscape scale), 2) WY12 rainfall during high temperature months when ET is high, and 3) erroneous conclusions based upon averages rather than the time series. For WY12, probably all three are correct. The lag feature can be seen by examining the WY12 hydrographs for each region in comparison to the WY11 drought.

As part of this report, four water-years are included in the discussion of the ecology of the Everglades. The purpose is to highlight the time-series patterns of stage associated with having two droughts in the last four years and to discuss the ecological implications of a drought-wet-drought-wet sequence on the restoration of wading birds. To jog your memory as we discuss each WCA below: 1) the WY09 drought was a fantastic year for many species of wading birds, 2) WY10 flooding was a terrible year for most wading birds, and 3) the WY11 drought was not a good year.

The following hydropattern figures highlight the average stage changes in each of the WCAs for the last four years in relation to the recent historic averages, flooding tolerances for tree islands, drought tolerances for wetland peat, and recession rates and depths that support both nesting initiation and foraging success by wading birds. The wading bird nesting period is divided into three simple categories (red, yellow, and green). A red label indicates poor conditions due to recession rates that are too fast (greater than 0.6 foot per week) or too slow (less than 0.04 foot for more than two weeks). A red label is also given when the average depth change for the week is positive rather than negative. A yellow label indicates fair conditions due to poor foraging depths (i.e., depths greater than 1.5 ft), or slow recession rate of 0.04 foot for a week, or rapid recessions between 0.17 foot and 0.6 foot per week. A green/"good" label is assigned when water depth decreased between 0.05 foot and 0.16 foot per week and water depths are between 0.1 - 1.5 ft.

Figures 1a through **g** show the ground elevations in the WCAs as being essentially the same as the threshold for peat conservation. The wading bird nesting period is divided into three categories based upon foraging observations in the Everglades (Gawlik, 2002).

- A red label indicates poor conditions due to recession rates that are too fast (greater than 0.6 foot per week) or too slow (less than 0.04 foot for more than two weeks). A red label is also given when the average depth change for the week is positive rather than negative.
- A yellow label indicates fair conditions due poor foraging depths (i.e., depths greater than 1.5 ft), or slow recession rate of 0.04 foot for a week, or rapid recessions between 0.17 foot and 0.6 foot per week.
- A green/good label is assigned when water depth decreased between 0.05 foot and 0.16 foot per week and water depths are between 0.1 - 1.5 ft.

WATER CONSERVATION AREA 1

Right after an exceptionally smooth and steady recession rate from November 2008 until May 2009 in WY09 (**Figure 1A**); a recession rate that fostered record-breaking nesting and foraging for WY09, water levels rose about one foot over a two month period; not an extreme rehydration rate, but just enough to bring optimum foraging conditions to an end. At this late stage in the nesting season, the invertivorous white ibises, the dominant species nesting in WCA-1, were able to weather the reversal by feeding in the EAA and urban environments, and very large numbers of nestlings fledged successfully. Water depths in WCA-1 for the WY11 dry-season followed the same smooth and steady recession rates seen in WY09, producing highly favorable foraging conditions. However, in WY11 the dry season began at a lower stage than in WY09, depths got much lower than the drought of WY09, and low water depths continued into the WY12 wet season (June 2012 – July 2012). This intrusion of the WY11 dry season into the WY12 wet season created a large hydrologic deficit. This was also apparent in WCA-3 (**Figure 1E**); and Shark River Slough (**Figure 1G**).

The water level in WCA-1 during the WY12 wet season and part of the dry season were below average. For WY12, hydrological conditions in support of wading bird foraging were good at the start of the season but the region got too wet, too rapidly, leaving "limited" prey resources (Note: The WY11 drought may have been too severe, causing prey for wading birds to be limited) to scatter across the marsh towards the end of the fledgling period. The 2009 to 2012 hydrographs (**Figure 1A)** for this section of the Water Conservation Area suggest a long-term trend of above average foraging and nesting. For the last four years, the hydrograph indicated mostly green arrows.

Table 1. Average, minimum, and maximum stage [feet National Geodetic Vertical Datum (ft NGVD)] and total annual rainfall (inches) for Water Year 2012 (WY12) in comparison to historic stage and rainfall. (Average depths calculated by subtracting elevation from stage.)

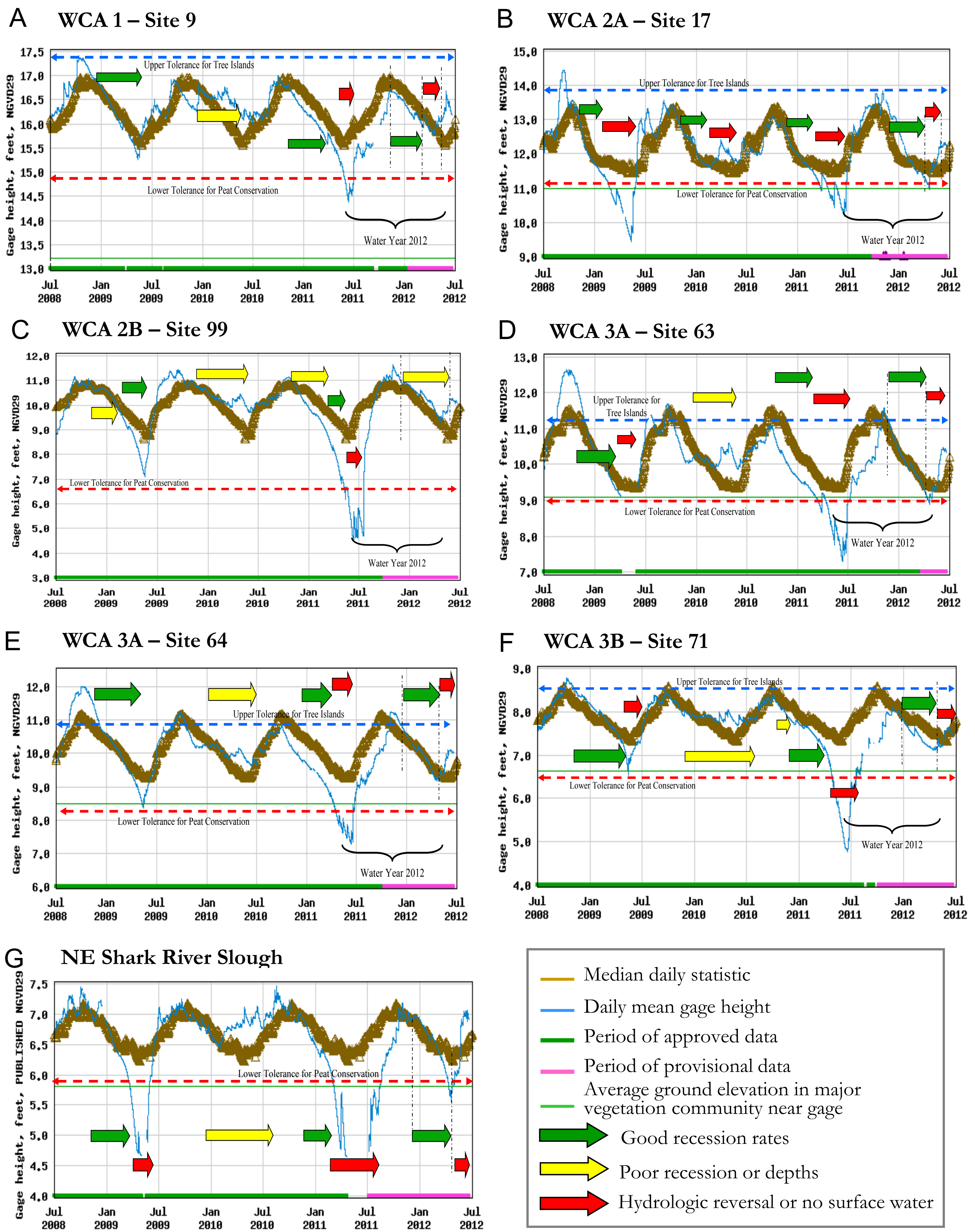
Area	WY2012 Rainfall	Historic Rainfall	WY2012 Stage Mean (min; max)	Historic Stage Mean (min; max)	Elevation
WCA-1	53.9	51.96	15.69 (13.07; 16.86)	15.63 (10.0; 18.16)	15.1
WCA-2	53.9	51.96	12.23 (10.22; 13.85)	12.52 (9.33; 15.64)	11.2
WCA-3	55.1	51.37	9.56 (7.25; 11.17)	9.56 (4.78; 12.79)	8.2
ENP	53.8	55.22	5.89 (4.33; 6.76)	5.99 (2.01; 8.08)	5.1

WATER CONSERVATION AREA 2A AND 2B

Last year, WCA-2A's good recession rates were short lived followed by a rapid and long-lived period of peat oxidation **(Figure 1B)**. This year, water rehydration rates during the wet season and recession rates during the dry season were excellent for vegetation and sapling survival, and wading bird foraging, respectively; (Note: The lack of tree islands in WCA-2A and -2B makes these regions unsuitable for nesting). As with the other regions in the EPA, the question remains: Were the WY12 prey densities for wading birds below average and if they were, was this due to the previous drought and/or the very successful WY11 dry season foraging? The 2009 to 2012 hydrographs (**Figure 1B)** for this section of the Water Conservation Area suggest a long-term trend of above average foraging and poor nesting. For the last four years, the hydrograph indicated equal distributions of green, red and yellow arrows.

WCA-2B tends to be utilized by wading birds during droughts because it tends to stay deeper for longer periods than the rest of the EPA. This was true in WY09 when dry season water levels went below ground in WCA-2A and northern WCA-3A, and the wading birds moved to WCA-2B. It was not true in WY11 because dry season water levels went almost 2.5 feet below ground for an extended period of time **(Figure 1C)**. It was ecologically problematic to observe water levels increase by some four feet over a few months, as this region became rehydrated in WY12. Young tree seedlings that happen to establish during the previous drought cannot keep their "heads" above water when water rises this quickly. Never-the-less, this region consistently gets a poor foraging depth designation (yellow arrows in (**Figure 1C**). The 2009 to 2012 hydrographs (**Figure 1C)** for this section of the Water Conservation Area suggest a long-term trend of very poor foraging and nesting. For the last four years, the hydrograph indicated mostly yellow arrows.

Figure 1. Hydrology in the WCAs and ENP in relation to recent average water depths (A: 14yr ave, B: 14 yr ave, C: 16 yr ave, D: 17 yr ave, E: 17 yr ave, F: 12 yr ave, G: 25 yr ave) and indices for tree islands, peat conservation, and wading bird foraging depths.



WATER CONSERVATION AREA 3A

In the northeastern region of WCA-3A (Gage-63) the WY12 began with an extensive and intensive dry period **(Figure 1D)**. Water levels were significantly below average from May until December. There were a few marsh fires in the northern and central areas. Why they were not peat burns and why they were so contained is a mystery. Like last year, recession rates were excellent starting in December (good for Wood Storks) and optimum depths started to appear around January 2011. However, unlike last year (when depths got too low for too long) water levels during the dry season stayed high and large numbers of foraging birds in this important NE section of WCA-3A were observed from February until May (Mark Cook; pers. communication). Unfortunately, in May, surface water rapidly increased causing prey to disperse, foraging to decline and nests to be abandoned. Of particular interest was the return of Roseate Spoonbills that nested successfully at this colony. This species typically nests in the coastal habitats of Florida Bay.

The hydrologic pattern in Central WCA-3A (Gage-64) was very conducive for wading bird foraging **(Figure 1E)**. However, moving out of the WY11 drought took some time and water levels stayed below average until December. Like most regions, WY12 in central Everglades was probably a good year for foraging, but poor for prey rejuvenation due to the good dry-season recession rates. Average to small flocks of wading birds were observed following the receding dry-downs fronts in Central WCA-3A during WY12. The 2009 to 2012 hydrographs for this section of the Water Conservation Area suggest a long-term trend of above average foraging and nesting. For the last four years, the hydrograph (**Figure 1E)** indicated mostly green and yellow arrows.

WATER CONSERVATION AREA 3B

During the WY11 drought, in WCA-3B, water levels fell at an almost steady perfect 0.10 ft per week during the dry season. The set-up for optimum January and February foraging by wading birds could not have been better. Then, like everywhere else in the EPA, there was an abrupt water level decline in April and May 2012, followed by intensive dry season with water depth of -2.0 ft. Recovery from the extensive dry down took time and the WY12 wet season stages were much below average. Unlike most of regions in the EPA, WCA-3B held on to its dry-season water. Water depths and recession rates were good for foraging by wading birds, but it appears that foraging was very limited. There are three possible explanations, 1) The lack of sloughs in WCA-3B and thus a lack of foraging habitat, 2) The extensive WY11 dry down and thus a lack of prey, and 3) Both 1 and 2.

As the prey density data are processed over the next year or so, it will be valuable to see if low foraging intensity was due to the WY11 drought and a lack of prey, or if the low foraging intensity was due to a lack of good foraging habitat. Like everywhere else, dry season in WCA-3B ended early in May, thus making the foraging season very limited.

The 2009 to 2012 hydrographs for this section of the Water Conservation Area suggest a long-term trend of average foraging and nesting. For the last four years, the hydrograph (**Figure 1F)** indicated equal distributions of green, red and yellow arrows.

NORTHEAST SHARK RIVER SLOUGH

Last year (WY11), the dry season had good recession rates for a few months (**Figure 1F)**. The rest of the time, the water levels in NE Shark River Slough decreased quickly and stayed dry for some four months and as a result did not support wading bird foraging or nesting. Like the rest of the EPA, recovery from the extensive dry down took time and the wet season stages were much below average. Water levels returned to normal around December and recession rates were excellent for the entire nesting season. However, there was no evidence of even average foraging success during the WY12 dry season (Mark Cook, pers. communication). If there was, it would have come to an early end due to the early onset of the WY13 wet season.

The 2009 to 2012 hydrographs for this section of the Park suggest a long-term trend of sub-optimum foraging and nesting. For the last four years, the hydrograph (**Figure 1F)** indicated mostly red and yellow arrows.

SUMMARY

Last year it was stated in Chapter 6 of the 2012 SFER, that "water year 2012 is expected to be another drought year due to La Nina conditions. If it is, then the District will need to evaluate the possible connection of droughts to climate change and the serious impacts it could have on peat fires, oxidation and conservation in the Everglades." It turned out that WY12 was indeed another La Nina year, but a severe drought in the Everglades was averted because of a huge amount of rain in October 2011. As a result, rainfall was substantially more than last year, especially in WCA-3, where it was 14.2 inches more than last year. This was good for the Everglades and a possible indication of the climatic buffering capacity of the Everglades. The general WY12 hydropattern seen across most of the Everglades was: 1) a significant delay in the start of the wet season, 2) followed by a quick rise to average water depth of about 2 ft, 3) followed by a recession rate very conducive for wading bird foraging. However, late dry-season (April – May) water depths did not reach optimal foraging depths of 0.2-0.5 ft for very long, possibly influencing, in part, a rather unsuccessful nesting season.

Fred Sklar
Everglades Systems Assessment Section
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Fl 33406
561-682-6504
fsklar@sfwmd.gov

REGIONAL NESTING REPORTS

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

The University of Florida Wading Bird Project carried on its long-term monitoring of wading bird nests throughout the WCAs 2, 3 and Loxahatchee NWR in 2012. We focused primarily on counts for Great Egrets, White Ibises, Snowy Egrets, and Wood Storks, the species most readily located and identified through aerial searches. Additional estimates for other species were gleaned from systematic ground surveys and visits to nesting colonies.

Methods

We performed two types of systematic surveys in 2012: aerial and ground surveys. The primary objective of both kinds of surveys is to locate and evaluate nesting colonies. On or about the 15th of each month from February through June, we performed aerial surveys to find active colonies using observers on both sides of a Cessna 182. A flight altitude of 800 feet AGL and east-west oriented flight transects spaced 1.6 nautical miles apart have been used continuously since 1986 and shown to result in overlapping coverage under a variety of weather and visibility conditions. In addition to contemporaneous visual estimates of nesting birds by the two observers, we took aerial digital photos of all colonies. We made subsequent counts of nesting birds observed in these digital photos. The reported numbers of nest starts are peak estimates, in which the highest count for the season is used as the estimate of nests for each species within each colony. These counts may then be modified based on information from monthly SFWMD surveys, ground visits, and inference from a series of observations across the season.

Since 2005, we have performed systematic ground surveys in parts of WCA 3 that give an index of abundance for small colonies and dark-colored species not easily located during aerial surveys. In the case of ground surveys, all tree islands within 16 500m-wide belt transects comprising a total of 336 km^2 were approached closely enough to flush nesting birds, and nests were either counted directly, or estimated from flushed birds. These totals were added to the totals reported in Table 2. Note that because ground surveys were conducted on a subset of the total area, the figures should be used mainly for year-to-year comparisons and do not reflect the total number of nesting pairs for species like Little Blue, Tricolored, and Great Blue herons.

Results

Nesting Effort: We estimated a total of 14,629 wading bird nests (Anhingas not included in totals) were initiated at colonies within WCA 1, WCA 2, and WCA 3 (Table 1). No WOST initiated nests in the WCAs this year. This total nesting effort was only 45% of the average effort recorded during the last ten years, and 56% of the average of the last five years. This was the second lowest number of nests in the last 13 years. Nesting effort for WHIB was 42% of the ten year average and 50% of the last five years. GREG nesting effort was not as reduced as the other species – in 2012 this species showed 87% of the ten year average and 108% of the average for the past five years.

Spoonbills nested at 6th Bridge, Alley North, Cypress City, and Lox 99 (176 nests total). This nesting effort is up 4.24 times the average effort recorded for the past ten years, and 2.6 times the average of the last five years. They were also seen at Nanse during an aerial survey but were not confirmed to be nesting. This was only the second year they have been recorded at 6th Bridge and the first for Cypress City and Lox 99. In addition, we observed many more spoonbills roosting or flying around colonies, including around 200 roosting at 6th Bridge throughout the season, suggesting that the population using the WCAs this spring was considerably larger than the nest counts suggest. This continues a trend beginning in 2011 of much larger numbers of ROSP nesting in the WCAs.

We also continued long-term monitoring of small colonies in WCA 3 for the purpose of documenting change in small dark heron populations. Because of visibility problems these species are not counted in the aerial surveys, and our total counts of dark herons in the summary table should be treated as bare minimums. The only indicator of trends of dark herons is through ground surveys in selected transects. The same transects have been systematically surveyed annually since 1996. There has been a clear trend towards much smaller numbers of Tricolored Heron and Little Blue Heron nests in the study area over the past few years, which continued this year. The average number seen in 2005 – 2012 was reduced by 77% for LBHE and 58% for TCHE by comparison with 1996 – 2004 averages. In 2012 we saw only 46 nests of combined LBHE and TCHE, which was only 31% of the ten-year total. This pattern could be the result of a general reduction in nesting by these species throughout the Everglades, or it could indicate that these species are nesting elsewhere in the system (concentrating in larger colonies or areas outside our transects) in recent years. In any case, this trend should serve as an alarm for potential widespread declines of these two state-listed species.

Reproductive Success: We monitored nest success for 2 colonies in the WCAs; Vacation and 6th Bridge. We monitored individual nests of GREG at Vacation (n=23) and 6th Bridge (n=12). WHIB (n=16) and SMHE (n=26) were also monitored at 6th bridge.

Overall nest success (P; probability of fledging at least one young, prorated survival) was on the low end of the range reported both from the Everglades and other locations; GREG (P=0.32; SD=0.082) WHIB (P=0.307; SD=0.09), SMHE (P=0.18; SD=0.07). However, for many colonies complete or partial nest abandonment occurred during late April.

While drying patterns seemed favorable for much of the early part of the season, several unseasonally heavy rain events in late April caused large numbers of several species to abandon nesting, and intermittent rains after late April apparently damped further nesting. WOST showed the greatest response with a total abandonment at Paurotis Pond during the late April rain event. WOST in Tamiami West also suffered total abandonment but not immediately following the rain event. For other species, there was high variability between colonies after the late April rain, many colonies suffered high levels of abandonment, while a few showed little to no change.

Table 1. Number of nesting pairs found in Loxahatchee NWR during systematic surveys, February through June of 2012.

Latitude	Longitude	WCA	Colony	GREG	WHIB	WOST	ROSP	SNEG	GBHE	LBHE	TRHE	GLIB	BCNH	Unid. Large Wht.	Unid. Small Wht.	Unid. Small Dark.	ANHI	Colony Total*
26.3858	-80.24109	1	178	0	703	0	0	0	0	0	0	0	0	0	0	0	0	703
26.4951	-80.22533	1	180	0	336	0	0	0	0	0	0	0	0	0	0	0	0	336
26.438	-80.391	1	Lox 99	378	135	0	5	0	0	0	0	0	0	0	0	0	0	518
26.399	-80.250	1	Venus	240	0	0	0	0	0	0	0	0	0	0	0	0	0	240
26.394	-80.339	1	Uzume	39	0	0	0	0	0	0	0	0	0	0	0	0	0	39
26.450	-80.263	1	Volta	39	0	0	0	0	0	0	0	0	0	0	0	0	0	39
26.372	-80.266	1	Tyger	85	0	0	0	0	0	0	0	0	0	0	0	0	0	85
26.491	-80.267	1	Weldon	74	0	0	0	0	0	0	0	0	0	0	0	0	0	74
26.459	-80.240	1	Newcol 2	89	0	0	0	0	0	0	0	0	0	0	0	0	0	89
26.372	-80.310	1	Utu	43	0	0	0	0	0	0	0	0	0	0	0	0	0	43
Air Surveys > 50				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Air Surveys < 50				6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Totals By Species				993	1,174	0	5	0	0	0	0	0	0	0	0	0	0	2,172

* Excludes ANHI

Table 2. Number of nesting pairs found in WCAs 2 and 3 during systematic surveys, February through June of 2012.

Latitude	Longitude	WCA	Colony	GREG	WHIB	WOST	ROSP	SNEG	GBHE	LBHE	TRHE	GLIB	BCNH	Unid. Large Wht.	Unid. Small Wht.	Unid. Small Dark.	ANHI	Colony Total*
26.237	-80.310	2	New 1 18 May	87	0	0	0	0	0	0	0	0	0	0	0	0	0	87
25.801	-80.490	3	3B Mud East	57	0	0	0	0	0	0	0	0	0	0	0	0	0	57
26.124	-80.541	3	6th Bridge	337	296	0	46	0	0	***	100	0	0	0	100	0	0	879
26.201	-80.529	3	Alley North	1626	6500	0	100	0	0	0	100	0	0	0	0	0	0	8,326
26.124	-80.504	3	Cypress City	155	0	0	25	0	0	0	0	0	0	0	0	0	0	180
25.874	-80.654	3	Enlil	50	0	0	0	0	0	0	0	0	0	0	0	0	0	50
25.941	-80.593	3	Hagrid	70	0	0	0	0	0	0	0	0	0	0	0	0	0	70
25.819	-80.840	3	Henry	46	0	0	0	0	0	0	0	0	0	0	0	0	0	46
25.774	-80.837	3	Hidden	200	0	0	0	0	0	0	100	0	0	0	0	0	0	300
26.000	-80.595	3	Janus	112	0	0	0	0	0	0	0	0	0	0	0	0	0	112
25.805	-80.849	3	Jetport South	100	0	0	0	0	0	0	0	0	0	0	0	0	0	100
26.012	-80.632	3	Joule	223	0	0	0	0	0	0	0	0	0	0	0	0	0	223
26.016	-80.563	3	Jupiter	266	0	0	0	0	0	0	0	0	0	0	0	0	0	266
25.961	-80.572	3	L-67 (Horus)	62	0	0	0	0	0	0	0	0	0	0	0	0	0	62
25.771	-80.693	3	Little D	40	0	0	0	0	0	0	0	0	0	0	0	0	0	40
26.107	-80.498	3	Nanse	201	0	0	0	0	0	0	0	0	0	0	13	0	0	214
25.916	-80.630	3	Vacation	206	0	0	0	0	0	0	0	0	0	0	0	0	0	206
25.821	-80.677	3	Yonteau	41	0	0	0	0	0	0	0	0	0	0	17	0	0	58
Air Surveys > 50				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Air and Ground < 50 **				454	2	0	0	2	115	36	45	0	527	0	0	0	200	1,381
Totals by Species				4,333	6,798	0	171	2	115	36	345	0	527	0	130	0	200	12,657

* Excludes ANHI

** Includes **COUNT** wading bird nesting pairs from ground surveys

***Present but not counted

In WCAs 2 and 3, 32% of colonies had been completely abandoned in the period between April and May aerial surveys and 52% saw 50% or greater reduction in active nests during the same period. Alley North for example went from ~7000 active nests in mid-April to <1000 active nests in mid-May. Colonies in WCA 1 appeared to be the most stable (75% of colonies were still active and had either small or no losses in numbers between April and May aerial surveys). One of the most obvious things about this season was the late initiation of nesting for most species. WOST did not initiate nesting until mid- (Paurotis Pond) to late March (Tamiami West); normal initiation in the past two decades has been in late January or March. Similarly, Great Egrets did not initiate nesting until early to mid-March; early to mid-February is typical for the WCAs in most years. While White Ibis were less extreme in nesting late, they still showed a tendency, beginning in late March (Tamiami West) to early April (6th Bridge) as opposed to early March.

Between late nesting and widespread abandonment, numbers of nests and nest success this year were both depressed considerably by comparison with previous years.

Peter Frederick
Nick Vitale
Department of Wildlife Ecology and Conservation
P.O. Box 110430
University of Florida
Gainesville, Florida 32611-0430
352-846-0565
nevitale@ufl.edu
pfred@ufl.edu

EVERGLADES NATIONAL PARK

Status of Wading Bird Colonies in Everglades National Park (Mainland), 2012 Nesting Season

This summary report addresses colony monitoring within the mainland slough and estuarine areas of Everglades National Park using data collected during the 2012 wading bird breeding season.

Wading bird nesting colonies in Everglades National Park (ENP) are surveyed as part of a regional monitoring program to track wading bird nesting effort and success throughout the greater Everglades ecosystem. Data collected during surveys and monitoring flights help guide ongoing ecosystem restoration projects. The long-term monitoring objectives for wading bird nesting colonies in ENP are:

- Collect data on wading bird nesting effort, locations, numbers of colonies, and timing of colony nesting.
- Compile and share data with other agencies that monitor wading birds in South Florida with the ultimate goal of restoring and sustaining wading bird populations in the Florida Everglades.

Methods

We started our survey flights of known colonies in October 2011 in order to detect the earlier nesting of Roseate Spoonbills. Established colony sites were spot-checked monthly while conducting other wildlife project flights until birds were seen roosting in colonies. At that point, dedicated colony flights were flown monthly to document nesting activity in detail. One observer checked all known colony locations using a Cessna 182 fixed-wing aircraft. Altitude was maintained at about 800 feet above ground level. Flights were conducted starting 24 October 2011 and ending on 14 June 2012 when young were observed to be fledged. During each flight, visual estimates of nest numbers by species were made and photos were taken of colonies using a Canon digital SLR camera with a 70-200mm lens. Photos were later compared to visual estimates to assist with determining nest numbers, nesting stage, and species composition. Birds that were difficult to see or that tend to nest under vegetation (i.e., Roseate Spoonbills, Little Blue Herons, Tri-colored Herons and Black-crowned Night Herons) were noted as present and assumed to be nesting if adults were seen flying in and out of the colonies.

We conducted a systematic colony survey on 11 May of Shark River Slough and Taylor Slough. Two observers, with 1 observer sitting on each side of a Cessna 182 fixed-wing aircraft, searched for colonies along 20 established transects oriented east to west and spaced 1.6 nautical miles apart. Flight altitude was maintained at 800 feet above ground level throughout the survey. Coordinates were recorded and photos were taken of colony sites.

Species monitored include Great Egret (*Ardea alba)*, Wood Stork (*Mycteria americana*), White Ibis (*Eudocimus albus*), Snowy Egret (*Egretta thula)*, Roseate Spoonbill (*Ajaia ajaja*), Tri-colored Heron (*Egretta tricolor*), Little Blue Heron (*Egretta caerulea*), Cattle Egret (*Bubulcus ibis*), and Black-Crowned Night Heron (*Nycticorax nycticorax*). Other birds found nesting in colonies such as the Great White and Great Blue Heron (*Ardea herodias*), Anhinga (*Anhinga anhinga*), Brown Pelican (*Pelecanus occidentalis*) and Double-Crested Cormorant (*Phalacrocorax auritus*) are noted as well.

Results

Overall nesting effort in ENP was up by 105% compared to the 2011 nesting season. Twenty-three wading bird colonies were located (Figure 1). The total pooled species nest estimate was 9,559 (Table 1). Wood Storks had an estimated 820 nests, a decrease of 35% compared to last season. Great Egret nest counts (N=1,964) were up by 23% and Snowy Egret nest counts (N=1,685) were up by 26%. White Ibis had the largest spike in numbers (N=5,050), up by 2195% this season compared to the low counts seen during the previous season.

Wood Storks initiated nesting late this season. The majority of stork colonies were not observed nest building and incubating until 27 March. The Rodgers River Bay colony was the only exception with approximately 140 pairs of storks and 70 nests starts observed on 29 February. With such late nesting, it was unlikely that they would have enough time for their young to fledge before water levels came up and dispersed prey. Unfortunately for the late-nesting storks, several rain events that began early (starting in late April and continuing into May) significantly raised water levels throughout ENP. When colonies were checked again on 8 May, most stork nests were abandoned. All stork nests failed at Cuthbert Lake and most nests failed at Paurotis Pond, Cabbage Bay, Lostmans Creek, Broad River and Tamiami West. Rodgers River was still the exception with only about 35 failed nests seen out of the original 135 nests. However during following checks of this and the other stork colonies in May and June, most nests had failed. On 14 June, only 10 active stork nests remained at Rodgers River Bay and contained what appeared to be weak and/or dead chicks. These last few remaining nests most likely failed as well.

While this season was not successful for nesting storks, Great Egrets, Snowy Egrets, and White Ibis managed to raise and fledge young in ENP. Great and Snowy Egrets were first seen nesting on 25 January in several of the "headwaters" colonies (Broad River, Otter Creek, Rookery Branch) and at Rodgers River Bay. Most were already incubating on nests and some eggs were seen. White Ibis appeared to be at peak nesting numbers (most looked to be incubating) when checked on 27 March. On 8 May large egret and ibis chicks were seen standing on nests and many fledged ibis young were seen in all colonies. By 14 June, colonies were mostly finished. Few egrets remained however adult ibis were still seen roosting in several of the colonies.. When photographs of these colonies were later viewed, many dark brown ibis young could also be seen, roosting together in groups on top of the canopy.

Lori Oberhofer
Everglades National Park
South Florida Natural Resources Center
40001 State Road 9336
Homestead, FL 33034
305-242-7889
lori_oberhofer@nps.gov

EVERGLADES NATIONAL PARK (FLORIDA BAY)

A formal wading bird aerial nesting survey was not conducted in Florida Bay; however we continue to monitor nesting activity of wading birds that are seen while flying other wildlife survey flights.

Frank Key: Colony Location: 25.10243, -80.90667 (NAD83)
The colony of Great Egrets, White Ibis, Brown Pelicans, and Double-crested Cormorants on Frank Key did not form this season.

Clive Key: Colony Location: 25.08028, -80.93010 (NAD83)
A small colony of Great Egrets and Snowy Egrets plus a larger colony of Brown Pelicans, and Double-crested Cormorants nested this season on Clive Key. Clive Key is located roughly 3 km to the southwest of Frank Key in western Florida Bay. Approximately 30 Great Egrets were first observed standing on nests on 1 March. A larger group of Great and Snowy Egrets along with a few Roseate Spoonbills were observed roosting nearby and below the canopy. More than 125 Brown Pelicans were incubating or brooding small chicks and about 200 cormorants were standing on nests. On 25 April, the same number of Great Egrets and approximately 40 Snowy Egrets were also observed incubating or brooding on nests, however most Snowy Egret nests were located under the thick mangrove canopy and were therefore difficult to estimate. A few Great Blue and Great White Herons (N<10 each) were also seen nesting in the colony. White Ibis were not seen on the island (they had previously nested on Frank Key). This colony was not visited again after 25 April so the outcome is unknown.

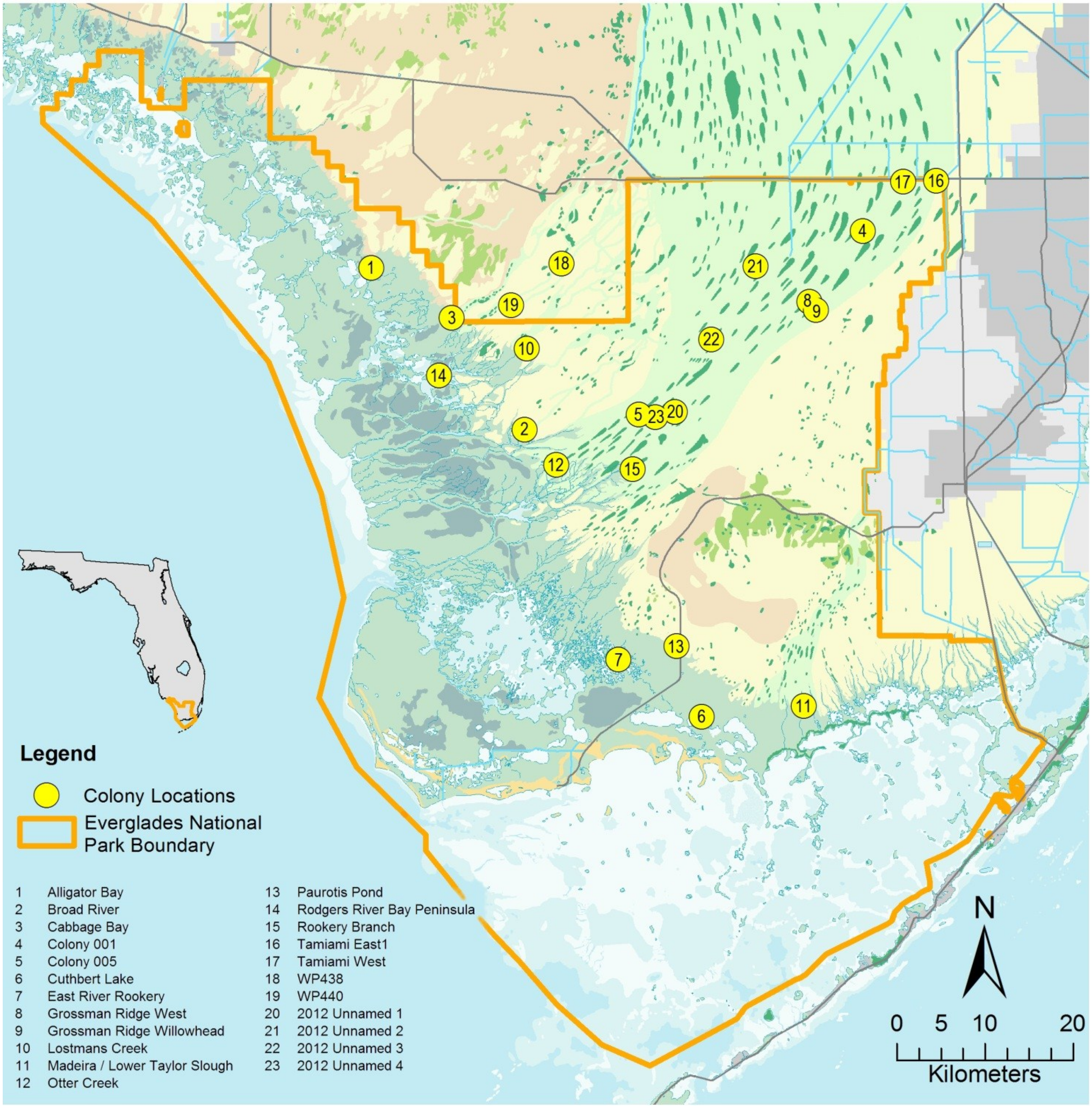
Lori Oberhofer
Everglades National Park
South Florida Natural Resources Center
40001 State Road 9336
Homestead, FL 33034
305-242-7833
lori_oberhofer@nps.gov

Table 1. Peak numbers of wading bird nests found in Everglades National Park colonies, January – June 2012.

Colony name	Latitude NAD83	Longitude NAD83	GREG	WOST	WHIB	SNEG	ROSP	TRHE	LBHE	GBHE	BCNH	*Total*
Tamiami West *	25.75784	-80.54484	300	120	2,500	100	0	+	0	0	+	3020
Cabbage Bay	25.62000	-81.05612	200	75	600	300	+	+	0	0	0	1175
Rookery Branch	25.46356	-80.85256	150	0	600	200	+	+	+	0	0	950
Otter Creek	25.46781	-80.93772	300	0	300	300	+	+	+	0	0	900
Broad River	25.50293	-80.97440	250	60	400	100	30	0	0	0	0	840
Paurotis Pond	25.28150	-80.80300	125	320	100	100	10	+	+	0	0	655
Lostmans Creek	25.58723	-80.97204	100	50	300	200	0	0	0	0	0	650
Alligator Bay	25.67099	-81.14714	100	0	200	100	0	0	+	0	0	400
Rodgers River Bay Peninsula	25.55975	-81.07026	150	135	0	0	0	0	0	0	0	285
Cuthbert Lake	25.20933	-80.77500	75	60	0	60	0	0	0	0	0	195
Madeira / Lower Taylor Slough	25.22697	-80.68428	40	0	50	50	+	0	0	0	0	140
Grossman Ridge Willowhead	25.62613	-80.64582	50	0	0	40	0	0	0	0	0	90
Colony 001	25.70752	-80.59087	0	0	0	80	0	0	0	0	0	80
Grossman Ridge West	25.63511	-80.65130	40	0	0	0	0	0	0	0	0	40
WP440	25.63213	-80.98903	2	0	0	35	0	0	0	0	0	37
East River Rookery	25.26860	-80.86785	25	0	0	0	0	0	0	0	0	25
2012 Unnamed 1	25.52268	-80.80405	20	0	0	0	0	0	0	0	0	20
Tamiami East1	25.75762	-80.50801	15	0	0	0	0	0	0	0	0	15
2012 Unnamed 2	25.67187	-80.71222	2	0	0	10	0	0	0	0	0	12
2012 Unnamed 3	25.59691	-80.76277	5	0	0	5	0	0	0	0	0	10
2012 Unnamed 4	25.51738	-80.82617	10	0	0	0	0	0	0	0	0	10
WP438	25.67487	-80.93170	0	0	0	5	0	0	0	0	0	5
Colony 005	25.51995	-80.84463	5	0	0	0	0	0	0	0	0	5
Total			1,964	820	5,050	1,685	40	+	+	0	+	9,559

* UF estimates used, except for SNEG.
+ Indicates species present and nesting, but unable to determine numbers

Figure 1. Locations of wading bird nesting colonies in Everglades National Park, January – June, 2012.



2012 WOOD STORK NESTING IN SOUTHWEST FLORIDA

National Audubon Society gathered nesting data for five rookeries in 2012. While wood storks were the primary focus of the monitoring effort, we were able to gather data on other wading birds at some of the colonies.

Methods

Surveys were conducted in a fixed-wing Cessna 172 on March 13th and April 24th. Nesting effort was recorded by taking digital aerial photographs of the colonies for later analysis. We used a Canon 30D equipped with a 70-300mm zoom lens with an image stabilizer. An altitude of between 800'-1000' was maintained during the survey. Images were examined to quantify the number of nest starts. In each survey set there were varying numbers of image features that we were unable to identify. While some of these features may have been active nests, they were not included in the analysis. Consequently, the results of our analysis are conservative, as only verifiable nests were counted.

Hydrology

Peak antecedent water levels beneath the colony slightly exceeded the 50 year average at the Corkscrew colony. Wet-season rainfall records at the nearest monitoring station similarly showed volumes in excess of the 50 year average. Roughly 50% of the time these conditions were met over the past 30 years the wood storks have nested at Corkscrew, albeit, typically in January or later. A strong winter drought dropped the water table more than a foot by January 1st, taking the colony water level 5 inches below the 50 year average. Drier than normal winter conditions were attributed to a La Nina weather pattern.

CORKSCREW SWAMP SANCTUARY - Location: N26 22.502, W081 36.985

The Corkscrew colony is located in the expanse of old growth bald cypress at National Audubon Society's Corkscrew Swamp Sanctuary. No nesting was recorded at Corkscrew throughout the duration of the 2012 nesting season. A low water table is suspected to have contributed to the lack of nesting effort.

LENORE ISLAND (aka CALOOSAHATCHEE WEST) - Location N26 41.332, W081 49.809

This colony is located on a mangrove island in the Caloosahatchee River. The colony supported an estimated 138 nest starts. Wood stork nest initiation began in late January or early February and represented the largest component of the rookery with 60 nest attempts. The final survey was conducted on April 24th, at which time 39 wood stork nests had chicks old enough (≥7weeks) to be considered fledged. Given the late onset of rainy season in Southwest Florida with no significant rainfall events well into June, the number of fledged wood storks is likely higher than the 102 storks reported. Other wading birds nesting on Lenore Island include great egrets, great blue herons, cattle egrets and snowy egrets. The island also supports nesting anhingas, cormorants and brown pelicans.

CALOOSAHATCHEE EAST - Location N26 41.795, W081 47.697

This colony is located on a mangrove island in the Caloosahatchee River. No wading birds were observed nesting at this site; however, it appeared to be a roosting site for great egrets.

COLLIER/HENDRY LINE - Location N26 22.223, W081 16.363

This bird colony is located in a uniquely-shaped cypress head along the border of Collier and Hendry Counties. The site was initially active, with 27 wood stork nests observed on our March 13th monitoring flight. However, as of the second flight on April 24th all nests had been completely abandoned and no remains of nests were visible. Only wood storks were observed at this site on our initial flight – no other wading bird species were present.

BARRON COLLIER 29 - Location N26 16.383, W081 20.633

The Barron Collier 29 colony is located on a spoil island within a man-made lake in eastern Collier County. Nests are built on nonindigenous Brazilian pepper trees. Nest initiation at this colony is thought to have occurred relatively late, perhaps mid-February, as evidenced by the age of observed wood stork chicks. Based on the abandonment of nests or absence of nesting in nearby cypress habitats (Corkscrew Swamp and Collier-Hendry Line) we estimate that no wood storks fledged from this colony, although this could not be confirmed by aerial surveys. Various other wading birds, mostly great egrets, nested along with the wood storks but the degree of nesting success in these species also could not be ascertained.

Jason Lauritsen
Corkscrew Swamp Sanctuary
375 Sanctuary Road West
Naples, FL 34120
jlauritsen@audubon.org

Table 1. 2012 wading bird nesting effort recorded in Southwest Florida.

			WOST							
Colony	Latitude	Longitude	Nests	Successful	Fledged	GBHE	GREG	SM WHT	SM DRK	Total
Corkscrew Swamp	26 22.502	-81 36.985	0	0	0	0	0	0	0	0
Lenore Island	26 41.332	-81 49.809	60	39	102	5	26	40	7	138
Caloosahatchee East	26 41.795	-81 47.697	0	0	0	0	0	0	0	0
Collier-Hendry Line	26 22.223	-81 16.363	27	0	0	0	0	0	0	0
Barron Collier 29	26 16.383	-81 20.633	18	0	0	0	16	8	2	44
Total			105	39	102					

SOLID WASTE AUTHORITY OF PALM BEACH COUNTY ROOKERY

Methods

Typically, Breeding Bird Censuses (BBCs) are conducted from February – July 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 are systematically surveyed from a small boat, and the identified bird species and nest numbers are recorded. Surveys are conducted during the morning hours so as to minimize any burden caused by the presence of observers. The peak nest numbers are a compilation of early season boat counts and visual counts from the observation towers.

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°46'42.22"N: Long. 80°08'31.15"W NAD83). 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 a partial data set for the 2012 breeding season. Because of engine malfunctions, the number of nest surveys conducted was limited. Typically, nesting activities have been observed at this colony February through September. Wood Stork monitoring and productivity was conducted by Rena Borkhataria and the results of that study can be found in a separate section of this report. Wood Storks peaked at 341 nests in April.

The estimated total number of wading bird nests for the SWA Colony is 1287. There were nests of the following bird species: Great Egrets, Cattle Egrets, Wood Storks, White Ibis, Tricolor Herons, Roseate Spoonbills, and Anhinga.

Table 1. Peak number of wading bird nests in SWA Rookery from February to July 2012.

GREG	SNEG	CAEG	GBHE	LBHE	WOST	WHIB	ANHI	TRHE	ROSP	Total Nests
43	4	56	0	50	341	525	204	60	4	1287

Mary Beth (Mihalik) Morrison, David Broten & Michael Tyson
Solid Waste Authority of Palm Beach County
7501 North Jog Road
West Palm Beach, FL 33412
(561) 640-4000 ext. 4613
mmorrison@swa.org

ROSEATE SPOONBILL NESTING IN FLORIDA BAY ANNUAL REPORT 2011-2012

Methods

Spoonbill Colony Surveys

Forty-two of the Keys in Florida Bay have been used by Roseate Spoonbills as nesting colonies (Table 1). These colonies have been divided into five distinct nesting regions based on the primary foraging locations utilized by the birds nesting in each region (Figure 1, Lorenz et al. 2002). During the 2011-12 nesting season (Nov 2011-Apr 2012), complete nest counts were performed in all five regions of the bay by entering the colonies and thoroughly searching for nests. Nesting success was estimated for four of the five regions through mark and revisit surveys at the most active colony or colonies within each region (hereafter referred to as focal colonies; Table 2). These surveys entailed marking up to 29 nests shortly after full clutches had been laid, and then revisiting the colonies on a ten-day to twenty-one-day cycle. Nests were monitored until failure or until all surviving chicks reached at least 21 days of age, the age at which chicks begin branching and can no longer be assigned to a nest. A colony was considered successful if it averaged at least one chick to 21 days per nesting attempt (c/n). Mean laying and hatching dates refer to the first egg laid in each clutch and the first egg to hatch in each clutch. We present our results in the context of spoonbill nesting activities in Florida Bay since 1984, the year that the South Dade Conveyance System (SDCS), which has direct water management implications on Florida Bay, was completed (Lorenz 2000, Lorenz et al. 2002).

Spoonbill Monitoring Results

Northwest Region: Clive Key

Three of the five colonies in the Northwest region were active producing a total of 90 nests, 32 more than the previous year, however, still well below the mean of 215 nests in the last 26 years (Table 1). There were 52 nests on Clive Key, the focal colony for the region, which is more than double the mean of 22 nests since 1984-85 (Table 1). Nesting surveys were conducted on Clive Key Nov 17, Dec 20, Jan 5, Jan 26, Feb 7, Feb 23, Mar 27. Of the 29 nests monitored, 53% were successful, producing a mean of 0.90 c/n (Table 2) which was below the mean for the Northwester Region (Table 3) but close to being considered successful. Total production for Clive Key was estimated at 46 young (Table 2). The mean lay date was December 19 and the mean hatch date was January 11 (Table 2).

Northeast Region: Duck Key

ENP's annual surveys of the Madeira Hammock colony (Figure 1) indicate that the colony became active in 2010 for the first time since 1989 and that spoonbills nested at this colony from 2009-10 to 2011-12. Access to this colony is extraordinarily difficult so there are no nest counts for 2009-10 or 2010-11. In 2011-12, the colony was surveyed twice. The first survey (Feb 1) found an estimated 164 nests. The second survey (Mar 22) in tandem with the ENP aerial surveys indicated a moderate to high degree of success. Using the methods of Lorenz et al. (2002) this colony falls into the Northeast region. The high number of nests at this colony casts doubts on the accuracy of the low number of nests reported for 2009-10 and 2010-11 nesting season (Northeast region: 41 and 3; Bay wide 233 and 69 respectively). Out of the other 9 colonies, only one of the nine colonies in the Northeast region was active producing 19 nests, for a regional total of 183, slightly above average since 1984-85 (Table 1). The Duck Key colony was 92% successful, producing an average of 1.4 c/n (Table 2). These production numbers were well above the long term means (Table 3). Total production for the colony was estimated at 26 young (Table 2). The nests at Duck Key were very high and difficult to monitor closely. Nest surveys were conducted Nov 14, Dec 15, Jan 4, Jan 24, Feb 10, Mar 19.

Southeast Region: East Key

The activity in the southeast region of the Bay increased since the previous year, producing a total of 29 nests, still well below the mean of 72 nests since 1984-85 (Table 1). East Key had the most nests (n=10) of the twelve colonies, although it was not successful (10% success rate), producing an average of only 0.1 c/n. For the region, the production rate was .57 c/n and 25% successful; well below the long term means (Table 3). The crash of the colony was made apparent right after a three-day rain in the middle Keys. Nest surveys were conducted on Dec 12, Dec 28, Jan 18, Feb 3, Feb 17, Mar 16. The majority of the nests was abandoned and thus never had the chance to hatch their clutch. However, we estimate the mean lay date to be late January, with the one successful nest lay date on Jan 3 and hatch date Jan 25.

Central Region: Jimmie Key

There was an increase in nesting activity from last year within the central Bay region this year, totaling 44 nests, which comes close to reaching the mean of 50 nests since 1984-85 (Table 1). New colonies were found on West Bob Allen and Central Bob Allen keys. Jimmie Key had a total of 20 nests and was nearly successful, producing an average of 0.95 c/n (Table 2) with most of the abandoned nests occurring after the major rainfall event. The 1.22 c/n and 60% nests successful compares favorably to the long term mean (Table 3). Nest surveys in this colony were conducted on Nov 11, Jan 10, Jan 28, Jan 31, Feb 11, Feb 23, Mar 16.

Southwest Region: Twin Key

All four colonies in the Southwest region were surveyed in 2011-12 but only one, Twin Key, was active (Table 1). Two nests were initiated on Twin Key but the fate of the nests is unknown.

Bay-wide Synthesis

Although disappointing from an historical perspective, the year was quite positive given the trends of the last decade. The quantification of the Madeira Hammock and three other new

Table 1. Number of Roseate Spoonbill nests in Florida Bay November 2011 through April 2012. An asterisk indicates a colony where nesting success surveys were conducted. Second nesting attempts are not included.

			Summary since 1984-85		
Region	Colony	2011-12	Min	Mean	Max
Northwest	Clive*	52	6	23.72	52
	Frank	0	0	43.00	125
	Han Van*	15	15	15.00	15
	Oyster	0	0	4.95	45
	Palm	0	9	30.22	87
	Sandy*	23	23	140.03	250
	Region Subtotal	90	48	200.76	325
Northeast	Deer	0	0	4.14	15
	Duck*	19	0	10.95	100
	Little Betsy	0	0	5.00	21
	Madeira Hammock	164	0	?	164
	North Nest	0	0	0.60	8
	North Park	0	0	14.72	50
	Pass	0	0	0.75	7
	Porjoe	0	0	23.91	118
	South Nest	0	0	16.90	59
	Tern	0	0	89.07	184
	Region Subtotal	183	3	152.71	333
Southeast	Bottle*	7	0	10.04	40
	Cotton	0	0	0.00	0
	Cowpens	0	0	5.22	15
	Crab	0	0	1.88	8
	Crane	0	0	10.25	27
	East*	10	0	3.14	13
	East Butternut*	4	0	5.00	27
	Low	0	0	0.00	0
	Middle Butternut*	6	1	17.50	66
	Pigeon	0	0	9.61	56
	Stake*	2	0	5.50	19
	West	0	0	2.75	9
	Region Subtotal	29	5	66.55	117
Central	Calusa*	5	0	9.83	21
	Captain	0	0	2.16	9
	East Bob Allen	0	0	12.50	35
	First Mate*	2	0	3.66	15
	Jimmie Channel*	20	0	17.59	47
	Little Jimmie	0	0	2.00	12
	Manatee	0	0	0.16	3
	North Jimmie	0	0	0.75	2
	Pollock	0	0	1.69	13
	South Park	0	0	9.22	39
	West Bob Allen*	5	5	5.00	5
	Region Subtotal	44	3	47.57	96
Southwest	Barnes	0	0	0.21	3
	East Buchanan	0	0	4.90	27
	Twin*	2	0	1.73	8
	West Buchanan	0	0	3.00	9
	Region Subtotal	2	0	8.42	35
	Florida Bay Total	348	69	475.10	880

colonies resulted in more than 5 times the nests from the previous year (although somewhat misleading since we know Madeira Hammock was active and not counted in 2009-10 and 2010-11). It is also promising that the largest colony is once again in the Northeastern region, indicating possible improvements in water management practices in regard to Florida Bay. It is possible that this increase may be attributed to relatively high reproductive rates over the last seven years (6 of 7 were successful in the Northeast). The birds that fledged during these successful years are now either sexually mature or will be soon. To put this in perspective there were only 7 successful years in the Northeast region over a 17 year period prior to the last 7 years. That we are seeing such high levels of success also leads to the conclusion that water management practices have become less detrimental to Florida Bay. We believe that the low success rates of the Southeastern colonies can be attributed to an unusual rainfall event in early February, a critical time for nesting spoonbills. This event may have raised water levels in their very limited foraging grounds (Lorenz et al. 2002) and caused them to abandon their nests. and is very likely unrelated to water management practices.

No second nesting or late nesting attempts were witnessed in Florida Bay.

Mac Stone
Jerome J. Lorenz
Audubon of Florida's Tavernier Science Center
115 Indian Mound Trail
Tavernier, FL 33070
305-852-5092
jlorenz@audubon.org

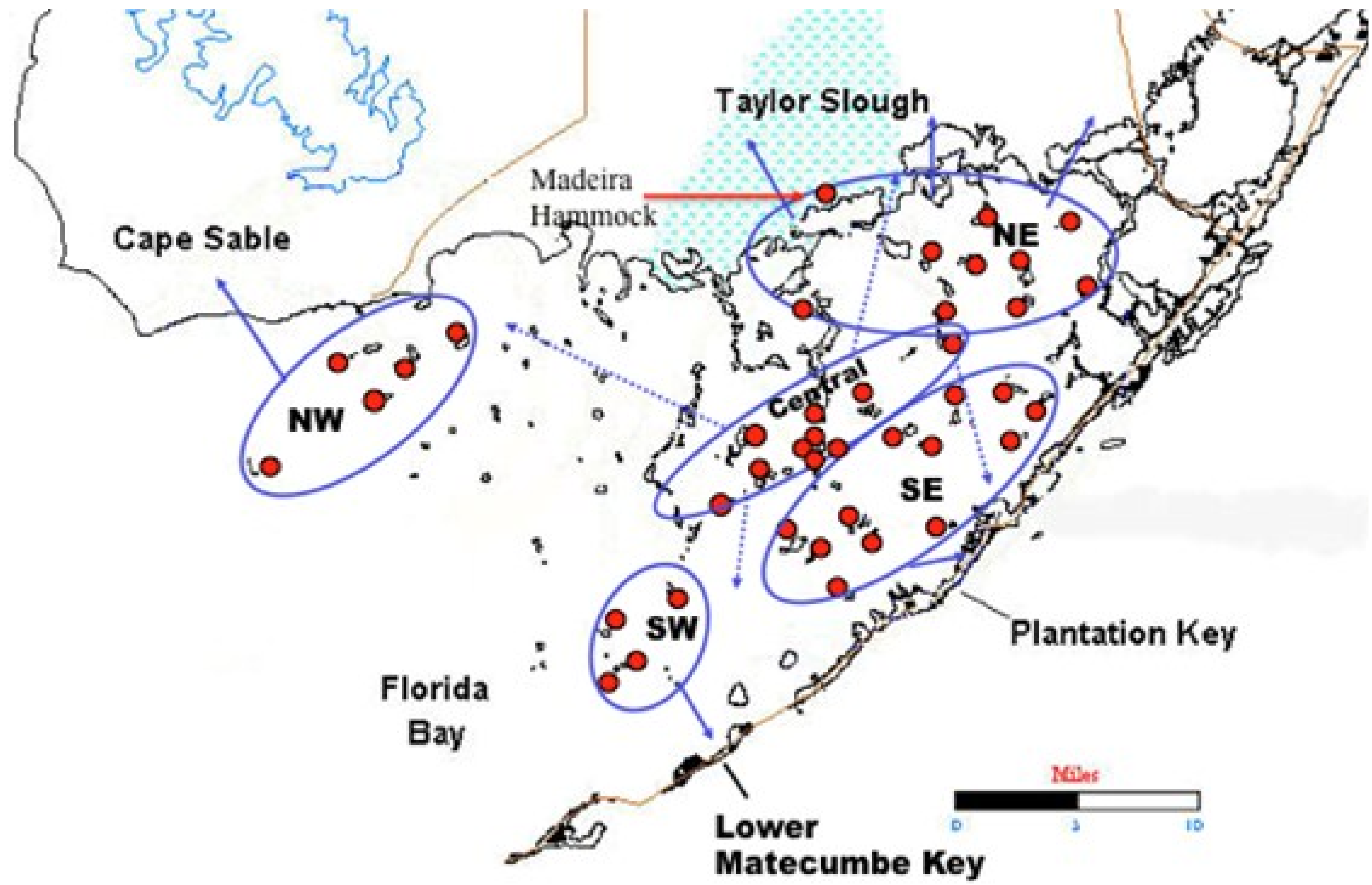
Table 2. Breakdown of colonies by region of all monitoring data collected.

	# Nests	# nests monitored to 21d	# chicks to 21d	Est Prod (c/n)	Est chicks fledged /colony	# nests with one chick to 21d	% success	Mean Lay date	Mean Hatch date
WBA	5	5	8	1.60	8.00	4	80%	Mid December	Early January
CBA	12	9	15	1.66	19.92	8	88%	15-Dec-11	6-Jan-12
Jimmie	20	20	19	0.95	19.00	9	45%	30-Dec-11	21-Jan-12
First Mate	2	2	3	1.50	3.00	2	100%	Mid December	Early January
Calusa	5	5	5	1.00	5.00	4	80%	4-Dec-11	26-Dec-11
CENTRAL	44	41	50	1.219512	53.66	27	65.85%	23-Dec-11	13-Jan-12
Sandy	23	8	15	1.87	43.01	8	100%	27-Nov-11	19-Dec-11
Clive	52	29	26	0.90	46.80	16	53%	20-Dec-11	11-Jan-12
Han Van	15	13	3	0.23	3.45	2	15%	13-Jan-12	4-Feb-12
NORTHWEST	90	50	44	0.88	79.20	26	52.00%	21-Dec-11	13-Jan-12
Madeira Hammo	164	0	unknown	unknown	unknown	unknown	unknown		
Duck	19	13	18	1.38	26.22	12	92%	28-Dec-11	19-Jan-12
NORTHEAST	183	13	18	1.38	253.38	12	92.31%	27-Dec-11	19-Jan-12
Middle Butternut	6	6	6	1.00	6.00	2	33%	13-Jan-12	4-Feb-12
Big Butternut	4	3	5	1.66	6.64	2	66%	31-Dec-11	22-Jan-12
Bottle	7	7	1	0.14	0.98	1	14%	13-Jan-12	4-Feb-12
Stake	2	2	3	1.50	3.00	1	50%	16-Dec-11	7-Jan-12
East	10	10	1	0.10	1.00	1	10%	mid January	unknown
SOUTHEAST	29	28	16	0.57	16.57	7	25.00%	7-Jan-12	29-Jan-12
South Twin	2	0	unknown	unknown	unknown	unknown	unknown		
SOUTHWEST	2								
TOTALS	348	132	128	1.03125	402.815	72	58.79%		

Table 3. Mean number of chicks to 21 days per nesting attempt and the percentage of nests that were successful. Success is defined as a mean of at least one chick to 21 days per nesting attempt. Summary figures refer to the focal colony or colonies surveyed in each year. Numbers in parentheses indicate how many years each region has been surveyed since 1984-85. Second nesting attempts are not included.

	2011-12 Nesting Season		Summary since 1984-85			
Region	Mean Production Per Nest	Percent Success Per Nest	Min	Mean	Max	% Years Successful
Northwest	0.88	52%	0.00	1.25	2.50	60% (n=25)
Northeast	1.38	92%	0.00	0.94	2.20	48% (n=25)
Southeast	0.57	25%	0.00	0.94	2.09	43% (n=14)
Central	1.22	66%	0.00	0.89	1.86	50% (n=14)

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.



WADER NESTING COASTAL SOUTH SOUTHWEST FLORIDA 2012

I think if I just changed the numbers a little in the table I could repeat last year's report verbatim. The wader nesting season started mid February. By the beginning of March numbers of GREG nests had increased considerably. Toward the end of April small waders started with very few nests at any of the colonies (Table 1). After that most left without fledging many young. In all it was a very poor wader nesting season; for the 39 years of nesting information recorded in the area, numbers of nests were down 71% for all wader species.

Hydrology

This year's rainfall (Jan-July) was down 24% from the 26 year mean this is less than the 50% recorded for 2011. The coastal wetlands at Rookery Bay were again almost dry in June but seasonal Spring high tides prevented total dry down, then the rains picked up and water levels started coming back. There were hardly any wading birds using the coastal ponds.

Location and Methods

Rookery Bay: 26°01.721'N 81°44.573'W. This year one Red Mangrove island, 0.14 ha. Nest census conducted 4/16, 5/20, 6/17, boat, 2 observers 0.5 hour.

Marco Colony (ABC) (named, ABC Islands by State of Florida): 25°57.389'N 81°42.232'W. Three Red Mangrove islands, 2.08 ha.. Nest census conducted 4/13, 5/27, 6/27, one observer, boat 1.5 hours.

Smokehouse Key: 25°54.562'N-81°43.885'W. One island in Caxambas Pass, 0.8579 hectares (Red Mangrove; a little terrestrial vegetation on sand ridge in center). 4/22, 5/14, 6/12, boat, one hour, one observer.

Chokoloskee Bay: 25°50.834'N 81°24.71 0.'W. Four Red Mangrove islands, 0.2 ha. (about). This year the waders used all four islands, boat census, 3/30, 4/28, 5/29, two people, one hour.

Note: Although for some of the colonies several censuses were conducted the numbers of nests in the table (Fig. 1) represent peak numbers of nests.

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 are 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 (North and East), 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 every two weeks with one boat and two observers (one a volunteer). The boat is anchored so that most of the birds can be observed flying in one hour before sunset to one half hour after sunset. 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: These egrets started the nesting season with good numbers building up at both ABC and CHOK; then as last year dropped off fast and did not produce many young.
Small Waders (SNEG, LBHE, TRHE, and CAEG): Started late in small numbers and also fledged few young.
Reddish Egret: again had a fair number of nests (for them) that all fledged young.
White Ibis: Feel it is important to note; that although no WHIB attempted to nest on the coast (again). WHIB that left the coast to nest inland (as usual) apparently had a very productive year. This was indicated by the ABC sundown census for July; the number of adults and fledglings arriving are recorded separately. The mean number of fledglings arriving for the last 23 years in July (when new fledges start showing up) is 13% of the total WHIB recorded, this year it was 16%; up considerably from last year's 4%.

Note: Although last year RB did not have any nesting, this year after having moved the night roosting to a nearby island there were a few nests (Table #1).

Even when it seems the same it is not.

Table 1. Peak Wader Nests Counts in Coastal Southwest Florida 2012.

Colony	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	WHIB	GLIB	Total
Rookery Bay		6	1		1					8
Marco (ABC)	12	96	17	2	22	5	12			166
Smokehouse Key		25	18		3	2				48
Chokoloslee Bay		135	2							137
Total	12	262	38	2	26	7	12	0	0	359
Mean (30 yrs)	12	215	235	46	379	6	326	29	34	1282

Theodore H. Below
Avian Ecologist
3697 North Rd.
Naples, FL 34104
thaovb3rd@comcast.net

WADING BIRD NESTING AT LAKE OKEECHOBEE

Introduction

In 2005, Florida Atlantic University initiated wading bird nesting surveys on Lake Okeechobee to determine location and size of colonies as part of the CERP Monitoring and Assessment Plan. We reported the highest nesting effort on record in 2006 with 11,310 nests, and the lowest nesting effort on record in 2008, with 38 nests. Herein we report our findings for 2012.

Methods

From February through June of 2012, Florida Atlantic University conducted wading bird nesting surveys to determine timing and location of breeding populations as a part of the CERP Monitoring and Assessment Plan. The January flight was delayed so we based the January count on airboat reconnaissance and a flight on 2 February. We conducted the February flight on 22 February. Detailed methods are described in previous editions of the South Florida Wading Bird Report.

We obtained rainfall and hydrology data from the SFWMD's DBHYDRO database. We calculated lake stage as the mean of four principle gages in the pelagic zone of Lake Okeechobee (L001, L005, L006, and LZ40). All elevation data are presented in National Geodetic Vertical Datum 1929 (NGVD 1929) and locations are in North American Datum 1983 (NAD 1983). Historical stage data are from 1977 to the present, which corresponds to the time period of systematic aerial surveys.

Hydrology

January 2012 was the driest January on record in the SFWMD region since record keeping began in 1932 and spring temperatures were above average. Not surprisingly, water levels were below average; starting at 4.15 meters (13.6 ft) on 1 January and receding at a moderate pace until March (Fig. 1). In early March, storms occurred throughout the system and caused a slight increase in water levels, peaking at approximately 3.91 m (12.8 ft) on 11 March. Thereafter, water levels receded quickly reaching the lowest point on 13 May at 3.51 m (11.5 ft). The 2012 wet season began early on May 7, but the heavy rainfall started in June when the lake and surrounding area received 7.10 in of rain, which was 0.12 in above the historical average for that time of year (SFWMD press release).

Results and Discussion

Colony Location and Size

With the lake stage around 4.1 m (13.5 ft) at the start of the nesting season and dropping below 3.9 m (13 ft) by the end of February, most of the traditional marsh colony locations were surrounded by little or no water, making them unattractive to wading birds. We detected 16 colonies (Fig. 2), 14 on-lake and two off-lake, with an estimated total of 3,079 nests. We derived this number by summing the peak nesting month for each species except for Anhingas (ANHI) and Cattle Egrets (CAEG; Table 1). We began monitoring a small off-lake colony in Taylor Creek after 16 May when we were made aware that a Roseate Spoonbill (ROSP) was nesting there. For historical comparisons, the cumulative total for Great Egrets (GREG), Great blue Herons (GBHE), White Ibises (WHIB), and Snowy Egrets

(SNEG) was 2,029 nests, making 2012 just above the median count of the 32 years monitored since 1957 (Fig. 3). Most of the colonies were at traditional sites that were detected last year. The few exceptions include Indian Prairie 1, which was not active last year but had been in the past, two new Clewiston spoil island colonies, and two new GBHE colonies. One of the largest colonies this year was Little Bear Beach with over 300 nests. It was first detected in 2007 (Marx and Gawlik 2007), and remained inactive until this year.

We detected the majority of nests (67% excluding ANHI, and CAEG) at the Eagle Bay East colony (Table 2). The next two largest colonies, Little Bear Beach and Clewiston Out, each on spoil islands with over 300 nests, were primarily inhabited by SNEG and Tricolored Herons (TRHE) and produced 18% of the total nesting effort. Clewiston Channel, also a Clewiston spoil island, and Lakeport Marina, both with ≥150 nests, accommodated the majority of the GREG nesting. Dynamite Hole and Moonshine 4 contained <15 nesting GBHE each. Both colonies were inaccessible by airboat due to dense vegetation, and were first detected from helicopter while conducting other activities. They were never detected during aerial surveys. The six remaining colonies were all under 100 nests (excluding ANHI and CAEG) and primarily comprised of SNEG, TRHE and GREG.

Timing and Success
Airboat surveys during January detected only a few GBHE nests (Table 1). GREGs were the next species to initiate; Lakeport Marina was the first egret colony to form (detected 15 February) with seven GREGs incubating and another 26 GREGs displaying on nest platforms. We detected GREGs at Moonshine 1 and 3 during the 22 February aerial survey and on 28 February, GREGs laid eggs at Clewiston Spit. Small herons were next to initiate; we detected them at the remaining Clewiston spoil islands (Clewiston Mid, Clewiston Out and Clewiston Channel) on the 22 March aerial survey and by 17 April, chicks were starting to hatch. On 15 March, we observed SNEG and TRHE nest building in Eagle Bay Trail; however, by early-April the colony was overrun with CAEG. Ibis initiation was last this year; during routine airboat reconnaissance on 10 April, we observed roughly 700 WHIB and GLIB in Eagle Bay East but only GLIB had begun egg-laying. By 19 April roughly 3000 WHIB, SNEG and CAEG were nesting.

Although nest effort on the lake was about average, few chicks fledged. Clewiston Spit, one of the first colonies to be initiated, was abandoned by 13 March following storms with high winds and rain. Bird Island was abandoned in early-May coincident with the start of the wet season. On 11 May, Clewiston Out also was abandoned leaving many chicks to starve. By 22 May, Moonshine 3 was abandoned and Moonshine 1 had only 3 GREG nests. Clewiston Mid and Channel suffered enormous amounts of turnover causing many nests to never hatch. Eagle Bay East endured incessant turnover as well; storms throughout May wiped out many nest attempts by all species – each week, for every new nest established, 1 or 2 would be lost.

Wood Storks and Roseate Spoonbills
Wood Storks (WOST) have nested in a mixed species colony at an alligator farm about 4 km N of Harney Pond along County Road 721 from 2007 – 2010. Although the colony developed this year, WOST did not initiate nesting From March to May, we consistently observed a flock of roughly 100 ROSP foraging in Tin House Cove and roosting in the Indian Prairie 1 colony. While Botta and Gawlik (2009) reported ROSP nesting at this same location in 2009, subsequent ground visits showed no evidence of nesting this year. In May we were notified of a single ROSP nest in Taylor Creek, a suburb of Okeechobee City, which the homeowner reported had been an active wading bird colony, including WOST at one time, since at least the early 1950s. In late-May as the water levels were rising, the ROSP nest failed, presumably around the time the eggs hatched.

Environmental Conditions
The extremely low lake levels the previous year kept the littoral zone dry [lake level below 3.35 m (11 ft)] until October leaving little time for prey production. Throw-trap samples (Kushlan 1976) of aquatic prey in a separate study showed that mean prey density in 2011 was 165 ± 168 prey/m^2 with a maximum prey density of 936 prey/m^2, whereas the mean prey density in 2012 was only 87 ± 55 prey/m^2 with a maximum prey density of 267 prey/m^2 (Fig. 4; Chastant and Gawlik, unpubl. data). Fish populations in 2011, as well as nest effort, which fell within the top ten on record, were likely a response to high prey availability from high water in the wet season and an extended dry-down that began in September of the previous year (Fig. 4).

Acknowledgments
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Jennifer E Chastant
Dale E Gawlik
Department of Biological Sciences
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431-0991
561-297-3333
jchastan@fau.edu
dgawlik@fau.edu

UPCOMING MEETINGS

Joint Meeting of American Ornithologists' Union (131st) and Cooper Ornithological Society.
13-17, August 2013. Chicago, Illinois, USA.
- http://www.aou.org/meetings

The 20th Wildlife Society Annual Conference.
5-9, October. 2013. Milwaukee, Wisconsin, USA.
- http://wildlife.org/conferences

Figure 1. Comparisons of 2012 lake stage (m) and daily precipitation totals (cm) with the mean daily lake stage from 1977 to the present.

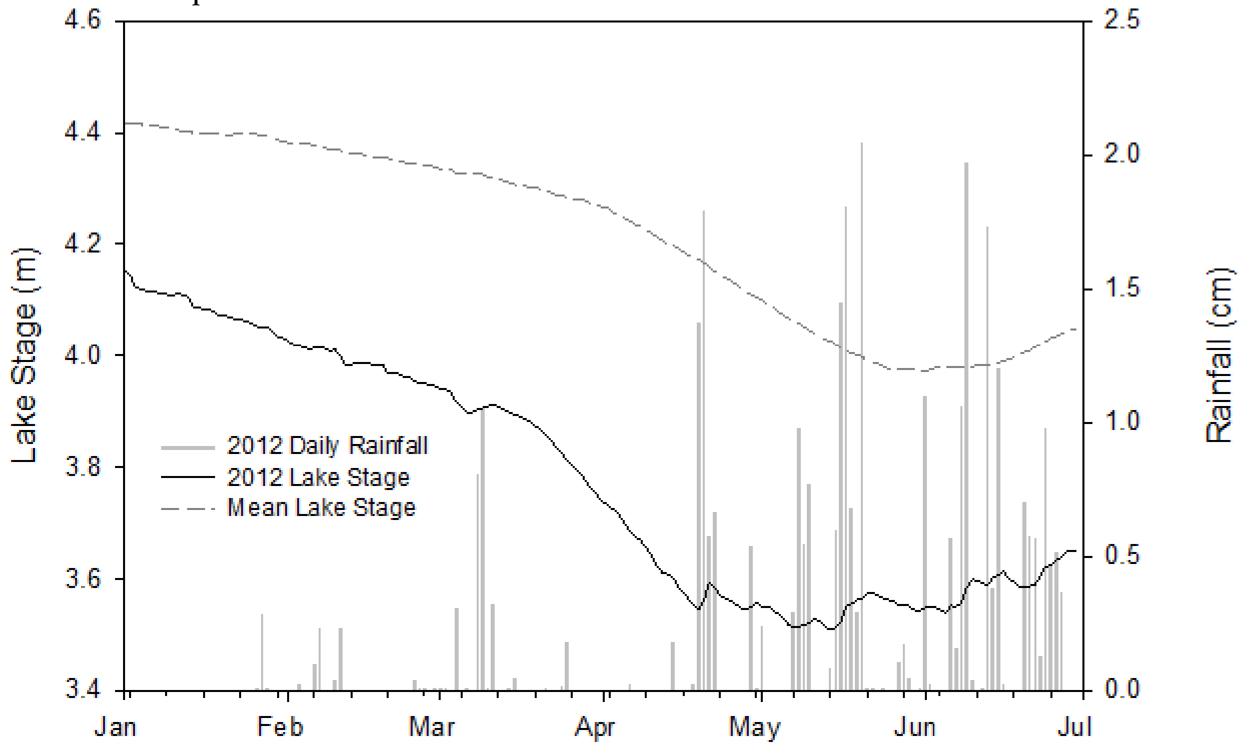


Table 1. Timing and nest effort for species breeding in wading bird colonies during 2012 at Lake Okeechobee. Bold denotes peak nest effort for species included in grand total.

Month	GREG	GBHE	WHIB	SNEG	LBHE	TRHE	WOST	GLIB	ROSP	CAEG	ANHI	Peak nest
January	---	6	---	---	---	---	---	---	---	---	---	6
February	40	86	---	---	---	---	---	---	---	---	---	126
March	407	25	---	385	---	100	---	---	---[2]	---	10	917
April	397	16	800	797	5	283	---[2]	700	---[2]	550	22	2998
May	235	10	600	445	5	125	---	500	*1*	1150	8	1921
June	98	---	80	172	---	---	---	50	---	1050	---	400

[1] Does not include CAEG or ANHI

[2] Species detected during monthly survey effort but never seen nesting

Table 2. Geographic coordinates (NAD 83) and species-specific peak nest efforts in detected colonies during the 2012 breeding season at Lake Okeechobee.

Colony	Peak Month[1]	Lattitude	Longitude	GREG	GBHE	WHIB	SNEG	LBHE	TRHE	WOST	GLIB	ROSP	CAEG	ANHI	Total[1]
Bird Island	APR	26.97199	-81.00917	---[2]	4	---	3	---	2	---	---	---	---	---	9
Clewiston Channel	APR	26.78324	-80.89298	15	---	---	70	---	65	---	---	---	---	---	150
Clewiston Mid	APR	26.77965	-80.90157	---	---	---	25	---	10	---	---	---	---	---	35
Clewiston Out	APR	26.78091	-80.89850	30	---	---	120	---	180	---	---	---	---	---	330
Clewiston Spit	FEB	26.77658	-80.90914	25	1	---	---	---	---	---	---	---	---	---	26
Dynamite Hole	FEB	26.69746	-80.77078	---	12	---	---	---	---	---	---	---	---	---	12
Eagle Bay East	MAY	27.17987	-80.83080	---	15	900	600	2	50	---	800	---	1000	5	2367
Eagle Bay Trail	MAR	27.18659	-80.83056	---	2	---[2]	45	---	45	---	---	---	100	---	92
Gator Farm	APR	27.02278	-81.06084	130	---	---	250	---	---	---	---	---	400	---	380
Indian Prairie 1	APR	27.08526	-80.88613	---	---	---	---	---	---	---	---	---[2]	---	15	---
Lakeport Marina	MAR	26.97260	-81.11440	100	1	---	50	1	12	---	---	---	600	---	164
Little Bear Beach	APR	26.72139	-80.84222	25	---	---	225	---	75	---	---	---	---	---	325
Moonshine 1	MAR	26.91292	-81.02474	10	1	---	10	---	---	---	---	---	---	---	21
Moonshine 3	MAR	26.92755	-81.03479	5	---	---	10	---	---	---	---	---	---	---	15
Moonshine 4	FEB	26.92600	-81.01903	---	7	---	---	---	---	---	---	---	---	---	7
Taylor Creek	MAR	27.21569	-80.79831	250	50	---	---	---	---	---	---	1	---	10	301

[1] Does not include CAEG or ANHI [2] Species detected during monthly survey effort but never seen nesting

Figure 2. Map of wading bird colonies observed at Lake Okeechobee from January to June 2012.

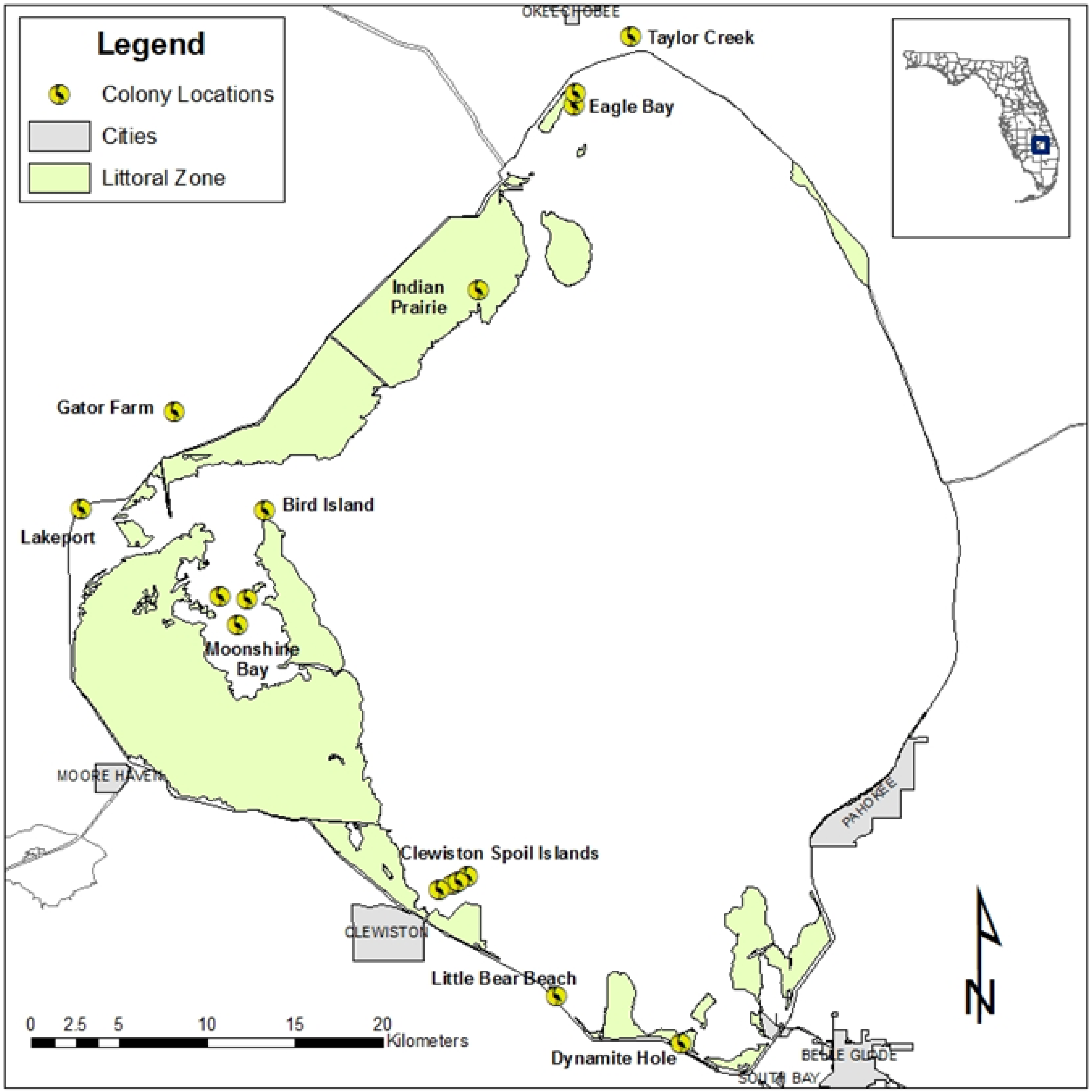


Figure 3. Historic record of wading bird nesting on Lake Okeechobee (four species include GBHE, GREG, SNEG, WHIB). Data for the following years are not available: 1961-1970, 1973, 1976, and 1993–2004.

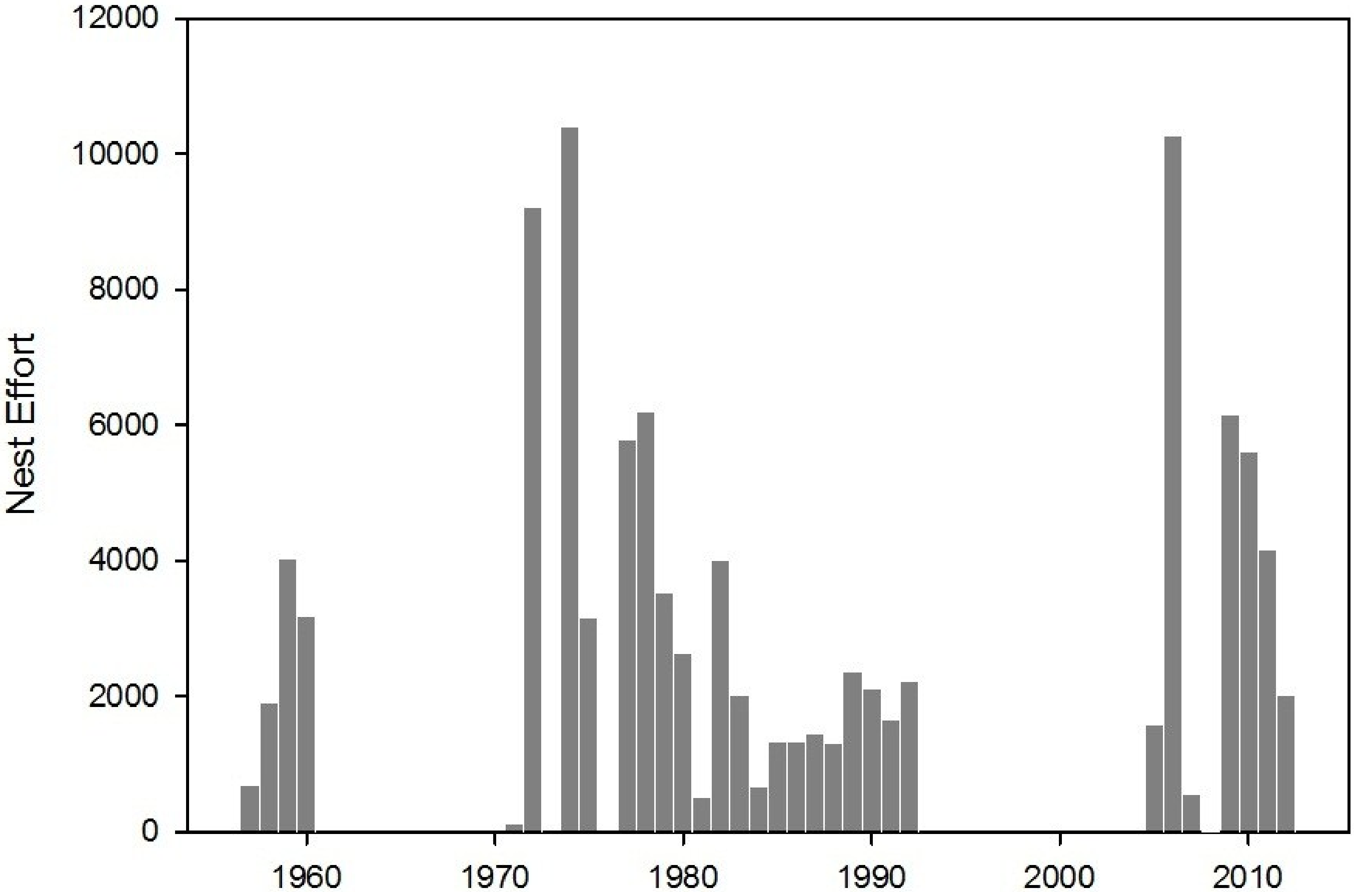
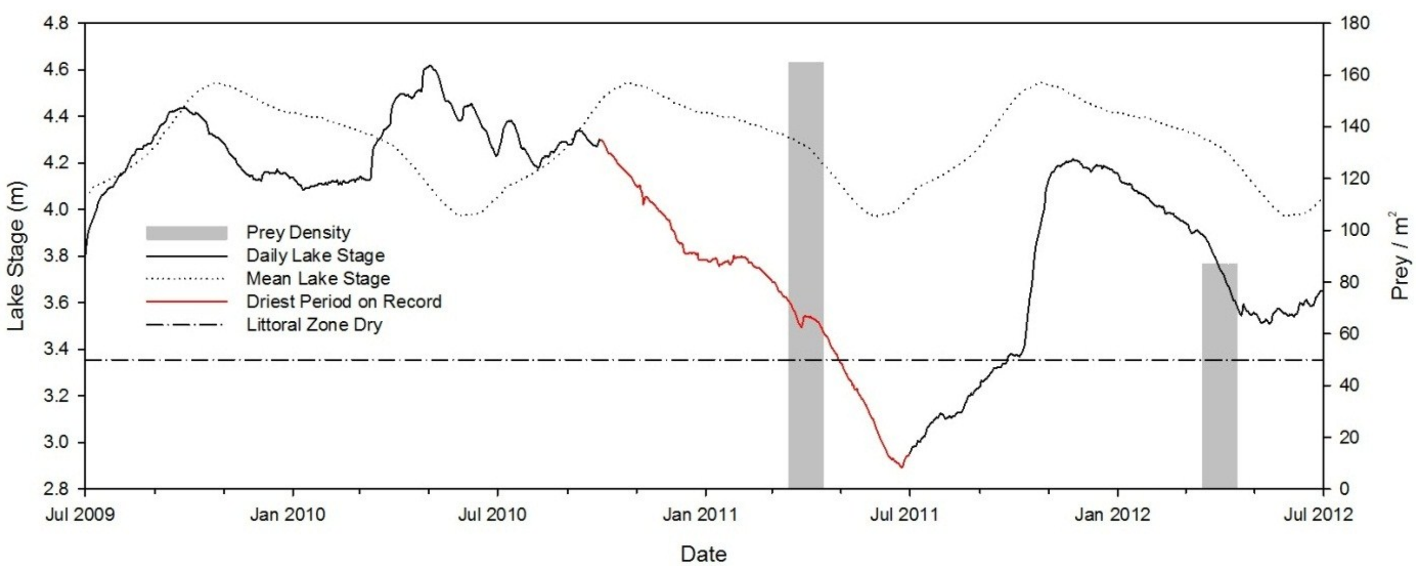


Figure 4. Lake Okeechobee hydrograph from the 2009 wet season – 2012 dry season with the mean daily lake stage from 1977 to the present. When lake levels fall below 3.35 m (11 ft), the majority of the littoral zone marsh is dry. We are currently developing predictive models that link nesting and hydrology on the lake, which we expect to significantly aid management by increasing the certainty of how wading birds will respond to changes in hydrology.



KISSIMMEE RIVER

The South Florida Water Management District (SFWMD) surveys wading bird nesting colonies and foraging wading bird abundance along the Kissimmee River as part of the Kissimmee River Restoration Evaluation Program (KRREP)(Williams and Melvin 2005, 2005a). To date, approximately 7,710 acres of wetland habitat (ca. ½ of project total) has been restored and the interim response of foraging wading birds has exceeded expectations (Bousquin et al. 2010). While there is no formal expectation for wading bird nesting effort, the number and size of colonies that have formed along the river since restoration began in 2001 has been below the historical average (Williams and Melvin 2005). All construction is scheduled for completion by the end of 2015, when new water regulation schedules for headwater lakes and the river will also be implemented, further improving wading bird habitat. Wading bird responses to the river restoration project will be monitored through 2020.

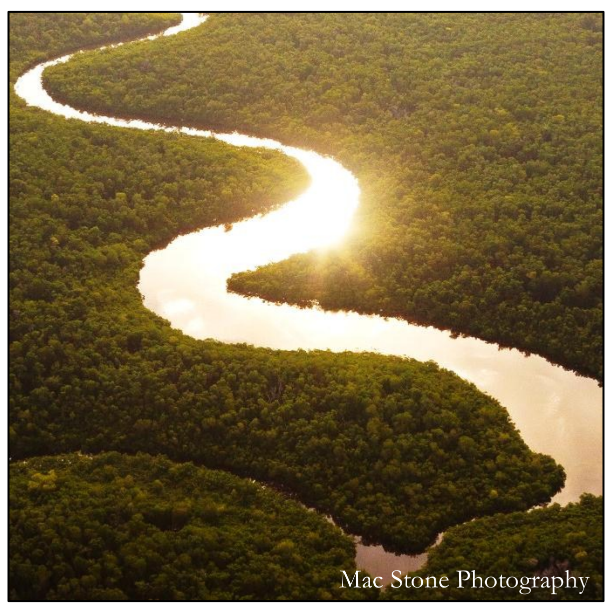
Methods

As part of the KRREP, the SFWMD performed systematic aerial surveys on March 6, April 9, and Jun 5, 2012, to search for wading bird nesting colonies within the Kissimmee River floodplain and surrounding wetland-upland complex approximately 3 km east and west of the 100 year flood line (Figure 1). Nesting colonies were also monitored, when encountered, during separate aerial surveys of foraging wading birds on January 17, February 13, March 13, April 17, and May 14, 2012. Known colonies in Lakes Mary Jane, Kissimmee (Rabbit Island), and Istokpoga were surveyed at least once. Observers were placed on both sides of a helicopter flying at an altitude of 244 m along east-west transects spaced 2 km apart. Once a colony was located, nesting species and the number of active nests were visually estimated by the principal observer while photographs were taken by another observer. Nest counts were also obtained later from the digital photos to improve the accuracy of initial counts made from the air. The number of nests reported here represent the maximum number of nests for each species observed. It is likely the nests for a relatively small number of dark-colored birds, such as little blue heron (*Egretta caerulea*), glossy ibis (*Plegadis falcinellus*), tricolored heron (*Egretta tricolor*), yellow-crowned night heron (*Nyctanassa violacea*) and black-crowned night heron (*Nycticorax nycticorax*), were undercounted during the aerial surveys because of their lower visibility from above (Frederick et al., 1996). Thus, the colony totals presented in Tables 1and 2) are considered conservative. Nest fate and nesting success were not monitored but one ground survey was conducted at the S-65C colony on April 25 to obtain a more accurate nest count and determine the presence of less visible dark-colored species.

Results

Four colonies were active within the Kissimmee River Floodplain (Table 1, Figure 1), the relatively large S-65C colony, and three much smaller colonies, Melaleuca Island, River Ranch, and Orange Grove. Nesting effort along the Kissimmee River was dominated by the terrestrial cattle egret (*Bubulcus ibis*) (~1202 nest), while nesting by aquatic wading bird species (e.g. great blue heron (*Ardea herodias*) great egret (*Ardea alba*) and snowy egret (*Egretta thula*)) was limited (~160 nests). The remaining three colonies were observed in Lakes Mary Jane, Kissimmee, and Istokpoga. The colonies on Lakes Mary Jane and Istokpoga were dominated by aquatic species, while nesters on Lake Kissimmee were mostly cattle egret. (Figure 1). The second largest colony to form this year after S-65C was in Lake Kissimmee on Rabbit Island, which has supported the largest number of aquatic wading bird species (i.e. excluding cattle egrets) in both the Upper and Lower Kissimmee basins in recent years. The number of nests of aquatic species at the Rabbit Island colony this year was down from 2011 by approximately 408 nests (≈43.4%), largely due to lower numbers of nesting white ibis (*Eudocimus albus*), down by 384 nests (≈71.0%)(Table 1; Cook and Kobza 2011). Cattle egret nests in this colony increased by 295 (≈84.3%). Lake Mary Jane, the third largest colony this season, had an increase in cattle egret (235 nests) and white ibis (119 nests) over last year, when neither of these species nested in the lake. The total number of aquatic species nests on the island was up by 92 (≈23%) over last year. Bumblebee Island in Lake Istokpoga, the fourth significant colony, had a decrease in the number of both cattle egret (306 nests, ≈80.3%) and white ibis (50 nests, 100%), with an overall decrease in aquatic species on the island of 45 nests (≈15.3%)(Table 1). The total number of aquatic species nesting within both the Kissimmee River and Upper Chain of Lakes Basins was down by approximately 293 nests (≈17.0%), while the number of cattle egret nests was up by approximately 675 (≈45.5%)(Table 2). The peak number of nests of all aquatic species combined was observed during the April survey, while the peak number of nests of the terrestrial cattle egret was observed during June.

The continued small numbers of aquatic species nesting along the restored portion of the river suggests that prey availability on the floodplain is not yet sufficient to support the completion of breeding for these wetland dependent birds. While foraging conditions can become optimal for foraging wading birds (see Foraging Abundance below) on the floodplain, the timing and magnitude of floodplain inundation and recession is not yet optimal for rookery formation due to operational constraints. Implementation of the regulation schedule for the Headwaters Revitalization Project in 2015 will allow water managers to more closely mimic the historical stage and discharge characteristics of the river, presumably leading to suitable hydrologic conditions for wading bird nesting colonies.



Mac Stone Photography

Table 1. Peak numbers of wading bird nests inside or within 3 km of the Kissimmee River 100 yr flood line between Lake Kissimmee and S65-D structures during 2012 (Mar, Apr, and Jun).

Lat, Long	Colony Name (Location)	CAEG	GREG	WHIB	SNEG	GBHE	SMDH	GLIB	BCNH	Total
27.8078, -81.2512	Melaleuca Island	-	-	-	-	12	-	-	-	12
27.7747, -81.1857	River Ranch Island (Island in C-38 canal; east of River Ranch Resort)	-	2	-	-	2	-	-	-	4
27.3176, -81.0305	S-65C boat ramp (Approx. 0.6 mile SW of ramp)	1,202	-	-	18	-	108	-	-	1,328
27.3595, -81.093	Orange Grove (1.0 mile SW of Pool D floodplain)	-	-	-	-	18	-	-	-	18

Table. 2. Peak numbers of wading bird nests inside or within 3 km of the Kissimmee River 100 yr flood line between S-65 and S65-D structures and within Lakes Mary Jane, Kissimmee, and Istokpoga. Surveys were conducted Mar-Jun, 2004; Mar-Jun, 2005; Feb-Jun, 2006; May-Jul 2007; Jan-May 2008; Feb-Apr 2009; Feb-May 2010, February-May 2011, and March, April, and June 2012.

Kissimmee River

Year	CAEG	GREG	WHIB	SNEG	GBHE	LBHE	TRHE	SMDH	BCNH	Total
2004	-	-	-	-	-	-	-	-	-	-
2005	400	81	-	-	5	-	-	-	-	486
2006	500	133	-	-	4	-	-	-	-	637
2007	226	-	-	-	-	-	1	-	-	227
2008	-	2	-	-	4	-	-	-	-	6
2009	240	126	-	-	27	11	3	-	-	407
2010	891	35	-	-	31	22	15	-	-	994
2011	751	14	-	8	35	26	9	-	-	843
2012	1,202	2	-	18	32	-	-	108	-	1,362
Total	4,210	393	-	26	126	59	28	108	-	4,962

Lake Mary Jane

Year	CAEG	GREG	WHIB	SNEG	GBHE	LBHE	TRHE	WOST	BCNH	Total
2010	-	250	-	-	-	-	-	100	1	351
2011	-	200	-	-	-	-	-	200	-	400
2012	235	176	119	25	-	-	-	172	-	727
Total	235	626	119	25	-	-	-	472	1	1,478

Lake Kissimmee

Year	CAEG	GREG	WHIB	SNEG	GBHE	LBHE	TRHE	GLIB	BCNH	Total
2009	740	150	75	-	50	42	87	10	3	1,157
2010	200	249	1,156	-	59	-	-	-	-	1,664
2011	350	250	540	75	75	-	-	-	-	1,290
2012	645	250	156	39	87	-	-	-	-	1,177
Total	1,935	899	1,927	114	271	42	87	10	3	5,288

Lake Istokpoga

Year	CAEG	GREG	WHIB	SNEG	GBHE	LBHE	TRHE	WOST	BCNH	Total
2010	103	325	110	-	75	-	-	-	-	613
2011	381	200	50	-	45	-	-	-	-	676
2012	75	175	-	-	75	-	-	-	-	325
Total	559	700	160	-	195	-	-	-	-	1,614

CAEG = cattle egret (*Bubulcus ibis*)
GREG = great egret (*Ardea alba*)
WHIB = white ibis (*Eudocimus albus*)
SNEG = snowy egret (*Egretta thula*)
GBHE = great blue heron (*Ardea herodias*)
LBHE = little blue heron (Egretta caerulea)
TRHE = tricolored heron (Egretta tricolor)
GLIB = glossy ibis (Plegadis falcinellus)
WOST = wood stork (Mycteria americana)
BCNH = black-crowned night heron (Nycticorax nycticorax)
SMWH = small white heron (snowy egret and juvenile little blue heron combined)
SMDH = small dark heron (little blue heron and tricolored heron combined)

Figure 1. Aerial survey transect routes and nesting colony sites within the Kissimmee River floodplain and surrounding wetland/upland complex during 2012. The Lake Mary Jane colony (not shown) is approximately 30 miles to the north-northeast of Lake Kissimmee and 16 miles southeast of Orlando.

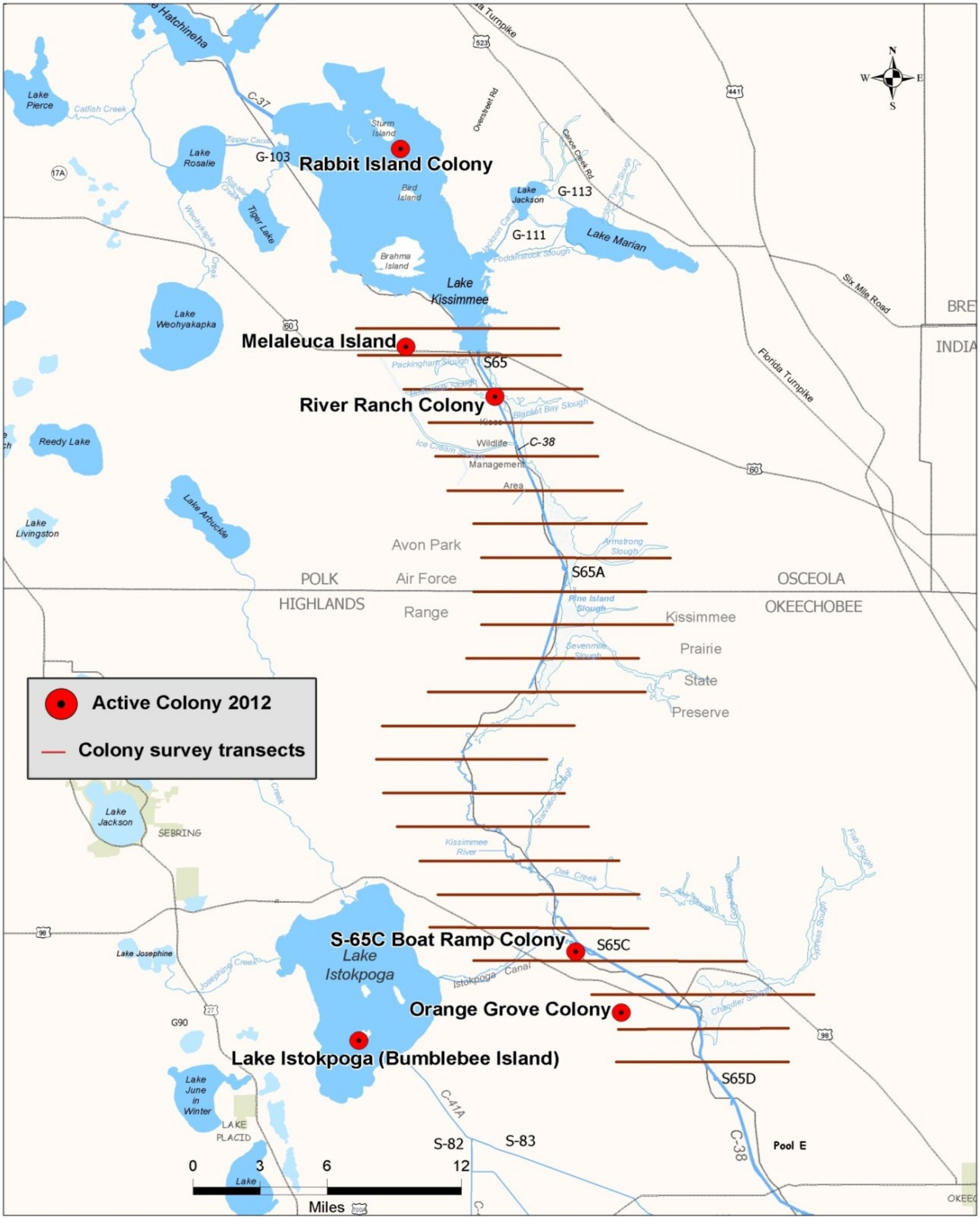
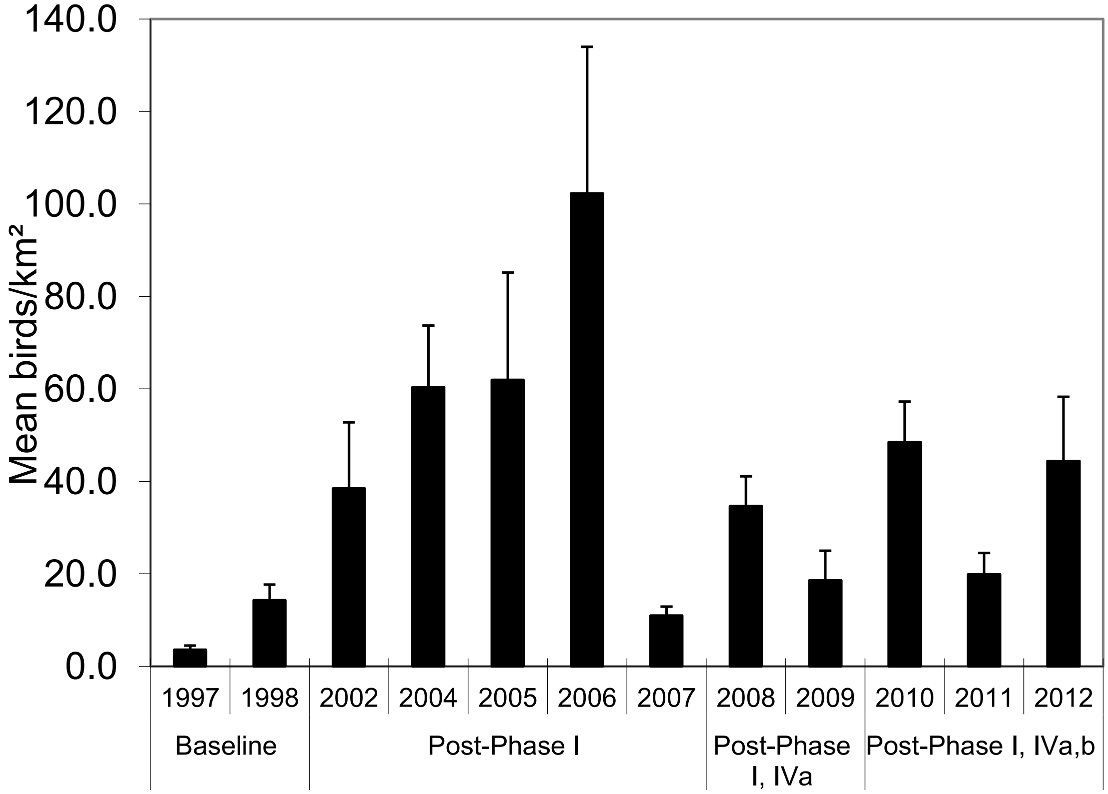


Figure 2. Baseline and post-Phases I, IVa, and IVb mean abundance (± SE) of long-legged wading birds (excluding cattle egrets) per square kilometer (birds/km²) during the dry season (Dec-May) within the 100-year flood line of the Kissimmee River. Baseline abundance was measured in the Phase I area prior to restoration. Post-restoration abundance was measured beginning approximately 10 months following completion of Phase I.



Kissimmee River Foraging Abundance

Methods

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 1 for structure locations). Each month, a minimum of 20 percent of the 100-year floodplain was surveyed in both the restored and unrestored portions of the river/floodplain. Surveys were conducted via helicopter flying at an altitude of 30.5 m and a speed of 80 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).

Results

Prior to the restoration project, dry season abundance of long-legged wading birds in the Phase I restoration area averaged ± SE 3.6 ± 0.9 birds/km² in 1997 and 14.3 ± 3.4 birds/km² in 1998. Since completion of Phases I, IVA, and IVB of restoration construction in 2001, 2007, and 2009, respectively, abundance has exceeded the restoration expectation of 30.6 birds/km² (evaluated as a three-year running average), except during 2007–2009 and 2009–2011 (Table 3, Figure 2).

Table 3. Post-restoration abundance (three-year running averages (± SE)) of long-legged wading birds excluding cattle egrets during the dry season (December–May) within the Phase I, IVA, and IVB restoration areas of the Kissimmee River. The restoration expectation for wading bird abundance is 30.6 birds per square kilometers (birds/km²) (three-year running average).

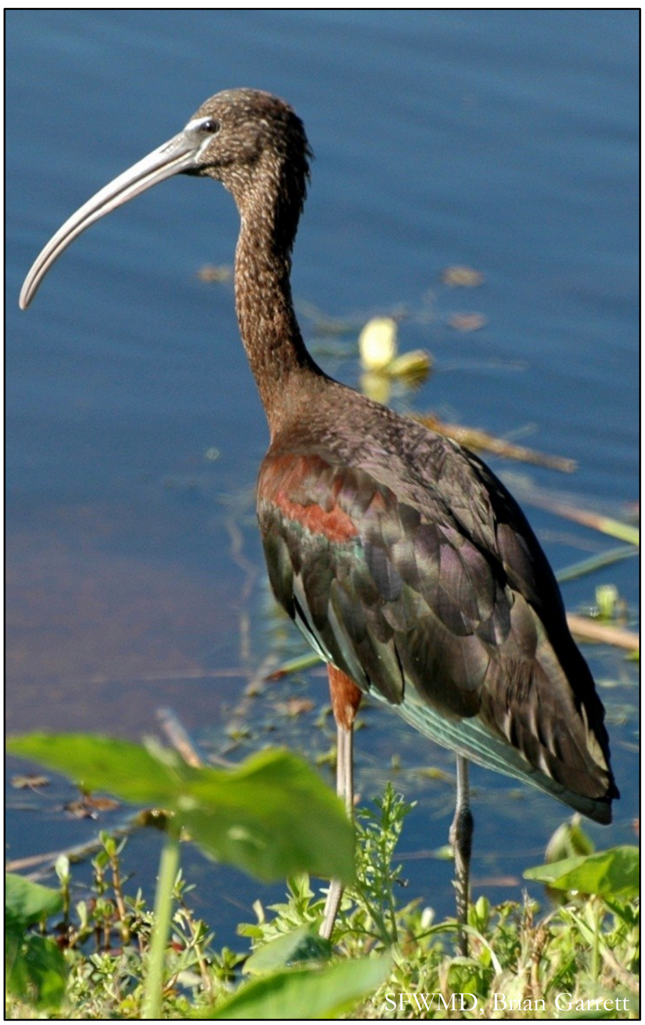
Period	Three-year Running Average ± SE
2002–2004	65.4 ± 5.1
2003–2005	74.3 ± 3.5
2004–2006	76.4 ± 4.8
2005–2007	58.9 ± 8.8
2006–2008	49.3 ± 27.4
2007–2009	21.4 ± 7.0
2008–2010	33.9 ± 8.6
2009–2011	29.0 ± 9.8
2010-2012	37.6 ± 9.0

Mean monthly wading bird abundance within the restored portions of the river during the 2011–2012 season (44.4 birds/km²) was more than double last year's estimate of 19.9 birds/km², bringing the three-year running average back above the restoration target of 30.6 birds/km². Wading bird numbers were low in November 2011 due to high water levels following the record-setting rainfall in October (Bousquin et al. 2012).

Numbers gradually increased from December through March and were slightly above their respective monthly averages. The March abundance estimate was extremely high at over 105 birds/km^2, during which time a record-setting single foraging flock was observed consisting of at least 2,123 wading birds, with an additional 237 white pelicans; the largest single congregation of waterbirds observed since restoration began in 2001. Wading bird abundance declined by roughly half in April to 46.8 birds/km^2, then dropped dramatically to only 2.1 birds/km^2 in May when the floodplain was essentially dry, the single lowest monthly abundance of wading birds recorded since restoration began.

White ibis and glossy ibis dominated numerically, followed in order of abundance by great egret (*Ardea alba*), cattle egret, small white herons (snowy egrets and juvenile little blue herons), wood stork (*Mycteria americana*), great blue heron (*Ardea herodias*), small dark herons (tricolored herons and adult little blue herons), black-crowned night-heron, roseate spoonbill (*Platalea ajaja*), and yellow-crowned night heron.

Michael D. Cheek
Kissimmee Division
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406
561.682.6616
mcheek@sfwmd.gov



SFWMD, Brian Garrett

ESTERO BAY AQUATIC PRESERVE COLONIAL WADING BIRD NEST MONITORING AND PROTECTION PROGRAM

Introduction

Estero Bay was designated as Florida's first aquatic preserve in 1966 and is managed under the Florida Department of Environmental Protection's Office of Coastal and Aquatic Managed Areas. The Estero Bay Aquatic Preserve consists of approximately 11,000 acres of sovereign submerged lands and is located in southwest Florida. The shallow estuary is designated as an Outstanding Florida Waterbody by the Florida Department of Environmental Protection and is fed by five freshwater tributaries and four passes connecting to the Gulf of Mexico. Small mangrove islands are located throughout the bay; 20 of which have been documented as breeding colonies for a variety of bird species, including 10 species of wading birds and three species of diving birds.

Nesting surveys in Estero Bay began in 1977 and the program has implemented a variety of survey techniques throughout its history. Since 2008, Estero Bay Aquatic Preserve staff and volunteers have conducted monthly nest counts throughout the nesting season. This program provides peak estimates of nesting effort for each species of colonial nesting bird; monitors population trends; maintains a current atlas of historic and active colonies; documents human disturbance; documents the number of entanglements and fatalities due to fishing-line and trash; and increases community involvement through volunteerism and by engaging and educating the public. Long-term monitoring data of wading and diving bird populations is an important resource for aquatic preserve managers who are tasked with preserving the bay in its *essentially natural or existing condition so that their aesthetic, biological and scientific values may endure for the enjoyment of future generations Chapter 18-20.001(2) F.A.C.*

Methods

Islands within the aquatic preserve and state owned islands bordering the aquatic preserve were monitored for nesting birds once a month, starting in January and continuing through the end of nesting season. Nineteen islands were monitored monthly January through July and one island, Big Bird Island, was monitored in July when a Great Blue Heron began nesting there.

A 17' Boston Whaler was used to conduct surveys. Each island was circled at a consistent speed, approximately 1.7 mph, while keeping a distance of approximately 100 feet from the island. Two observers conducted counts indicating the number of nests by species and nesting stage. Nests were recorded as *empty* if no birds or eggs were observed (those numbers were not included in the analyses); *unknown* if an adult was present at the nest but no eggs or chicks were visible or if the pair was copulating; *incubating* if the adult was in an incubating posture or if eggs were visible; or *chicks* if chicks were present in the nest or the vicinity of the nest.

Survey data collected between January and July 2012 were analyzed for this report. Surveys were conducted on 1/17, 1/18, 2/15, 2/16, 3/14, 3/15, 4/11, 4/12, 5/16, 5/22, 5/23, 6/13, 6/14, 6/18, 7/12 and 7/16.

Results

Seventeen of the 20 islands surveyed contained 1 or more active nests between January and June of 2012. The peak nest count was 374 (Table 1) with the highest peak nest count, 163 active nests, recorded at the Matanzas Pass colony. In January, GBHE, GREG, DCCO and BRPE were recorded with a combined nest count of 106. Nesting activity peaked in May with 231 active nests and in July GBHE, TRHE, LBHE, SNEG, GREG, REEG, YCNH, BCNH, GRHE, DCCO and BRPE were recorded with a combined active nest count of 101.

Peak nest counts in EBAP had been decreasing annually since 2008; 2008 (N=534), 2009 (N=428), 2010 (N=424) and 2011 (N=351). However, in 2012 nest counts increased seven percent from 2011. Seven species showed an increase in nesting effort from 2011 including GREG, SNEG, LBHE, TRHE, REEG, YCNH and GRHE. Nesting effort decreased in BRPE, GBHE and BCNH populations. CAEG and ANHI showed no change in nesting effort from the 2011 nesting season.

Species Summaries

*Double-crested Cormorant (DCCO)***.** DCCO nests were documented on six islands with nest numbers ranging between two and 28. DCCO nests were recorded January through July; nesting activity peaked in January with 46 active nests. Peak nest counts for DCCO were 61.

Brown Pelican (BRPE). Active BRPE nests were recorded January through July nests on three islands with a peak nest count of 87. Peak nesting effort occurred in May with 82 active nests.

*Great Blue Heron (GBHE)***.** Nesting activities were recorded January through July and peak nesting activity occurred in March with 48 active nests. GBHE nested on ten islands with an annual peak nest count of 52. In January and February one **Great White Heron** nest was documented on Matanzas Island; however no chicks were observed.

*Great Egret (GREG)***.** Sixty active GREG nests were documented in April at the peak of nesting season and an annual peak nest count of 69 was recorded for the season. Active nests were recorded January through July with nesting occurring on six islands.

*Snowy Egret (SNEG)***.** Nests were documented on three islands with an annual peak nest count of 32. SNEG nests were documented between February and July and nesting peaked in May with 28 active nests.

Little Blue Heron (LBHE). Active nests were documented March through July and nesting activity peaking in May with 13 nests. LBHE nesting activity was recorded on four islands with a peak nest count of 15.

*Tri-colored Heron (TRHE)***.** TRHE were documented on three islands with a peak count of 19. Active nests were documented between March and July and nesting activity peaked in July with 18 nests.

Reddish Egret (REEG). Nesting activity was documented on four islands with a peak nest count of nine. REEG nests were documented in March, May, June and July. Peak nesting activity was documented in July with eight active nests.

Black-crowned Night-Heron (BCNH). BCNH were documented on three islands with a peak nest count of six. Nesting was documented between April and July with peak nesting activity recorded in June with four active nests.

Yellow-crowned Night-Heron (YCNH). Nested activity was documented on nine islands with a peak nest count of 17. Active nests were documented between March and July with the peak of nesting activity occurring in April with 11 active nests.

Green Heron (GRHE). Nesting activity was recorded on four islands with a peak nest count of five. GRHE nesting activity was recorded May through June with two nests documented in May and July and one nest documented in June.

Cattle Egret (CAEG). Two CAEG nests were documented in May on Matanzas Island.

Acknowledgments

Thank you to all the volunteers that have donated countless hours to this program; your knowledge, skills and passion have made this program a success. Thank you to Lover's Key State Park and Lee County Parks and Recreation for providing launching and parking facilities.

Cheryl Parrott Clark
Environmental Specialist I
Estero Bay Aquatic Preserve
Coastal and Aquatic Managed Areas
Department of Environmental Protection
700-1 Fisherman's Wharf
Fort Myers Beach, Florida 33931
(239) 463-3240
Cheryl.Clark@dep.state.fl.us

Table 1. Peak numbers of nests found in Estero Bay Aquatic Preserve colonies between January and July 2012.

Colony	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	BCNH	YCNH	GRHE	CAEG	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	0	2	2	0	4
Big Bird Island*	26.38286	-81.84995	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Big Carlos Pass M-43	26.43155	-81.90066	0	0	0	1	0	0	0	3	0	0	4	0	0	8
Big Carlos Pass M-48	26.42771	-81.90050	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Big Carlos Pass M-50&52	26.42244	-81.89527	2	0	0	0	0	0	0	0	0	0	1	0	0	3
Big Carlos Pass S of M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	1	1	0	2
Big Carlos Pass W of M-46	26.42926	-81.90137	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-52	26.42469	-81.89359	7	0	0	1	10	3	1	2	2	2	1	0	0	29
Big Hickory E of M-85	26.35315	-81.84164	7	0	0	13	9	0	1	0	0	0	0	0	0	30
Big Hickory M-83	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Big Hickory M-49 2NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Big Hickory M-49 3NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Coconut Point East	26.38411	-81.84905	28	0	30	7	4	0	0	0	0	0	0	0	0	69
Coconut Point West	26.38111	-81.84976	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hogue Channel M-78	26.34988	-81.84644	0	0	0	1	0	0	0	0	0	2	5	0	0	8
Matanzas Pass	26.46092	-81.95717	14	0	55	12	21	26	12	14	4	2	1	0	2	163
New Pass M-21	26.38865	-81.85925	0	0	0	2	0	0	0	0	0	0	0	0	0	2
New Pass M-9	26.40465	-81.86816	3	0	2	3	1	0	0	0	2	0	0	0	0	11
North Coconut E of M-3	26.41131	-81.85486	0	0	0	11	24	3	1	0	1	0	0	0	0	40
North Coconut M-4	26.40737	-81.85998	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			61	0	87	52	69	32	15	19	9	6	17	5	2	374

* NOTES Nesting activity was observed on Big Bird Island in July 2012; prior to this date the island was not monitored.

CHARLOTTE HARBOR AQUATIC PRESERVES AND J.N. "DING" DARLING NATIONAL WILDLIFE REFUGE COLONIAL WADING AND DIVING BIRD NEST MONITORING

Introduction/Background

For five consecutive years, staff at Charlotte Harbor Aquatic Preserves (CHAP), a field site of the Office of Coastal and Aquatic Managed Areas (CAMA) of the Florida Department of Environmental Protection (FDEP) and J.N. "Ding" Darling National Wildlife Refuge (NWR) have been conducting colonial nesting bird surveys within the Ding Darling NWR Complex, and the Matlacha Pass, Pine Island Sound, Gasparilla Sound-Charlotte Harbor, Cape Haze, and Lemon Bay Aquatic Preserves (Figure 1). Colonial wading and diving bird nest monitoring began in 2008 with 9 islands and expanded to 34 islands in 2011. Goals of this continuous study include documenting population trends; biodiversity on islands; and the nesting shifts and efforts of wading and diving bird species.

Methods

The study area was divided between the two agencies based on location. J.N. "Ding" Darling staff monitored islands in South Matlacha Pass, San Carlos Bay, and South Pine Island Sound. FDEP/CHAP staff monitored islands in North Matlacha Pass, North Pine Island Sound, Gasparilla Sound, Lemon Bay, and Cape Haze. Both agencies employ a direct count method with a primary observer, secondary observer, boat captain, and data recorder. Islands were circled by boat and individual nests were recorded according to species. Nests were recorded as *incubating*, *chicks*, or *unknown* if the nesting stage could not be determined. Nests were documented as *incubating* when an adult was sitting on the nest in a crouched position shading the nest. *Chicks* was used when juvenile birds were visible in or near the nest. Data collected during the months of February through June 2011 and 2012 were analyzed for this report. Peak numbers reflect the highest number per species throughout the survey period. The number of total peak nests for all species combined were calculated for each island, as well. Monthly surveys will continue through 2012.

Results

The total peak nesting effort for 2011 was 1,473 (Table 1) compared to 1,211 in 2012 (Table 2). This resulted in a 17.8% nesting effort decline between the 2011 and 2012 season. Both years shared the same number of active islands; 28 out of 34 total islands monitored. Individual islands ranged from having 1 nest to 334 nests in 2011 and 1 nest to 247 nests for 2012 respectively. The highest peak nesting effort occurred on Hemp Key during both years with 334 recorded in 2011 and 247 in 2012.

The most abundant nesting species for both years were DCCO and BRPE with peak nests counts of 765 and 416 in 2011 and 557 and 333 in 2012. This resulted in a 27.2% decrease in DCCO and 20.0% decrease in BRPE. A 19.1% decrease in GREG occurred from 2011 to 2012 with a peak nest count of 94 to 76 respectively. Compared to 2011, there were some increases in 2012 species nest peaks. GBHE increased 6.2% from a count of 145 to 154 and SNEG increased 196% from23 to 68 nests.

Shifts in biodiversity occurred between islands during 2011 and 2012. The greatest diversity of colonial nesters was found in 2011 on Tarpon Bay Keys located in the J.N. Ding Darling NWR. 8 species were recorded including GBHE, TRHE, LBHE, YCNH, GREG, SNEG, REEG, DCCO, and BRPE. In 2012, White Pelican Island, located in Cape Haze Aquatic Preserve, had the greatest diversity, also with 8 species including GBHE, LBHE, SNEG, GREG, REEG, YCNH, BCNH, and DCCO. Thirteen wading and diving species were documented nesting in 2011 while 2012 only had 10 species nesting.

Tara Wertz
J.N. Ding Darling National Wildlife Refuge
1 Wildlife Drive
Sanibel, FL 33957
(239) 472-1100 x231
Tara_Wertz@fws.gov

Mary McMurray
Charlotte Harbor Aquatic Preserves
12301 Burnt Store Road
Punta Gorda, FL 33955
(941) 575-5861 x 111
Mary.McMurray@dep.state.fl.us

Figure 1. Locations of monitored colonial rookeries in the Charlotte Harbor Aquatic Preserves and J.N. Ding Darling NWR Complex

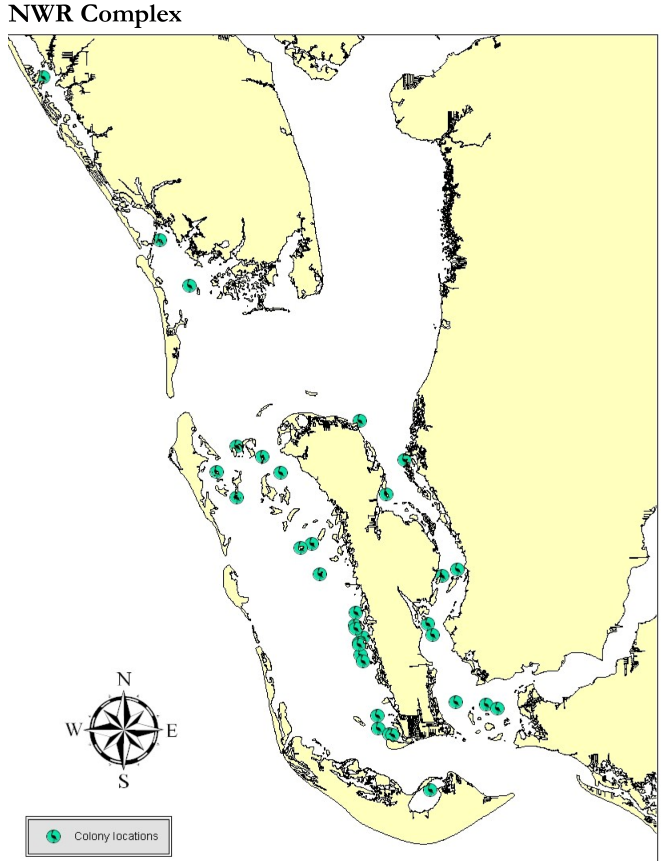


Table 1. Colonial nesting bird peak counts for Charlotte Harbor Aquatic Preserves and J.N Ding Darling NWR complex between February and June 2011.

COLONY (ISLAND)	Lat	Long	GBHE	TRHE	LBHE	SNEG	GREG	REEG	CAEG	YCNH	BCNH	GRHE	WHIB	BRPE	DCCO	ANHI	Total
Benedict Island	26.6200	-82.1585	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bird Keys	26.6679	-82.2276	0	0	0	0	0	0	0	0	0	0	0	0	24	0	24
Bird Rookery Keys	26.6742	-82.0897	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Bodifer Key	26.4977	-82.1124	5	1	0	0	2	0	0	0	0	0	0	0	28	0	36
Broken Islands	26.6777	-82.1940	4	1	1	0	0	1	0	0	0	0	0	49	157	0	213
Captiva Rocks	26.6176	-82.1670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clam Key	26.5063	-82.1128	4	0	0	0	0	0	0	0	0	0	0	0	1	0	5
Cork Island	26.5742	-82.1273	6	0	0	0	0	0	0	0	0	0	0	0	32	0	38
Crescent Island	26.5979	-82.0639	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darling Keys	26.6669	-82.1811	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dog Island	26.8205	-82.2671	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
E of Chadwick Cove	26.9289	-82.3511	11	0	0	0	0	0	0	0	0	0	0	0	0	0	11
Fish Hut Island	26.5467	-82.1245	6	0	0	0	2	0	0	0	1	0	0	0	30	0	39
Givney Key	26.5145	-82.0553	11	0	0	1	3	0	0	0	0	0	1	28	62	0	106
Hemp Key	26.5999	-82.1532	27	0	0	2	26	0	0	1	1	0	0	88	189	0	334
Limpkin Island	26.6015	-82.0526	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Lower Bird Island	26.5125	-82.0330	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Masters Landing	26.5666	-82.0749	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mondongo Rocks	26.6849	-82.2129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N of Big Smokehouse Key	26.7001	-82.1225	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
N of Mason Island	26.5582	-82.1220	1	0	0	0	0	0	0	0	0	0	0	0	18	0	19
N of Regla Island	26.5464	-82.1245	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
N of York Island	26.4945	-82.1043	11	0	0	0	7	0	0	0	0	0	0	48	41	4	111
NE of York Island	26.4940	-82.1021	4	0	0	0	2	0	0	0	0	0	0	27	10	2	45
NW of Mason Island	26.5545	-82.1252	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW of Pumpkin Key	26.5660	-82.1279	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Skimmer Island	26.5104	-82.0250	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
South of Indian Field	26.6518	-82.1035	1	0	0	0	0	0	0	0	0	0	0	0	10	0	11
SW of Mason Island	26.5534	-82.1250	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S. W. of Pumpkin Key	26.5640	-82.1275	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Tarpon Bay Keys	26.4577	-82.0744	6	6	1	10	27	1	0	1	0	0	0	46	28	0	126
Upper Bird Island	26.5592	-82.0714	13	0	0	0	1	0	0	0	0	0	0	27	12	0	53
Useppa Oyster Bar	26.6513	-82.2134	3	2	0	0	4	0	1	0	0	0	0	93	122	0	225
White Pelican Island	26.7905	-82.2463	9	0	0	10	19	0	1	0	3	0	0	10	0	0	52
TOTAL			145	10	2	23	94	2	2	2	5	0	1	416	765	6	1,473

Table 2. Colonial nesting bird survey peak estimates for Ding Darling NWR complex and Charlotte Harbor Aquatic Preserves colonies between February and June 2012. Counts reflect the maximum number of pairs of adults with nests by species.

COLONY (ISLAND)	Lat	Long	GBHE	TRHE	LBHE	SNEG	GREG	REEG	CAEG	YCNH	BCNH	GRHE	WHIB	BRPE	DCCO	ANHI	Total
Benidict Island	26.6200	-82.1585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bird Keys	26.6679	-82.2276	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12
Bird Rookery Keys	26.6742	-82.0897	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bodiford Key	26.4980	-82.1125	0	0	0	0	2	0	0	0	0	0	0	0	10	0	12
Broken Islands	26.6777	-82.1940	13	2	0	1	1	2	0	1	0	0	0	78	123	0	221
Captiva Rocks	26.6176	-82.1670	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Clam Key	26.5063	-82.1127	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Cork Island	26.5744	-82.1273	10	0	0	0	0	0	0	0	0	0	0	0	42	1	53
Cresent Island	26.5979	-82.0639	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darling Keys	26.6669	-82.1811	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dog Island	26.8205	-82.2671	9	0	0	0	0	0	0	0	0	0	0	0	0	0	9
E. of Chadwick Cove	26.9289	-82.3511	16	0	0	0	2	0	0	0	0	0	0	0	0	0	18
Fish Hut Island	26.5466	-82.1244	5	0	0	1	0	0	0	0	0	0	0	1	20	0	27
Givney Key	26.5145	-82.0552	13	0	0	0	6	0	0	0	0	0	0	8	41	0	68
Hemp Key	26.5999	-82.1532	21	0	0	6	26	0	0	0	0	0	0	57	137	0	247
Limpkin Key	26.6015	-82.0526	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Bird Island	26.5125	-82.0330	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Masters Landing	26.5666	-82.0749	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mondongo Rocks	26.6849	-82.2129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. of Big Smokehouse Key	26.7001	-82.1225	3	0	0	0	0	0	0	0	0	0	0	0	4	0	7
N. of Mason Island	26.5582	-82.1221	1	0	0	0	0	0	0	0	0	0	0	1	6	0	8
N. of Regla Island	26.5422	-82.1226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. of York Island	26.4946	-82.1043	4	1	0	2	2	0	0	0	0	0	0	43	28	0	80
NE of York	26.4938	-82.1020	4	0	0	2	1	0	0	0	0	0	0	5	22	0	34
NW of Mason Island	26.5543	-82.1251	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
NW of Pumpkin Key	26.5660	-82.1279	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
S. of Indian Field	26.6518	-82.1035	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Skimmer Key	26.5100	-82.0250	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
SW of Mason Island	26.5532	-82.1251	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
SW of Pumpkin Key	26.5639	-82.1274	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tarpon Bay Keys	26.4573	-82.0747	6	1	0	7	18	0	0	0	1	0	0	31	17	0	81
Upper Bird Island	26.5592	-82.0714	8	0	0	1	2	0	0	0	0	0	0	69	28	0	108
Useppa Oyster Bar	26.6513	-82.2134	3	2	0	0	0	0	0	0	0	0	0	40	63	0	108
White Pelican Island	26.7905	-82.2460	8	0	2	48	16	2	0	3	2	0	0	0	4	0	85
TOTAL			157	6	2	68	76	4	0	4	3	0	0	333	557	1	1,211

REGIONAL WADING BIRD ABUNDANCE

ABUNDANCE AND DISTRIBUTION OF WADING BIRDS IN EVERGLADES NATIONAL PARK DURING THE 2012 NESTING SEASON INCLUDING POPULATION TRENDS FROM 1985 TO 2012

Introduction

Wading birds are especially sensitive to changes in seasonal cycles of wet and dry surface conditions (Bancroft & Jewell 1987, Kushlan *et al* 1975, Frederick & Spalding 1994, Russell *et al* 2002). As a consequence, they have been utilized as indicator species to evaluate human impact and restoration efforts in the Everglades (DeAngelis et al 1996). The greatest concentration of wading birds in south Florida typically occurs from December to May when water level under natural conditions gradually recedes, making prey easier to capture. These changes in hydropattern have a profound effect on prey availability (Frederick & Spalding 1994) and thus on wading bird abundance and distribution (Gawlik & Sklar 2000).

Standard aerial transect counting techniques in conjunction with a systematic sampling design, better known as Systematic Reconnaissance Flights (SRF) has been used since 1985 to document wading bird abundance, distribution and changes in hydrologic patterns in Everglades National Park. For more detailed methodology description see Alvarado & Bass (2009). Fluctuations in wading bird populations have been observed since 1985, however the overall trend is to increase, despite of the low numbers obtained during the last two years. Data obtained during each SRF not only provides information on the status and trends of wading bird populations in Everglades National Park, but also provide information needed for modeling evaluations to select the best management options.

Results

Pooled wading bird abundance was lower in 2012 than 2011. The estimated abundance for all the species combined decreased by 13% (Figure 2) in relation to the previous year. Despite this reduction, since 1985, there has been an overall significant increase in the total abundance of all the species combined (R^2=0.337, F=13.226, P=0.001) when a linear regression model is fitted to the yearly estimations. Five species showed a decreased in numbers from 2011 to 2012 (Figure 3). Those species are: great blue herons (GBHE) 37%, roseate spoonbill (ROSP) 29%, wood stork (WOST) 28%, small dark herons (SMDH) 19% and white ibis (WHIB) 35%. Great egret (GREG) and small white heron (SMWH) remained practically unchanged with only 1% decrease and less than 1% increase respectively. Only glossy ibis (GLIB) and great white heron (GWHE) showed a slight increase of 5% and 3% correspondingly.


Mac Stone Photography

Despite the annual fluctuations observed for each species over time (Figure 3), an overall significant increase is observed in four of the species. Those species are: GREG (R^2=0.397, F=17.127, P<0.001), WOST (R^2=0.250, F=8.661, P=0.007), WHIB (R^2=0.221, F=7.388, P=0.012) and SMWH (R^2=0.162, F=5.018, P=0.034).

Another four species, GBHE (R^2=0.140, F=4.235, P=0.050), ROSP (R^2=0.138, F=4.161, P=0.052), SMDH (R^2=0.023, F=0.606, P=0.443) and GLIB (R^2<0.001, F<0.001, P=0.998) have remained stable in the number of individuals with no significant increases or decreases. GWHE (R^2=0.397, F=17.127, P<0.001) is the only species that displayed an overall significant decline in numbers since 1985.

During 2012, the maximum number of wading birds, regardless of the species, occurred between January and February (Table 1); with the highest number recorded in February. During this month, the highest numbers of GREG, GBHE, SMWH, WHIB, and GLIB were observed. Other species such as, SMDH, WOST and GWHE reached their peak numbers in January, while ROSP were more abundant in April. The fewest number of birds for all species combined, as well as for all individual species but GLIB occurred in May.

The most abundant species was WHIB which represented almost fifty-one percent of the total number of birds, followed by GREG (31.1%). These two species combined accounted for 81.9% of the total number of birds; the remaining 18.1% in order of abundance were SMWH (6.7%), WOST (5.4%), SMDH (1.9%), ROSP (1.7%), and GBHE (1.6%), GLIB (0.7%), and GWHE with less than 0.1%.

Differences in distribution and abundance of birds were observed among the different drainage basins regardless of the area covered by each one (Table 2). Shark Slough (SS) contained the highest number of wading birds (22.4%), followed by Shark Slough Mangrove Estuary (SSME) with 19.0% and East Slough (ES) with 13.2%. These three basins contained 54.6% of the total number of birds recorded during the survey period. The remaining birds were distributed in the following basins: Big Cypress Mangrove Estuary (BCME) with 8.3%, Long Pine Key/South Taylor Slough (LPK/STS) with 7.1%, Cape Sable (CS) with 6.8%, Long Pine Key/South Taylor Slough Mangrove Estuary (LPK/STSM) with 6.0%, Northeast Shark Slough (NESS) with 5.6%, Southern Big Cypress (SBC) with 5.5%, Eastern Panhandle (EP) with 3.5%, and Eastern Panhandle Mangrove Estuary (EPME) with 1.5% and Northern Taylor Slough (NTS) with only 1.1%.

If the available area for each basin is taken into consideration, ES was the basins with the overall highest density during the entire season, followed by SS, CS, LPK/STSME, BCME and SBC respectively (Figure 4). The basins with the lowest densities were, in increasing order, NTS, EPME, EP, NESS, SSME and LPK/STS.

High density of birds was observed at the estuarine basins (CS, BCME, LPK/STSME, EP, EPME and SSME) as well as at SBC during the beginning of the season. By the middle of the season, an increase in density in the interior basins (ES, SS, and NESS) was observed. Low densities were observed in most basins by the end of the season except for LPK/STS where density of birds peaked by April. Drainage basins also showed temporal differences within the same basin as the 2012 survey progressed from December 2011 to May 2012 (Figure 4). SBC, EP and NTS showed the highest densities of birds in December; SSME, CS, LPK/STSME and EPME showed their peak numbers in January; while BCME and NESS highest densities occurred in February. ES bird density peaked in March, and finally, SS and LPK/STS peak densities occurred in April.

Changes in hydro-patterns and bird distribution (Figure 5) were less pronounced this year in comparison with the previous year (see Alvarado & Bass, 2011). The maximum changes in the area covered by the different hydro-patterns during 2012 season took place at the WW category, followed by DD. From December to April, the extent of area covered by WW decreased 1,812 Km^2, while DD area experienced an increase of 1,408 Km^2. Intermediate categories such as WT, WD and DT showed moderate changes throughout the season. The areal extend of WD increased only 532 Km^2, while WT decreased 436 Km^2 from December to April. The hydropattern that change the least was DT, had an increase of 408 Km^2 from December to May. The driest category, DD, showed a constant increase from December to April. Highest densities of birds occurred at the DT hydro-pattern followed by WW and WT respectively, while lowest densities occurred at DD and WD respectively.

Figure 6 shows the results of Kriging's interpolations generated with the hydro-patterns obtained for each individual 2x2Km cells, as well as the bird abundance and distribution for each month. During December, birds were widely distributed across the entire area with few zones of higher concentrations in ES and SBC, as well as in the estuarine basins of BCME, CS, SSME and EP. By January, the higher concentrations of birds were located mostly at the estuarine basins. From February to April, as water recedes, zones of higher concentrations of birds begin to move from the estuarine basins (BCME, SSME, CS, LPK/STSME, EPME and EP) to the central basins (SBC, ES, SS, and LPK/STS), occupying areas with more suitable water surface condition for foraging; especially those at the edges of Shark Slough, East Slough and Taylor Slough. By May, when water levels increased, the few remaining birds in the system begin to disperse from the slough basins. Despite this bird dispersion, slough basins still holding areas of large concentration of birds. Very few birds were recorded at the Whitewater Bay area during the entire survey.

The spatial use of ENP by wading birds during the 2012 survey showed a gradual decreased in area used by wading birds from December to April. Sixty-five percent, of the 4,892 Km^2 available for wading birds to forage, was utilized at the beginning of the season. In April, birds were using only 29% of the total available area. By the end of the season, due to early rainfall, birds foraging area increased to 49% of the total area (Figure 7).

Stage values and numbers of estimated birds showed clearly that wading birds are less abundant during extreme water conditions (Figure 8). During 1995, a particularly wet year, the number of wading birds was the lowest for the period of record. In 1990, a very dry year, the number of birds was also low. A quadratic function model (Figure 9) was used to analyze this type of behavior where too much or too little water in the system can lead to drastic changes in wading bird abundance. A significant relationship was found between the number of birds observed and the average stage at the NP-203 (R^2=0.405, F=8.515, P=0.002). The curve also suggests an optimal stage value for wading bird abundance somewhere around 1.77 m, using NP-203 station as a reference.

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

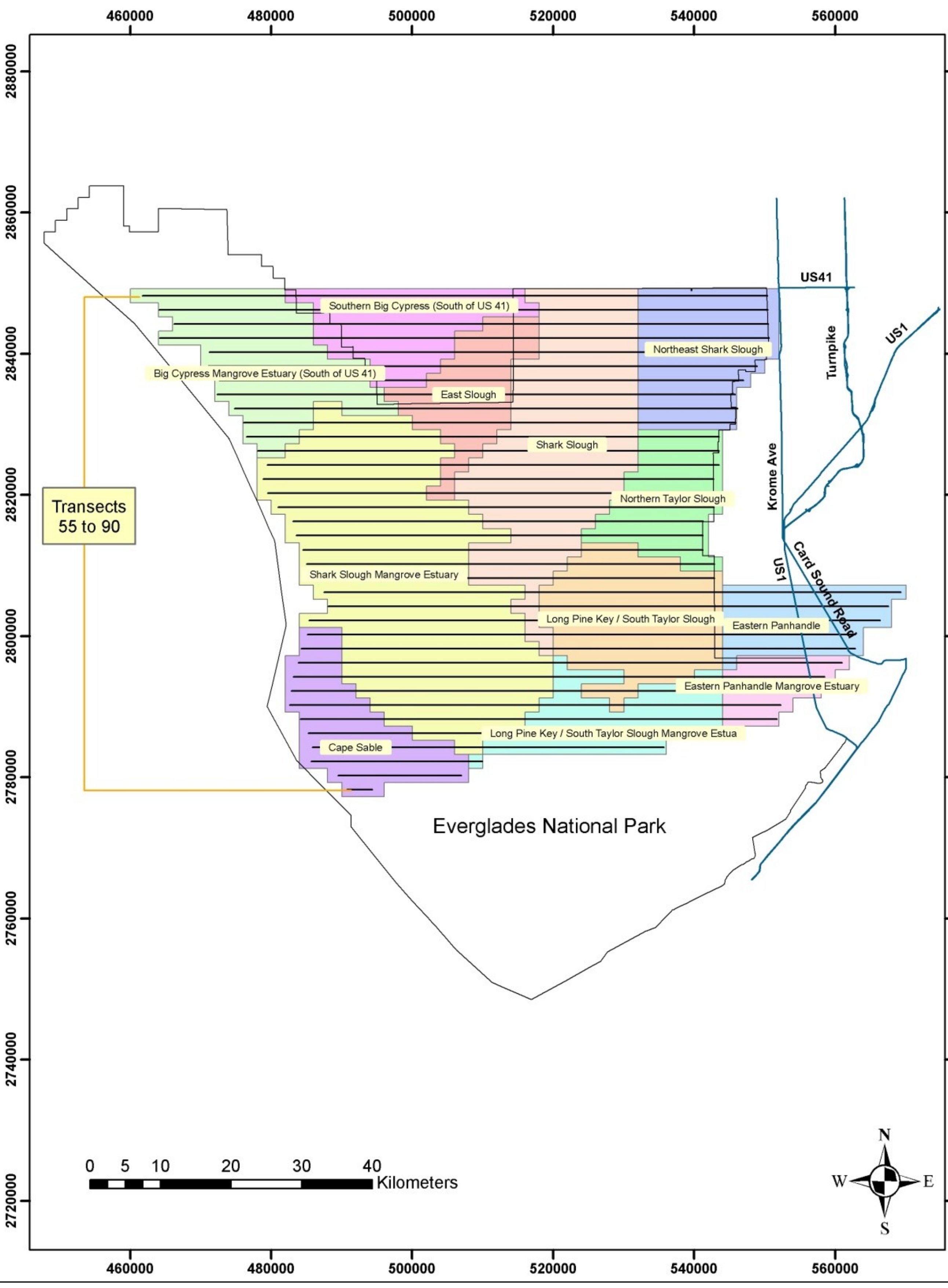


Figure 2. Estimated number of wading birds (all species pooled) observed from the months of December to May from 1985 to 2012. Red marks represent years with estimated missing data for one month.

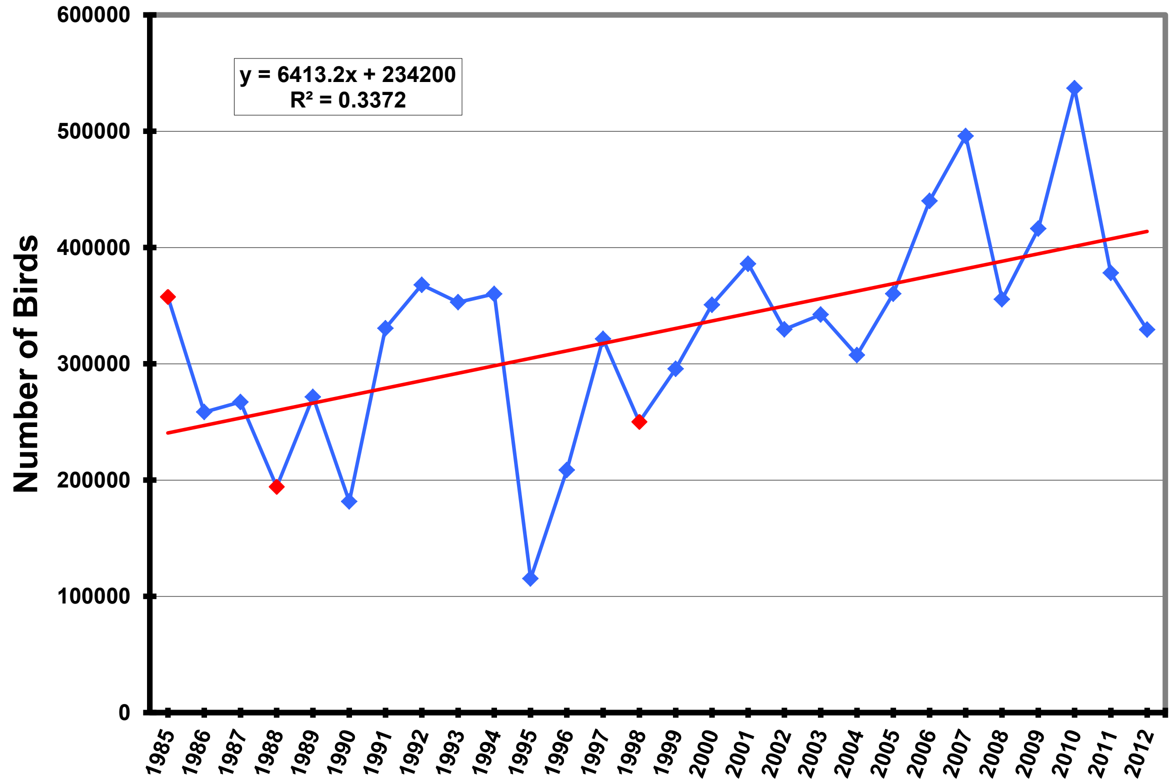


Figure 3. General trends in wading bird populations based on the total number of birds estimated during the surveys performed each year in the Everglades National Park from 1985 to the present.

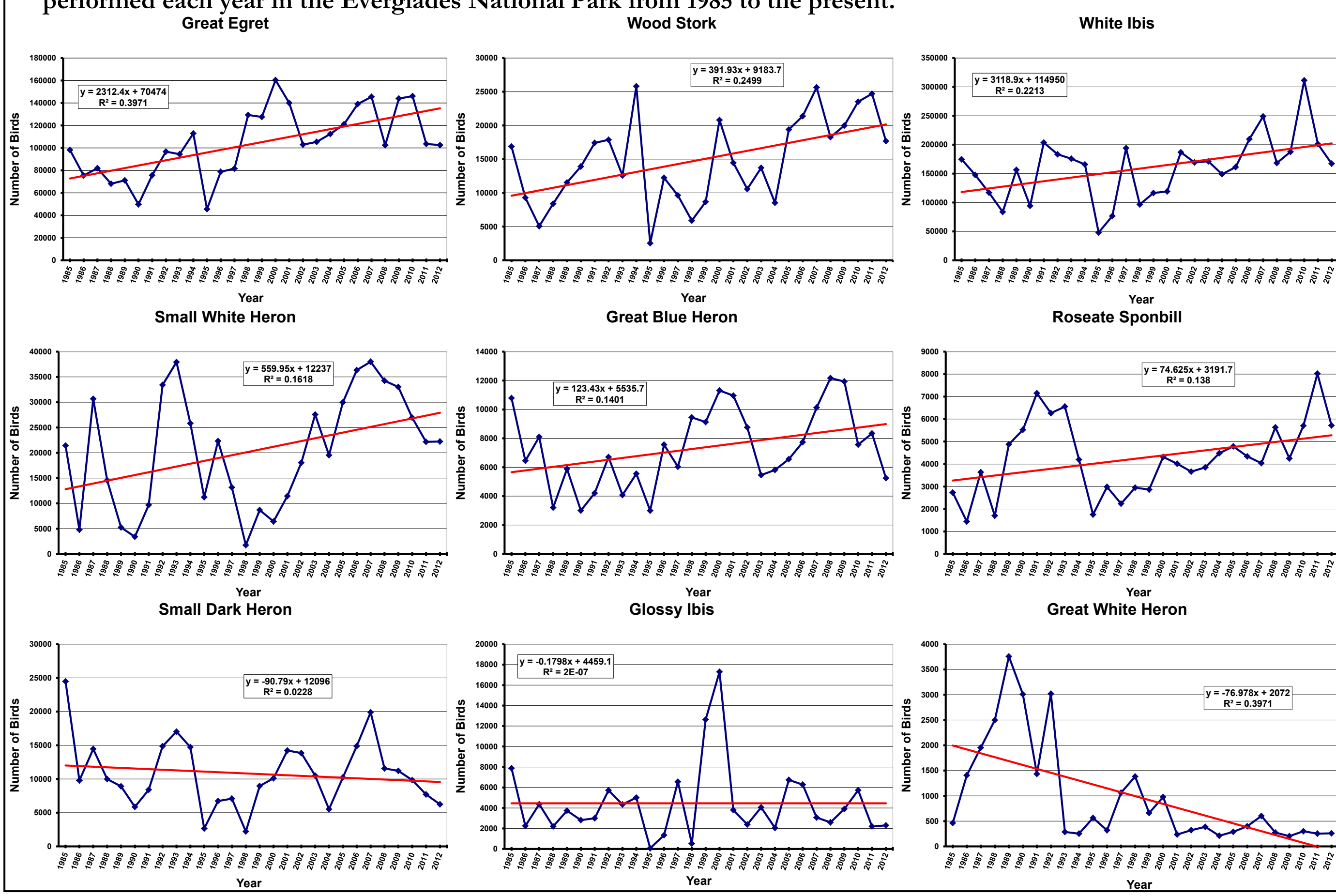


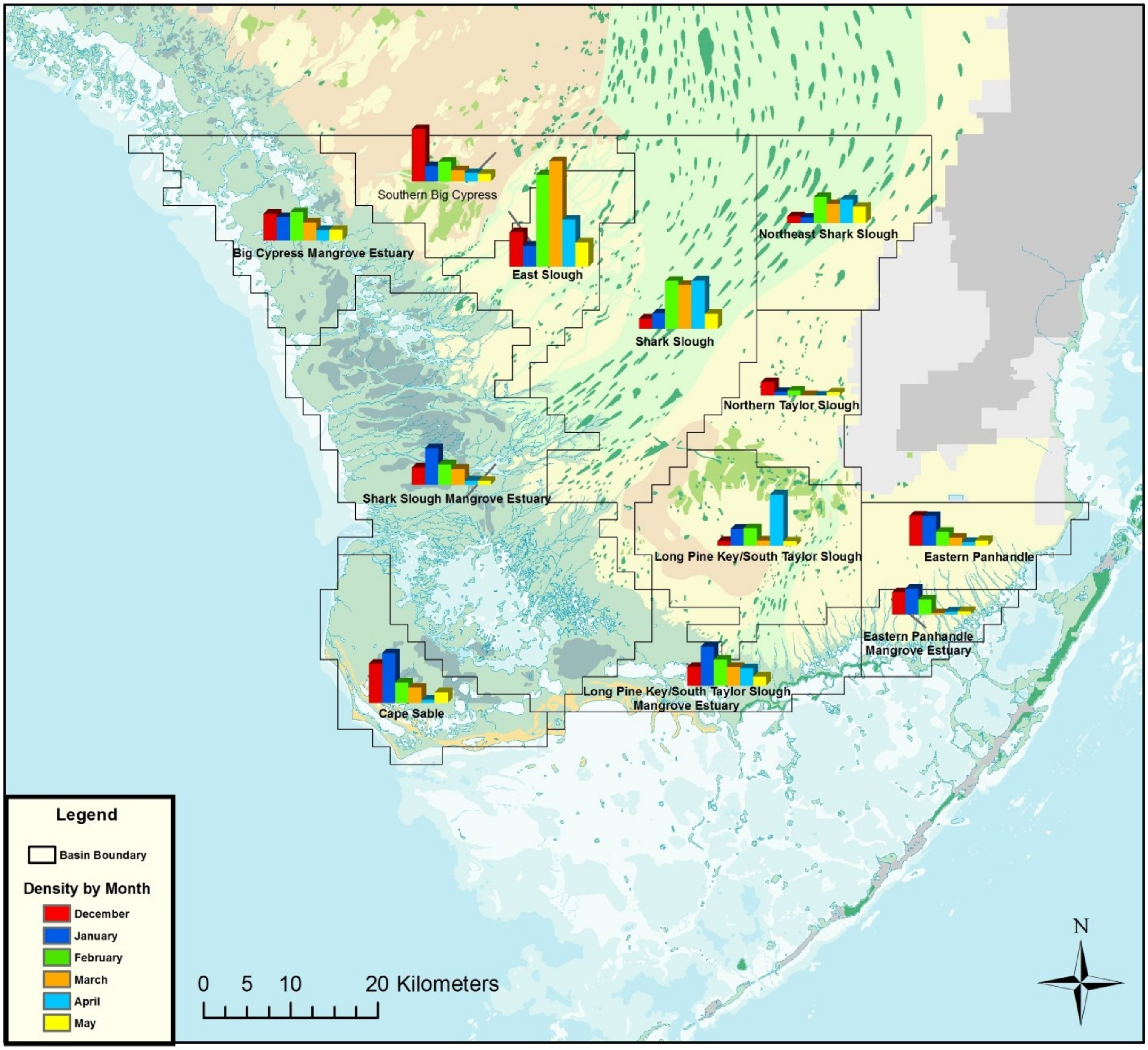
Table 1. Estimated abundance of wading birds in the Everglades National Park and adjacent areas, December 2011 to May 2012.

Species	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Total
GREG	17,235	23,864	24,902	15,518	13,497	7,515	102,531
GBHE	879	960	1,160	1,090	989	166	5,244
SMDH	972	1,428	1,079	1,163	1,171	426	6,239
SMWH	3,941	4,870	4,963	3,498	3,619	1,331	22,222
WHIB	27,625	26,686	36,708	33,366	28,711	14,101	167,197
GLIB	7	367	1,112	502	227	80	2,295
WOST	1,857	5,890	3,800	3,048	2,961	124	17,680
ROSP	728	1,048	707	1,267	1,635	332	5,717
GWHE	49	63	42	49	28	28	259
TOTAL	53,293	65,176	74,473	59,501	52,838	24,103	329,384

Table 2. Estimated abundance of wading birds (all species combined) for the different drainage basins in the Everglades National Park, December 2011 to May 2012.

Month	SBC	BCME	SS	NESS	ES	SSME	NTS	TS	EP	CS	TSM	EPME	Total
Dec-11	8,305	6,214	4,138	1,251	4,628	11,074	1,936	1,140	3,805	6,390	2,888	1,524	53,293
Jan-12	2,419	5,448	6,275	984	2,769	23,152	531	3,956	3,760	8,066	6,039	1,777	65,176
Feb-12	3,113	6,550	19,565	4,986	12,379	13,071	667	4,120	1,754	3,296	3,966	1,006	74,473
Mar-12	1,756	4,161	17,944	3,604	14,156	10,083	34	1,269	1,034	2,495	2,883	82	59,501
Apr-12	1,352	2,439	19,669	4,452	6,346	2,738	0	12,014	477	506	2,671	174	52,838
May-12	1202	2,453	6,161	3,071	3,213	2,467	431	1,039	723	1738	1,385	220	24,103
TOTAL	18,147	27,265	73,752	18,348	43,491	62,585	3,599	23,538	11,553	22,491	19,832	4,783	329,384

Figure 4. Spatial and temporal changes in wading bird density among the different drainage basins between Dec-11 and May-12.



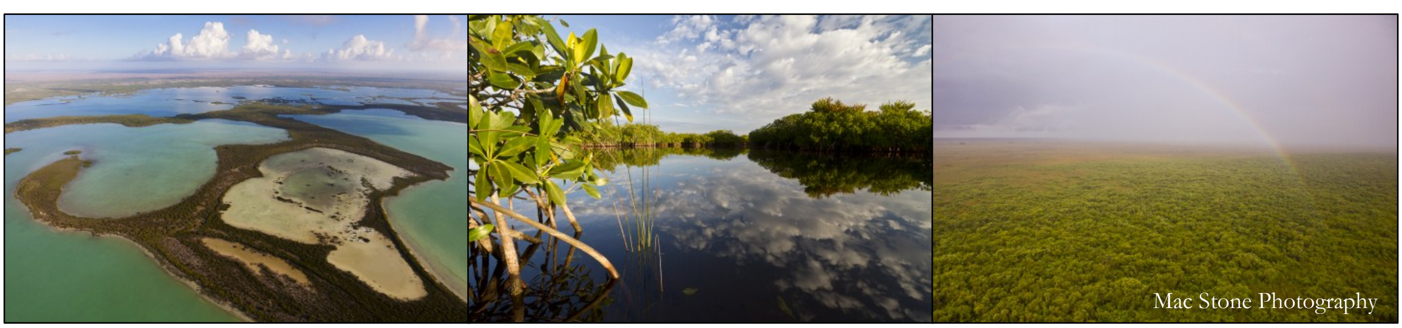


Figure 5. The 2012 areal extent and density of wading birds (all species pooled) in each surface water category: WW = continuous surface water; WT = mostly wet with scattered dry areas; DT = mostly dry with small scattered pools of water; WD = dry with water only in solution holes; DD = dry surface.

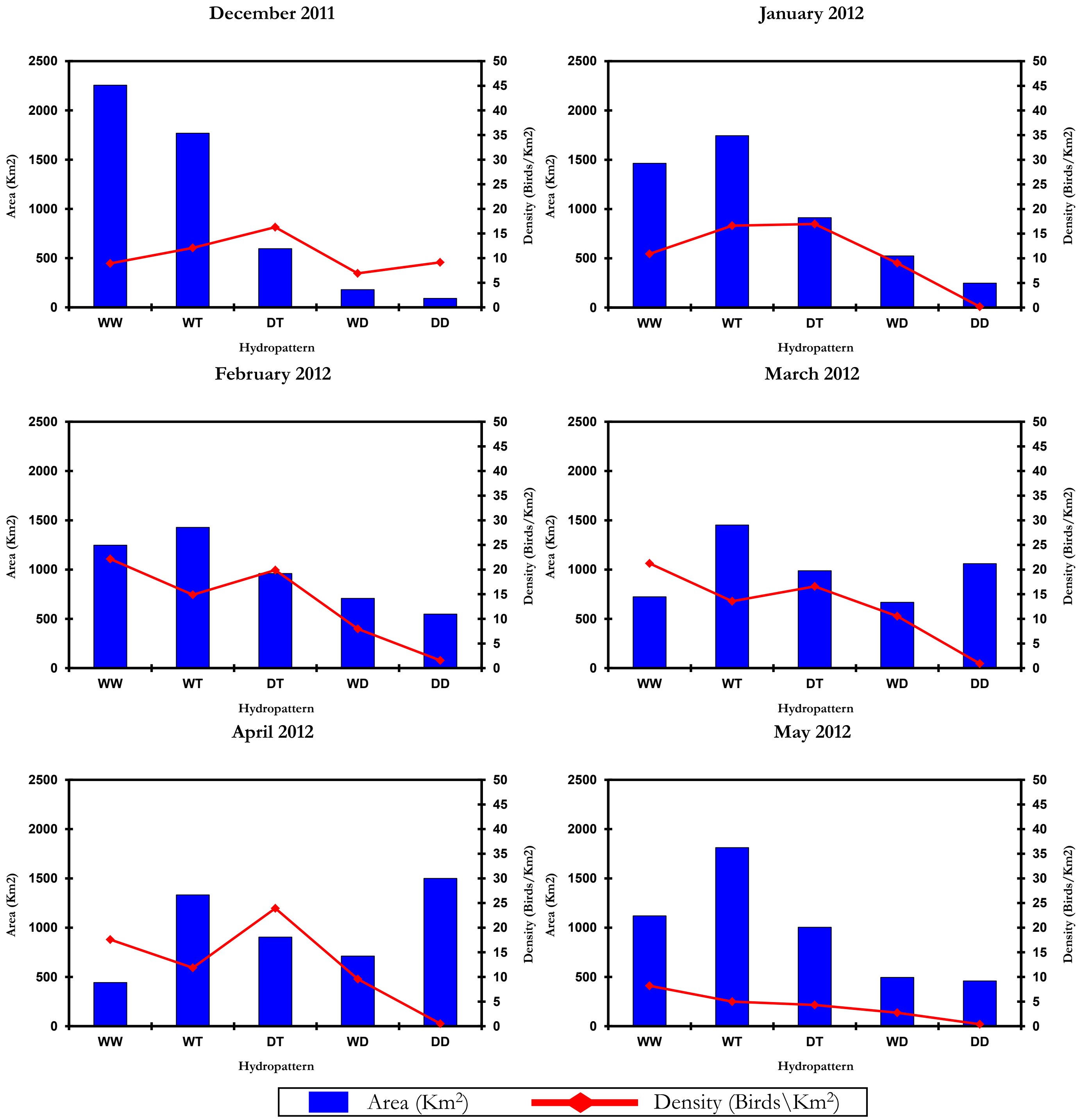


Figure 6. Kriging's interpolation of changes in hydropatterns observed between December 2011 and May 2012 and correspondent wading bird distribution.

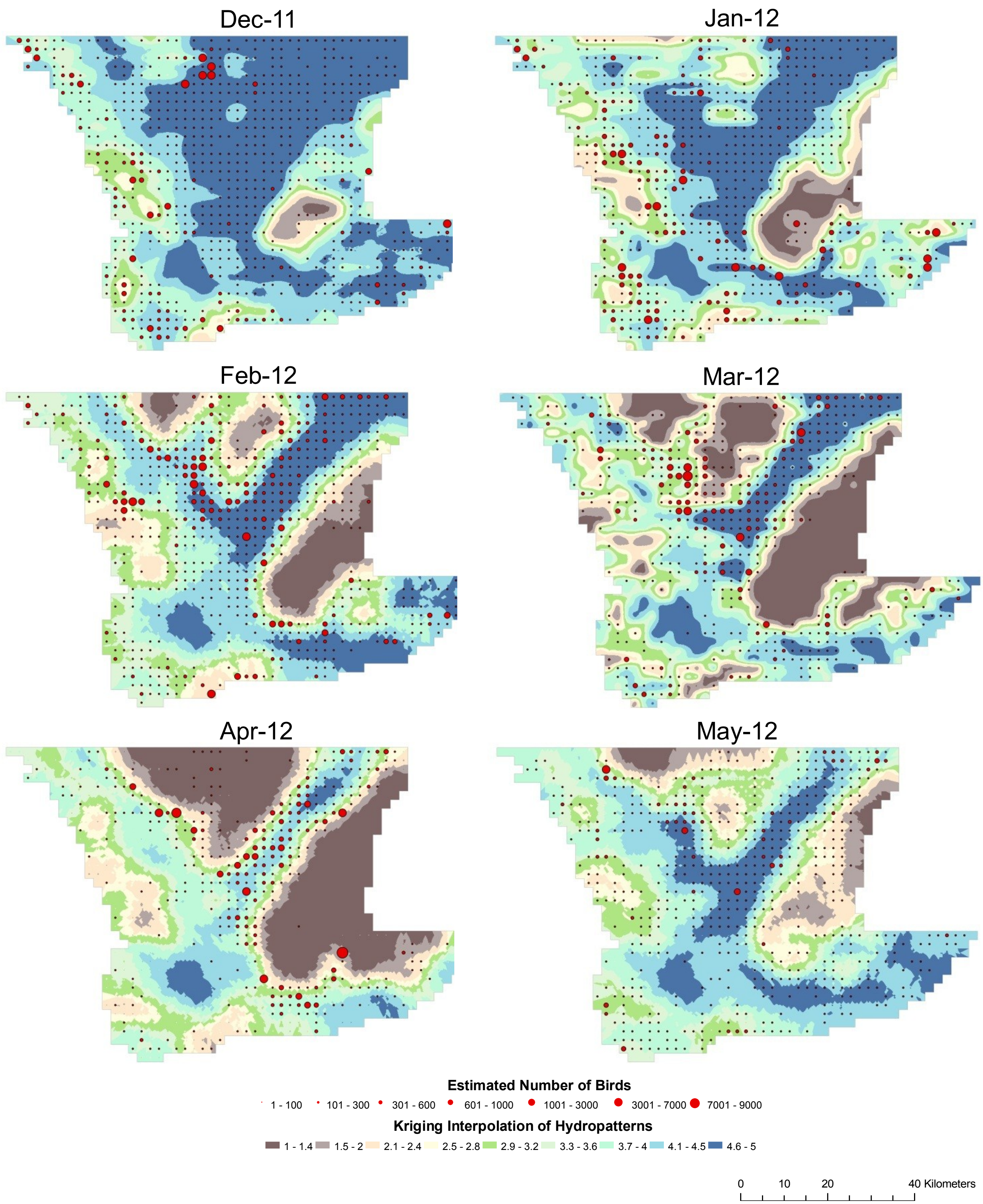


Figure 7. Monthly changes in wading bird areal utilization in the Everglades National Park from December 2011 to May 2012.

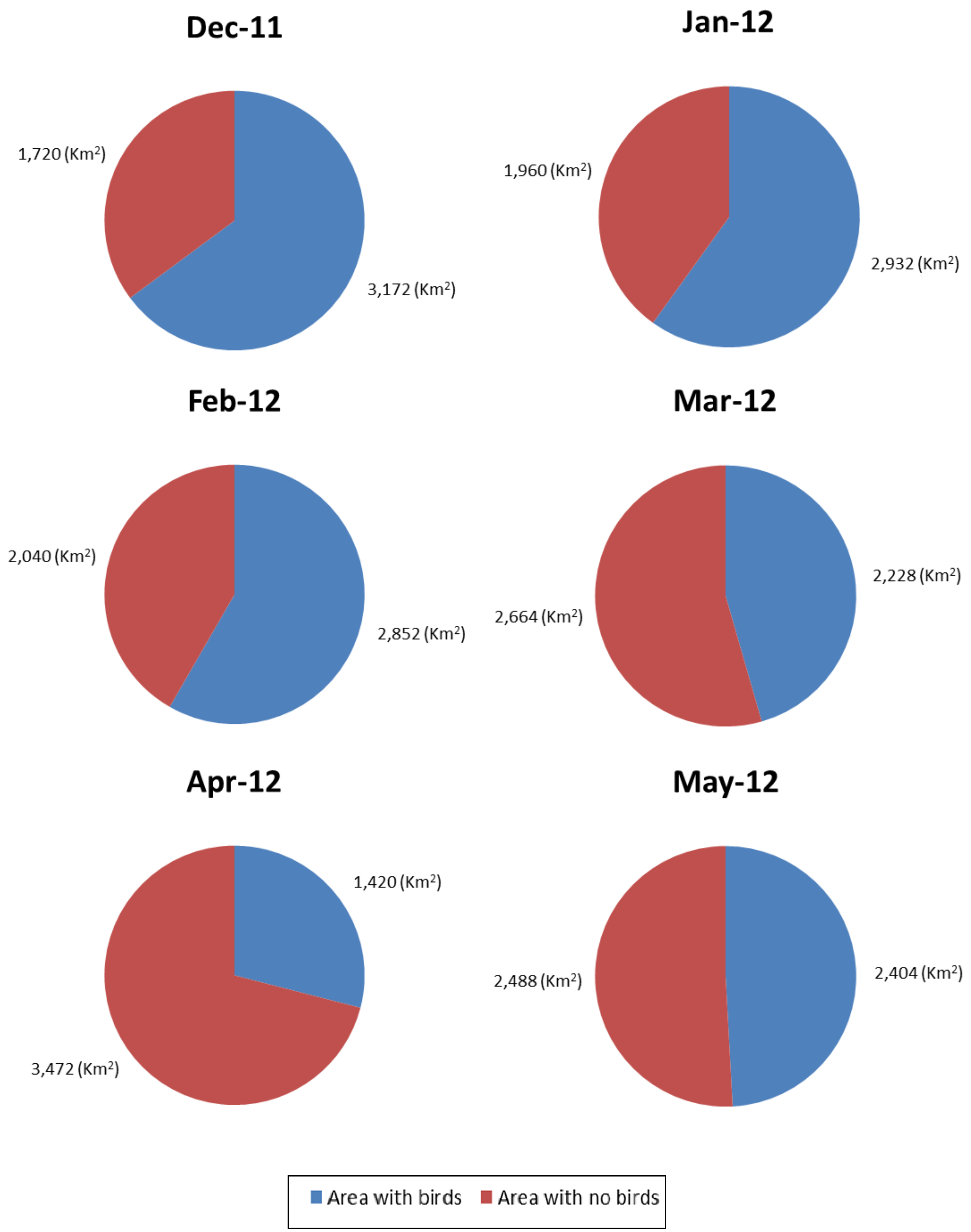


Figure 8. Relationship between numbers of birds observed for every year since 1985 to 2012 and the stage elevation in meters at the NP-203 hydrological station.

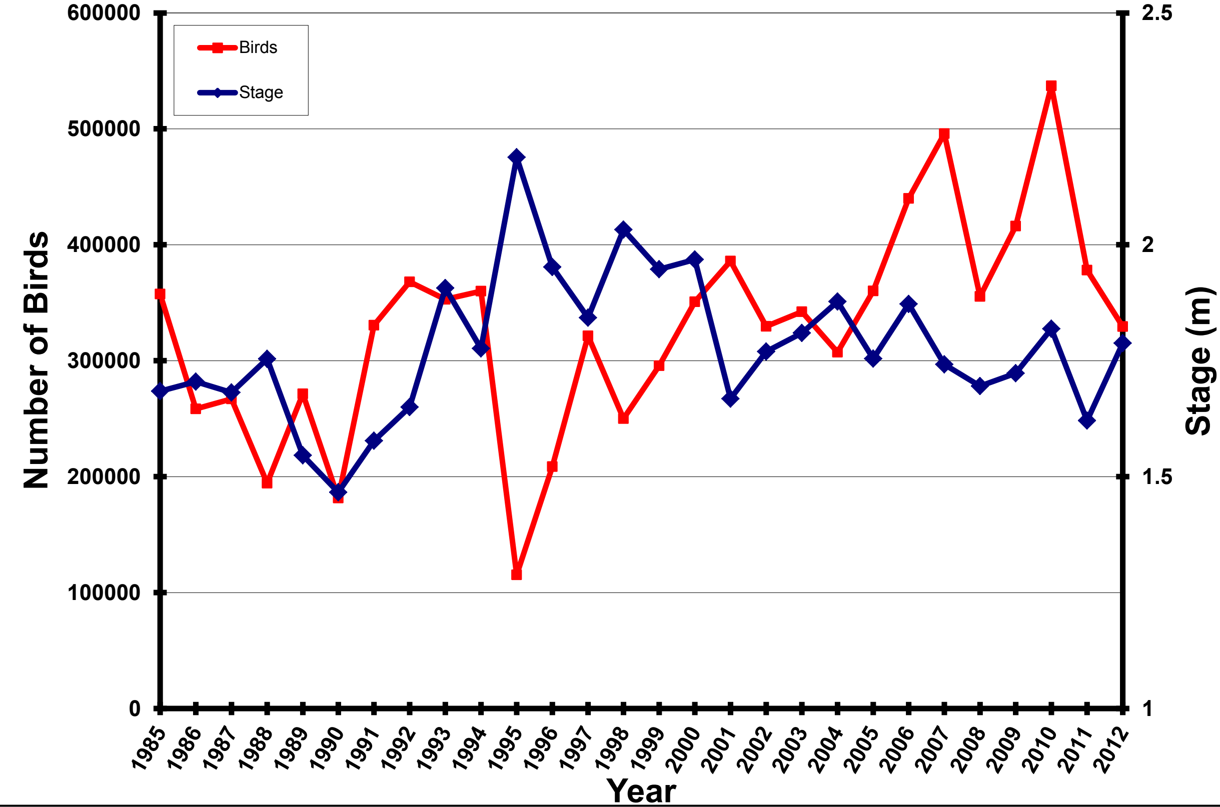
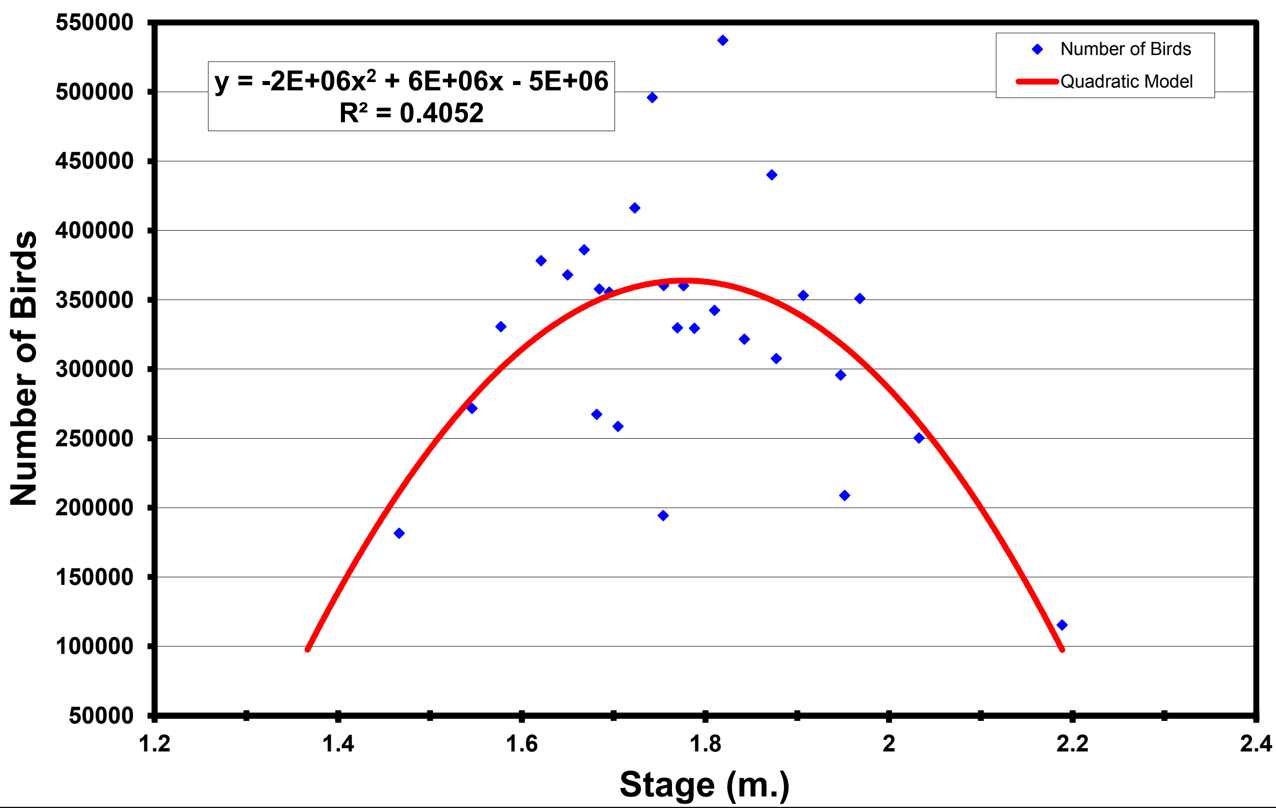


Figure 9. Quadratic function model used to test the relationship between wading bird abundance and average stage height using the NP-203 hydrological station data.



Discussion:

Long and short term temporal and spatial data analysis, strongly suggest the importance of hydrological conditions in the distributions of wading birds and areal utilization. Everglades populations of wading birds in general, based on SRF data over a 28-year period, still indicates an overall significant increase despite the low numbers observed during the past two years. A general trend to increase or to remain stable has been observed in most species. Unfortunately for GEWH, that is not the case, where the overall trend shows a significant population decrease. The 2012 survey represents the second consecutive year showing a decline in the number of wading birds; perhaps as a consequence of the extreme dry conditions observed during 2011. An estimated 39% decrease in wading birds has been observed since 2010. However, it has to be considered that 2010 represents the year with the largest ever estimation of wading birds since 1985.

The overall increase observed in wading bird population when a linear regression model is fitted to wading bird estimations, suggest some kind of success in the ongoing restoration efforts. However, more research is needed in order to fully support this statement. Currently I'm working, in conjunction with other park researchers, in a project to evaluate the use of generalized additive models (GAM) instead of the linear regression models to assess wading bird abundance and distribution in the future analysis.

Wading bird populations in the Everglades are dynamic, changing constantly and are influenced by many other aspects (Russell *et al.* 2002). However, the most influential aspect is perhaps human habitat alteration; particularly those that change the natural hydrological conditions. Food availability is consider the most important factor limiting populations of wading birds in the Everglades (Frederick & Spalding 1994); however hydrology is the factor that ultimately determines the availability of food. Data obtained during each SRF over the years, support the important role that hydrological conditions plays on the abundance and distributions of wading bird populations in the lower Everglades. The concept of too much/too little or just the right amount of water and the too late/too early or just at the right time seem to be of particular importance for wading birds. For example, rainfall deficit observed during the rainy season previous to the 2012 survey appears to be the cause of the early widespread distribution throughout the system. Because the SRF data are collected during the dry season (December 2011 to May 2012), the annual precipitation from the previous year best describes the water conditions and thus the birds foraging patterns in the area during the surveys. As water receded, later in the season, birds began to concentrate in those areas that still maintained the right water levels. By the end of the season, great numbers of birds left the system heading towards areas with longer hydroperiod and better foraging conditions such as the Water Conservation Areas (Cook & Herring 2007), while the ones that remained in the system concentrate in areas which probably provided them with the best foraging conditions.

Although this preliminary analysis can provide some general ideas of the trends in the number of individuals observed for each species or groups of birds through the 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.

Mario A. Alvarado
South Florida Natural Resources Center
Everglades National Park
40001 State Road 9336
Homestead, FL 33034
305-242-7884
Mario_Alvarado@nps.gov


SFWMD, Brian Garrett

STATUS OF WADING BIRD RECOVERY, 2012

The sustainability of healthy wading bird populations is a primary goal of CERP and other Everglades restoration programs in south Florida. A central prediction of CERP is that a return to natural flows and hydropatterns will result in the recovery of large, sustainable breeding wading bird populations, a return to natural timing of nesting, and restoration of large nesting colonies in the coastal zone (Frederick et al. 2010). There are at least two overlapping sets of measures of attaining these conditions, all based on historical conditions and thought to be representative of key ecological features of the bird-prey-hydrology relationship. RECOVER established Performance Measures (PM) (http://www.evergladesplan.org/pm/recover), include the 3-year running average of the numbers of nesting pairs of key avian species in the mainland Everglades, the timing of Wood Stork nesting, and the proportion of the population that nests in the coastal ecotone (Ogden et al. 1997). In addition to these three, the annual Stoplight Reports have added two other measures: the ratio of visual to tactile wading bird species breeding in the Everglades, and the frequency of exceptionally large White Ibis breeding events. These additional measures were added in an attempt to further capture key ecological relationships found in the historical ecosystem (Frederick et al. 2009). In this section, I report on the long term trends and current status of all of these measures. When thinking about progress towards these restoration measures, it should be remembered that the hydrological system is not yet restored to anything like the function expected in a completed CERP, and that based on the current hydrological system, we would not have predicted restored or even partially restored wading bird population indicators.

The main indicator species are Great Egret, Snowy Egret, White Ibis, and Wood Stork. Although the Tricolored Heron was originally included in these species (Ogden et al. 1997), this species has proven extremely difficult to consistently monitor due to the inability to see their dark plumage in colonies during aerial surveys. Ogden et al. (1997) lumped Tricolored Heron and Snowy Egret population targets (eg 10,000 breeding pairs), and it is difficult to derive an expected number for Snowy Egrets alone (Ogden 1994). Based on relative abundances in coastal colonies (Ogden 1994), roughly equal support can be derived for 1:1 ratios as for 2:1 ratios (Snowy:Tricolored). In practice, the distinction is unimportant since both species appear to be declining and are nowhere near any of the population restoration targets. These data are reported for the three Water Conservation Areas and mainland Everglades National Park.

Results

Numbers of nesting pairs

The three year running average for nesting pairs (2010 – 2012) are 6,296 pairs for Great Egrets, 1,599 for Snowy Egrets, 11,899 for White Ibises, and 1,182 pairs for Wood Storks. Trends for **Great Egrets** over time (Figure 1) for this measure increased markedly from 1988 – 2004, and have been stable or slightly declining since, with the 3-year running average meeting or exceeding restoration criteria for 17 consecutive sampling periods since 1996 (Table 1). Trends for **Snowy Egrets** also increased markedly 1986 – 2004, but have dropped dramatically since 2005, with the 2012 season showing continued declines compared with the previous three years. Three-year running averages of breeding Snowy Egrets have been consistently well below the target restoration goal in the time they have been monitored since 1986. The 3-year running average has increased markedly for **White Ibises** during 1986 – 2001 (2.7 X), and then remained variable but arguably stable for nearly a decade (2002 – 2011). The final period in this record (2010 – 2012) showed substantial decreases in ibis nesting (approximate 50% reduction), with all three years in that period being well below the average of the previous decade. White Ibis nesting populations have met or exceeded the breeding population criterion during 12 of the past 13 years. **Wood Storks** showed a marked increase from averages in the 2 – 300 pair range (1986 – 1992) to averages above 1000 after 1999. Wood Storks have equaled or exceeded the restoration population criterion during 6 of the last 12 years. Together, these statistics illustrate that there has been a very substantial increase in numbers of Great Egrets, Wood Storks and White Ibises since 1986, followed by a period of relative stability during which each of these species has met restoration targets in the majority of years. Snowy Egrets, however, continue to nest in declining numbers and have never met restoration targets. In addition, there is evidence from systematic ground surveys in WCA 3 (see earlier in this report) that breeding populations of the other two small herons in the genus *Egretta* (Tricolored and Little Blue herons) are also declining sharply in the Everglades.

Colony Location

It is estimated that more than 90% of the nesting of the indicator species occurred in the southern ecotone region during the 1930s and early 1940s, in all likelihood because this was the most productive area. A major restoration hypothesis holds that it is the reduction of freshwater flows to this coastal region that has reduced secondary productivity and resulted in the abandonment of the area by nesting wading birds. The proportion of the entire mainland Everglades nesting population that nests in the coastal zone is one of the restoration indicators, with at least 50% of nesting as the restoration target (Ogden et al. 1997). This measure has shown considerable improvement since the lows of the mid-1990s and early 2000's (2 – 10%, Figure 2), and during the last several years has ranged between 15 and 35%. In 2012 the proportion was 26%.

Ratio of visual to tactile foragers

This measure recognizes that the breeding wading bird community has shifted from being numerically dominated by tactile foragers (storks and ibises) during the predrainage period to one in which visual foragers such as Great Egrets are numerically dominant. This shift is thought to have occurred as a result of impounded, stabilized, or over drained marsh, which leads to the declining availability of both larger forage fishes (Wood Storks) and crayfishes (ibises). These conditions also seem to favor species like Great Egrets that are less reliant on the entrapment of prey and can forage both in groups and solitarily under a variety of circumstances. Restoration targets are set at 32 breeding tactile to visual foragers, characteristic of the 1930s breeding assemblages. While this measure has shown some improvement since the mid 1990's (movement from 0.66 to 3.5), the ratio is still an order of magnitude less than the restoration target. The 5-year running average for this measure in 2012 was 2.64.

Timing of Nesting

This parameter applies only to the initiation of nesting for Wood Storks, which has shifted from November - December (1930s through 1960's) to January - March (1980s – present). Later nesting increases the risk of mortality of nestlings that have not fledged prior to the onset of the wet season and can make the difference between the south Florida stork population being a source or sink population. This measure has shown a consistent trend towards later nesting between the 1930's and the 1980s (Figure 3), with variation around a February mean initiation date since that time. Although some years in the mid-2000's stimulated earlier nesting, there is has been no lasting improvement and the 2012 season was one of the latest nestings on record (March).

Exceptionally large ibis aggregations

Exceptionally large breeding aggregations of ibises were characteristic of the predrainage system, and are thought to be indicators of the ability of the wetland system to produce very large pulses of prey resulting in part from typical cycles of drought and flood. Large breeding aggregations during the recent period are defined as being above 16,977 nests each year, defined as the 70th percentile of the entire period of record of annual nestings. The interval between large ibis nestings in the predrainage period was 1.6 years and this serves as the target for restoration. This measure has improved very markedly since the 1970s, with the target achieved in 8 of the last 10 years (Figure 4). The 2012 ibis nesting did not reach the criterion, but in a healthy ecosystem, ibis nesting is not expected to exceed the threshold in every year. The interval averaged over the last five years is 1.8 years, only slightly higher than in the 1930s.

Discussion

Taken together, these measures of wading bird nesting suggest that while there have been real improvements in several of the measures during the past one or two decades, several key measures are stalled and not showing further improvement. Two measures are genuinely hopeful - numbers of nesting pairs of ibises, storks and Great Egrets in the system seem to be regularly achieving the restoration targets, and the interval between exceptional ibis nesting years has consistently met the restoration target for 8 of the past 10 years. There has been real progress in the location of nesting, but the proportion nesting in the coastal zone remains low (5-year running average of 17% compared to 50% target), and there is much room for improvement. Several measures are not improving. The numbers of Snowy Egrets are declining and remain far from restoration targets. There is little evidence that the timing of nesting for storks is improving, and this measure may actually be getting worse. The ratio of tactile to visual foragers has improved since the mid-2000's, but remains an order of magnitude below the restoration target.

This picture illustrates clearly that the birds probably have responded in the last two decades to a combination of altered water management regimes, good weather and hydropattern by nesting more consistently in the coastal zone, and by increasing populations of ibises and storks. While some of the population increases may be attributable to forces outside the Everglades system, the fact that these species have been attracted to nest in the Everglades in larger numbers remains a solid indicator. The lack of movement of the other measures suggests that the current management regimes are not powerful enough to nudge the timing of nesting, ratio of tactile foragers, or numbers of nesting Snowy Egrets further. While this illustrates an apparent statis, it should be remembered that full restoration of wading bird populations is predicted only as a result of full restoration of key historical hydropatterns, which has not yet occurred.

Peter Frederick

Department of Wildlife Ecology and Conservation

P.O. Box 110430

University of Florida

Gainesville, Florida 32611-0430

352-846-0565

pfred@ufl.edu

Table 1. Three year running averages of the number of nesting pairs for the five indicator species in the Everglades. Shaded values meet or exceed minimum target criterion for breeding population size. GREG = Great Egret, SNEG = Snowy Egret, WHIB = White Ibis, WOST = Wood Stork.

	GREG	SNEG	WHIB	WOST
Target minima	4000	5,000 – 10,000	10,000 to 25,000	1,500 to 2,500
1986-88	1,946	1,089	2,974	175
1987-89	1,980	810	2,676	255
1988-90	1,640	679	3,433	276
1989-91	1,163	521	3,066	276
1990-92	2,112	1,124	8,020	294
1991-93	2,924	1,391	6,162	250
1992-94	3,667	1,233	6,511	277
1993-95	3,843	658	2,107	130
1994-96	4,043	570	2,172	343
1995-97	4,302	544	2,850	283
1996-98	4,017	435	2,270	228
1997-99	5,084	616	5,100	279
1998-00	5,544	1,354	11,270	863
1999-01	5,996	2,483	1,655	1,538
2000-02	7,276	6,455	23,983	1,868
2001-03	8,460	6,131	20,758	1,596
2002-04	9,656	6,118	24,947	1,191
2003-05	7,829	2,618	20,993	742
2004-06	8,296	5,423	24,926	800
2005-07	6,600	4,344	21,133	633
2006-08	5,869	3,767	17,541	552
2007-09	6,956	1,330	23,953	1,468
2008-10	6,715	1,723	21,415	1,736
2009-11	8,270	1,947	22,020	2,263
2010-12	6,296	1,599	11,889	1,182

Figure 1. Trends in 3-year running average of nesting pairs of the five target species since 1986.

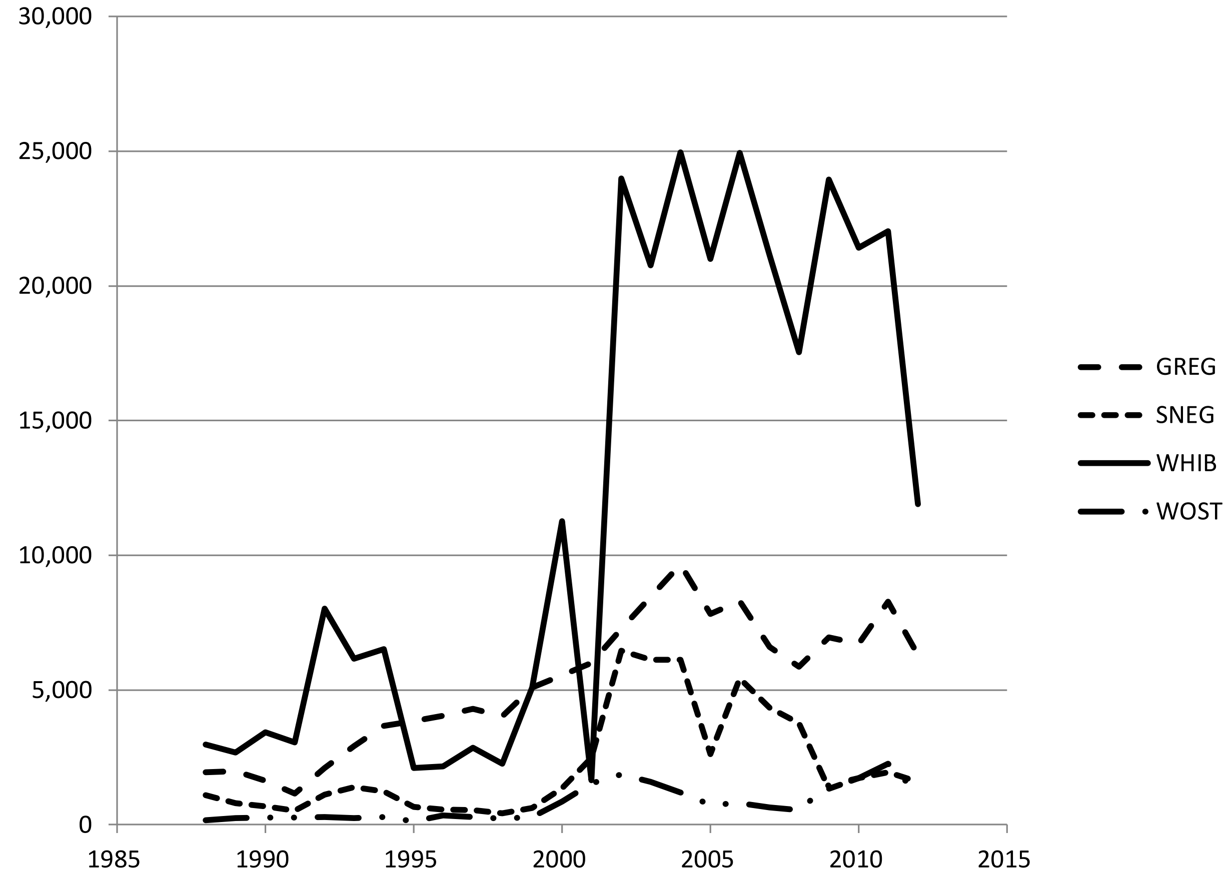


Figure 2. Proportion of all mainland Everglades nesting that is located in the coastal estuarine zone, 1986 – 2012.

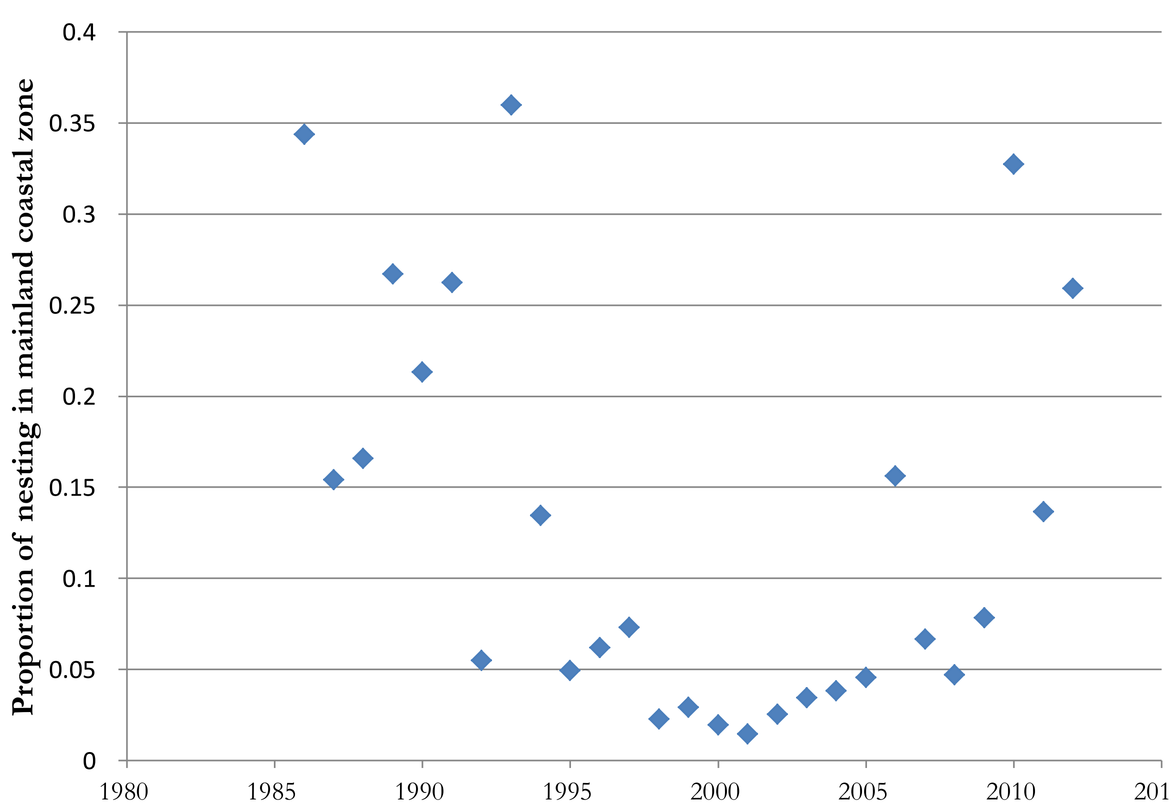


Figure 3. 4-year running average Wood Stork nest initiation date. 1 = March, 5 = November. Target nest dates for restored conditions are November – December.

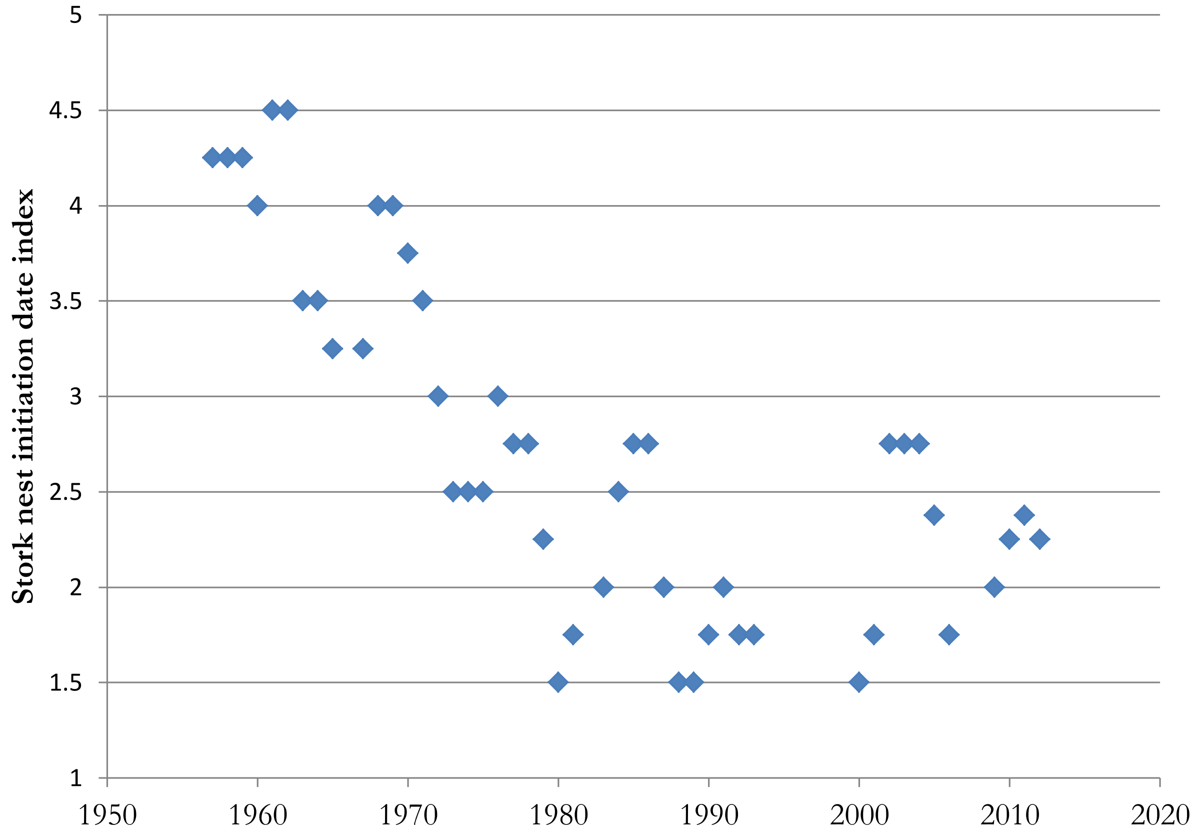
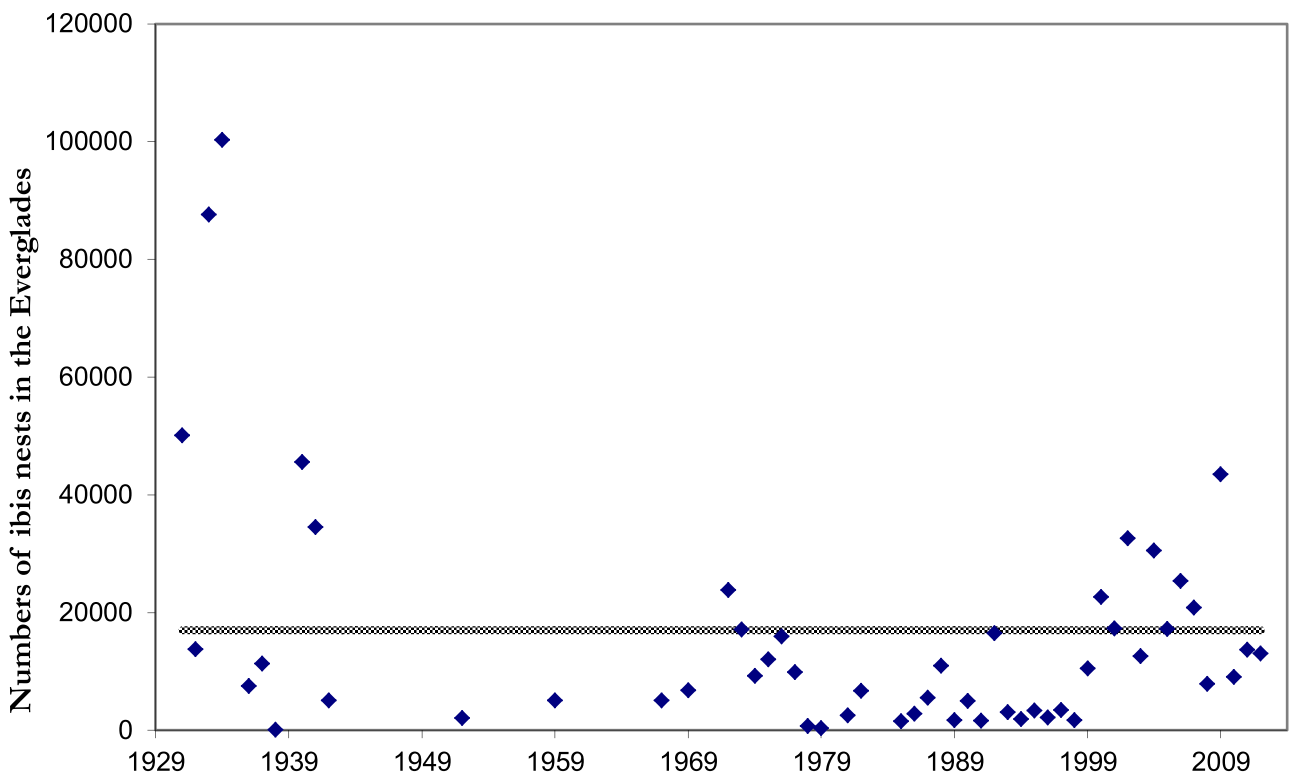


Figure 4. Numbers of White Ibis nests in the mainland Everglades, 1930 – 2012. Gray line illustrates the 70th percentile of the period of record, which is used as the criterion for exceptional ibis nesting events.



SPECIAL TOPICS

WOOD STORK NESTING AND PRODUCTIVITY AT THE PALM BEACH SOLID WASTE AUTHORITY

Methods

We monitored nesting by wood storks (*Mycteria americana*) at the Palm Beach Solid Waste Authority from 25 January 12 through 05 July 12 (see preceding article for complete site description). The colony was visited every 5-8 days, and all observations were made from the northeast and southeast observations towers to minimize disturbance to the birds. We took high resolution digital photographs from both towers using either a digital SLR with a 300 mm telephoto lens or a digital camera with 12x optical zoom. We were able to distinguish wood stork nests from those of other wading birds by digitally zooming in on photos using Adobe Photoshop. We used the photos to count all wood stork nests visible from each tower and to follow the fates of a subset of 57 nests photographed from the northeast tower. Nest fates were verified in the field using a spotting scope.

A nest was considered to have been successful if it was still active at least 90 days after the day it was first observed. This time period adequately encompassed the incubation and nestling period (28-30 days and 55-60 days, respectively) and by this point in time it was generally apparent that chicks were capable of flight and could be considered to have fledged. If chicks were not of an age-appropriate size, we considered a nest takeover to have occurred. Daily nest survival probabilities were calculated using Program MARK (White and Burnham 1999). We tested 3 survival models: one in which daily nest survival was constant over the entire nesting period, one in which it varied daily over the entire period, and one in which nests were divided into two groups, those that were initiated prior to March vs. those that were initiated during March, and nest survival was modeled separately for each group. Nests initiated in April or later were not monitored. We compared models using Aikaike's Information Criteria and selected the best model as the one with the lowest AICc (Burnham and Andersen 1998). We excluded from the analysis 4 nests that appeared to have been taken over by other wood storks at some point during the nesting cycle.

We also banded 26 chicks in the colony in early May, using aluminum bands and green and white alphanumeric bands.

Results

This report presents preliminary data for the 2012 nesting season. A total of 44 individual wood storks were counted in the colony on 25 Jan. No nests were visible at this time and birds appeared to be in the very early stages of pair formation. The first nests (10) were recorded on 02 Feb. The colony was extremely asynchronous, with nest numbers rising steadily through mid-April and peaking on 19 April with 341 nests. Nest numbers started declining rapidly thereafter, with only 277 nests counted on 26 April. Numbers continued declining steadily, with 155 nests counted on 25 May, 69 counted on 13 June, and 17 counted on 05 July.

Of the 57 nests that were monitored over time, 15 were successful (26.3%). The four nests taken over by other wood storks at some point in the study were considered to have failed. Modeling daily survival rates of nests that were initiated prior to March and those that were initiated during the month of March separately did not improve model fit relative to the null model in which nest survival was constant for all nests. Based on the 53 nests that we analyzed, daily nest survival was 0.989 (SE = 0.0017, 0.985-0.992). Using this estimate, the probability of a nest surviving for at least 90 days was 0.370 (95% CI = 0.257-0.485).

The nests we monitored fledged between one and three chicks. No nests were observed to have more than three chicks at any time during the nesting period, although very small nestlings could not be seen from the observation towers and it is possible that some nests hatched more than three chicks. Of the successful nests that we monitored 47% appeared to have fledged two chicks, 40% appeared to fledge one chick and 13% appeared to fledge three chicks. The average number of chicks that appear to have fledged from successful nest was 1.86.

Due to the asynchrony of the colony and the rapid decline in nest numbers in late April and May, we did not use the peak nest count to estimate productivity of the colony this year. Instead, we used the peak count obtained prior to April. Using a peak total nest count of 274 from 26 March, an average of 1.86 chicks per successful nest, and the 95% CI's for our estimated daily nest survival rate (for nests initiated prior to April), it would appear that between 132 and 247 chicks fledged from the SWA colony in 2011. Given conditions on the ground and our observations of the colony, we believe that the lower confidence limit is most likely to represent actual conditions, and may in fact be high. Relatively few fledged chicks were observed flying around the colony or standing in trees or along the road adjacent to the colony when compared to previous years.

Overall, 2012 was a poor year for Wood Stork nesting at the SWA. The low productivity of the colony this year was likely related to heavy rainfall and water level reversals that occurred in April and May. In contrast, in 2011 nests were active well into July, the probability of a nest surviving for at least 90 days was nearly twice that of 2012 (0.67 vs. 0.37), and the estimated number of chicks fledged was 370 – 546.

Sightings of banded wood storks can be reported to the Patuxent Wildlife Research Center Bird Banding Laboratory (http://www.reportband.gov/) or by contacting Rena Borkhataria (rrbork@ufl.edu).

Rena Borkhataria,
Mary Beth Morrison (Palm Beach SWA)
Everglades Research and Education Center
University of Florida
3200 E. Palm Beach Rd.
Belle Glade, FL 33430
(561) 993-1599
rrbork@ufl.edu

PRELIMINARY EVIDENCE OF PREY PREFERENCE AND COLONY DECLINE AFTER A WATER RECESSION REVERSAL

Introduction

Wading birds are food-dependent, leading several studies to address factors generating optimal wading bird foraging habitat. However, little is known about the exact prey wading birds are extracting from their environment, and how prey selection may change throughout a breeding season and with hydrological variation. One dramatic hydrological event, a reversal in the seasonal drying pattern, is well known to cause nest failure in wading birds. The mechanism by which the reversal acts on wading bird nesting is assumed to be a reduction in prey availability but this has not been quantified. Here we present preliminary data of prey selection at one colony before and after a reversal in receding water levels during the 2012 breeding season.

Methods

We collected boluses from nestling Snowy Egrets (*Egretta thula*) and Tricolored Herons (*Egretta tricolor*) within Hidden Colony (25.77353, -80.83722) in southwest WCA3A once a week from 19 April through 7 May 2012. Nestlings often regurgitate in the presence humans, making bolus contents readily available. In the event a targeted nestling did not voluntarily regurgitate, we gently massaged its trachea to encourage regurgitation. We also sampled available aquatic prey with throw-traps within 30 km of the colony. We identified, weighed, and measured prey from both boluses and throw-traps. To determine prey preference, we used the Chesson's index (α_i; Chesson 1978):

$$\alpha_i = \frac{r_i/p_i}{\sum_{i=1}^{n} r_i/p_i}$$

where r_i is the proportion of prey type *i* (among *n* total prey categories or size classes) in the wading bird diet, and p_i is the proportion of prey type *i* available in the Everglades system.

A severe recession reversal occurred on 29 – 30 April, increasing water levels approximately 10 cm around the colony. Since this event occurred in the middle of our sampling period, we were able to determine preliminary prey preferences and colony condition before and after this reversal.

Results

We collected 66 boluses: 29 from Snowy Egret nestlings and 37 from Tricolored Heron nestlings. Of these boluses, we collected 48 before the reversal event and 15 after the event.

Prey Preference

We did not find a significant difference ($p > 0.05$; t-test) in prey size between Snowy Egret and Tricolored Heron boluses. Therefore, we grouped boluses from both bird species for prey size preference analysis. Prey size ranged from 0.6 to 6.7 cm, with an average length of 2.7 cm. We found a negative selection against small prey (< 2 cm), no selection for intermediate sized prey (2 – 2.9 cm), and positive selection for large prey (> 3 cm; Fig. 1). The selection against small prey and the selection for large prey grew stronger across time and after the reversal event.

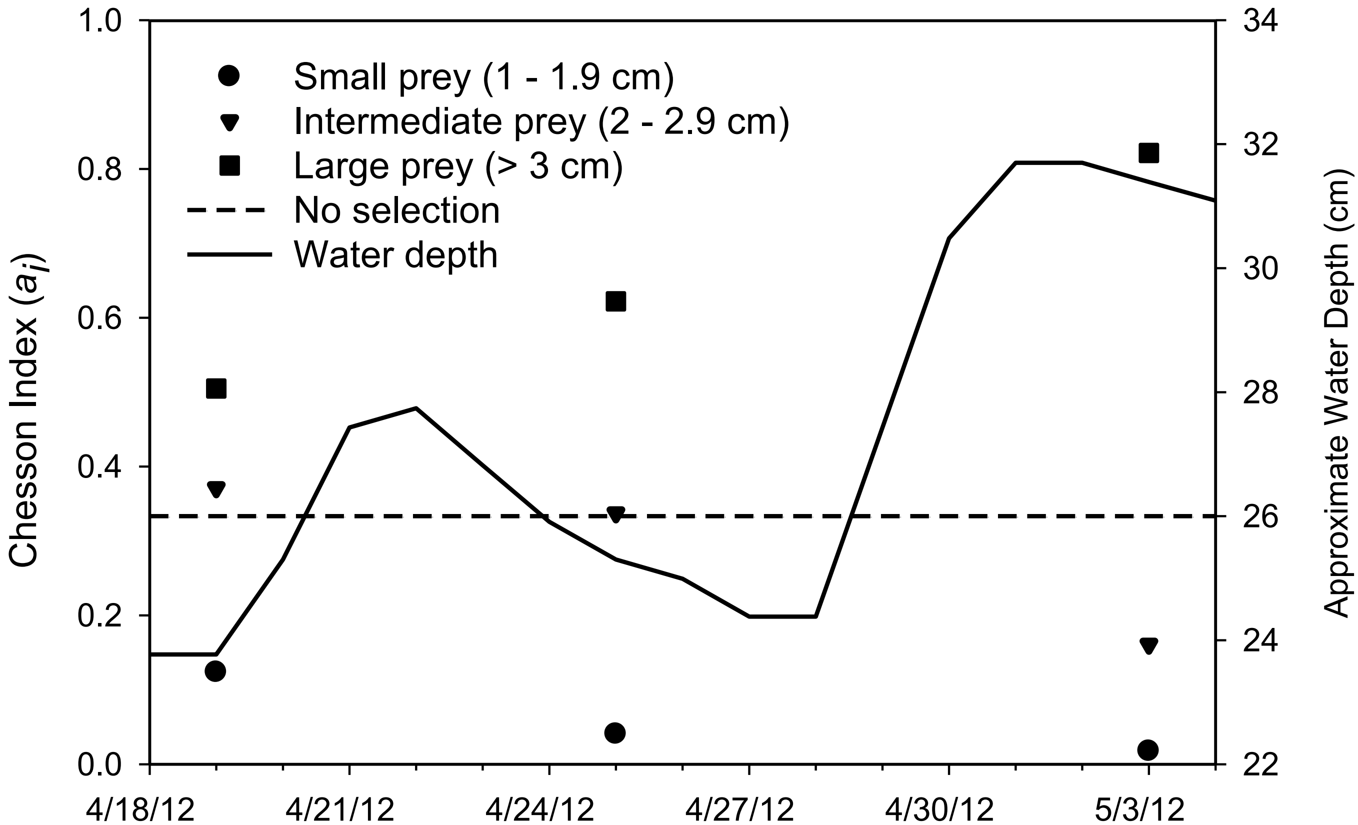
Within boluses, we identified 18 different prey species including fish, invertebrates, and amphibians. Both Snowy Egrets and Tricolored Herons showed positive selection for sunfish species (*Centrarchidae spp.*), flagfish (*Jordanellae floridae*), and golden topminnows (*Fundulus chrysotus*). Additionally, both bird species showed negative selection against grass shrimp (*Gambusia holbrooki*), bluefin killifish (*Lucania goodie*), and crayfish (*Procambarus spp.*; Table 1). However, prey species selection may be a function of prey size selection since the positively selected species tend to be larger than the negatively selected species.

Table 1. Chesson index for most common prey species found within Snowy Egret and Tricolored Heron boluses in Hidden Colony across the 2012 breeding season. Bold numbers indicate positive selection.

[1] Data from 7 May are not included because only 1 bolus was collected.

	Pre-Reversal		Post-Reversal
	19 April	25 April	3 May[1]
Bluefin killifish (*Lucania goodie*)	0	0	0
Flagfish (*Jordanellae floridae*)	0.17	0.26	0.18
Golden topminnow (*Fundulus chrysotus*)	0.05	0.24	0.57
Grass shrimp (*Palaemonetes paludosus*)	0	0	NA
Least killifish (*Heterandria formosa*)	0.17	0.04	NA
Mosquito fish (*Gambusia holbrooki*)	0.09	0.19	0.02
Sunfish spp. (*Centrarchidae spp.*)	0.47	0.24	0.13
Crayfish (*Procambarus spp.*)	0	0	0.01
Insects	0.03	0.02	0.07

Figure 1. Prey size selection for Snowy Egrets and Tricolored Herons and approximate water depth at Hidden Colony during the 2012 breeding season.



Colony Response

We sampled the colony twice before the reversal event, and twice after the event. Colony failure after a major reversal is common, and thought to be a result of decreased food availability. Whereas this proved true at the colony level, we did not find that immediate pattern within individual birds. On 19 and 25 April, we found the average bolus weight to be 5.8 g. After the reversal event (3 May), the average bolus weight increased to 8.2 g, but this was based on only 14 samples. The primary effect of the reversal was a reduction in the number of nestlings that had food boluses. Before the reversal, we were able to collect boluses from 70 – 80% of the nestlings sampled. This number decreased to 35% on 3 May, and 10% on May 7. The larger prey size after the reversal suggests that while some birds were able to locate high quality prey following a reversal (and thus maintain a high average bolus weight), the colony as a whole did not find prey as readily. However, the success of these few birds was short-lived. By 7 May, the entire colony failed.

Jessica A. Klassen
Dale E. Gawlik
Department of Biological Sciences
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431-0991
561-297-3333
jklassen@fau.edu
dgawlik@fau.edu

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Mark I. Cook
Everglades Systems Assessment Section
3301 Gun Club Rd.
West Palm Beach, Florida 33406
(561) 686 – 8800 x4539
mcook@sfwmd.gov

Mac Kobza
Boulder County Parks and Open Space
5201 Saint Vrain Rd.
Longmont, Colorado 80503
(303) 678-6203
mkobza@bouldercounty.org