SOUTH FLORIDA WADING BIRD REPORT

Volume 21 Mark I. Cook, Editor January 2016

SYSTEMWIDE SUMMARY

The estimated number of wading bird nests in South Florida during the 2015 nesting season (December 2014 to June 2015) was 43,896 (excluding Cattle Egrets). This is a relatively average nesting effort compared to the mean count of the past 10 years (41,975 nests) and a moderate improvement over recent years (2014: 34,714 nests; 5-year average: 35,090 nests).

This year's improvement is attributed largely to increased nesting by the White Ibis (WHIB). WHIB are the most numerous wading bird in South Florida and typically account for approximately half of all wading bird nests in the region. This year, WHIB produced 28,139 nests, approximately 11,000 (64%) more nests than the 5-year average and 32% more than the 10-year average.

Most other wading bird species exhibited reduced or average nesting effort during 2015. Great Egret (GREG) nesting effort (8,213 nests) was within 3% of the 5-year and 10-year averages, while Wood Stork (WOST) nesting (1,469 nests) was down 32% from the 5-year average and 36% from the 10-year average.

Small herons of the *Egretta* genus have shown sharp and consistent declines in nest numbers over the past decade. Nesting efforts by Snowy Egret (SNEG; 2,034 nests) and Little Blue Heron (LBHE; 248 nests) continued to decline in 2015, with nest numbers reduced by 42% and 21% , respectively, relative to the 5-year averages, and down 51% and 70%, respectively, from the 10-year averages. The exception was the Tricolored Heron (TRHE), whose nesting effort increased in 2015 (1,148 nests) relative to recent years (e.g., 544 nests in 2014) and was within 4% of the 10-year average. Much of the TRHE improvement was due to an increase in the number of nests recorded in Florida Bay.

For the largely coastal nesting Roseate Spoonbill (ROSP), reproductive effort generally improved in 2015. In Florida Bay, ROSP produced 365 nests, almost 3 times the number of nests recorded last year (126 nests) and 1.5 times more than the 5-year average (269.8 nests). However, this effort is low from a historical perspective, being 23% lower than the 30-year mean (475 nests) and far below the mid-20th century nesting effort when more than 1,000 nests per year were common.

INSIDE THIS ISSUE

Wading bird nesting effort is not evenly distributed in South Florida (**Figure 1**). Most nesting occurs in the Everglades Protection Area (approximately 80% of all nests in South Florida) and Lake Okeechobee (approximately 10% of all nests). This year Lake Okeechobee produced an estimated 3,852 nests, which is slightly more than last year (3,457 nests) but 22% less than the 10-year average. Other regionally important nesting areas in 2015 were Florida Bay and the Kissimmee Lakes, both of which supported more than 1,000 wading bird nests.

A nesting area of concern is Audubon's Corkscrew Swamp Sanctuary, which has experienced substantially reduced nesting activity in recent years. This historically important nesting area had up to 7,000 WOST nests per year in the 1960s and often more than 1,000 nests per year in the early 2000s. WOST did not nest at Corkscrew during 2015 and have nested there only twice in the past 8 years. It is possible that loss of critical WOST foraging habitat in southwestern Florida is responsible for the decline (Lauritsen 2011).

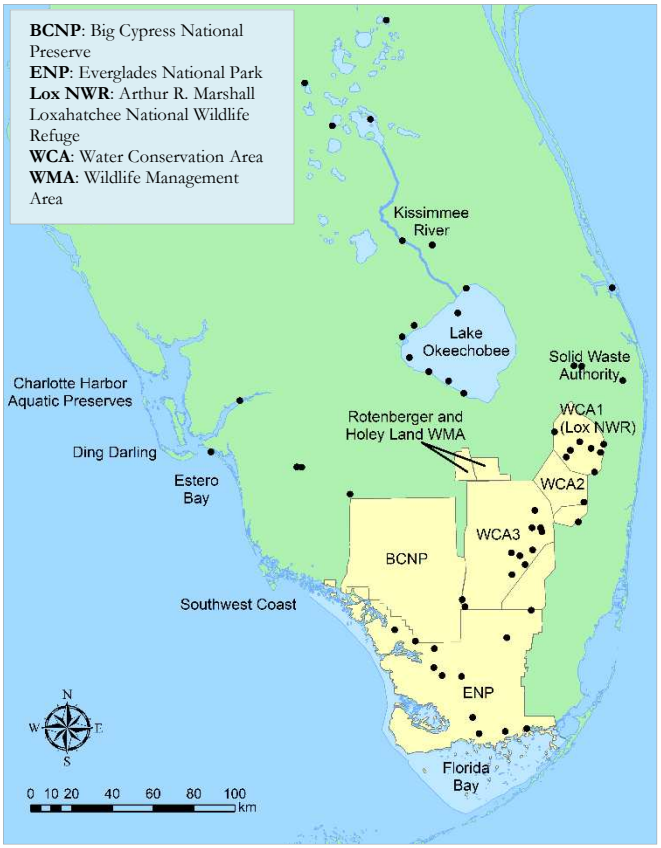

Figure 1. Locations of wading bird colonies with 50 or more nests in South Florida, 2015.

NESTING IN THE EVERGLADES

Nest Numbers

The Everglades Protection Area, comprising Water Conservation Areas (WCAs) and Everglades National Park (ENP), is the primary nesting region for wading birds in South Florida. Wading birds initiated an estimated 33,140 nests in the Everglades Protection Area during 2015. This nesting effort is within a single percentage point of the 10-year average (33,091.7 nests) and is 30% greater than last year. The improvement is solely a result of increased WHIB nesting (25,256 nests; 70% greater than the 5-year average) as all other wading bird species experienced reduced or average nesting effort relative to recent years (**Figure 2**). The declines of *Egretta* herons have been particularly acute in the Everglades Protection Area and are cause for concern. Numbers have steadily dropped from thousands of nests per species for a typical year in the mid-2000s to only 766 SNEG nests, 4 TCHE nests, and 42 LBHE nests in 2015 (**Figure 2**).

Three of the four indicator species (GREG, WHIB, and WOST) met their numeric restoration targets (3-year running average numbers of nesting pairs) for 2015. GREG and WHIB have exceeded target counts every year since 1996 and 2000, respectively, and WOST have exceeded theirs during 5 of the last 12 years. SNEG have been consistently below target since 1986 (**Figure 3**; **Table 1**).

Table 1. 3-year running averages of the number of nesting pairs for the four indicator species in the Everglades. Bold entries are those that meet minimum criteria.

Period	GREG	SNEG	WHIB	WOST
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
2011-13	**7,490**	1,299	**16,282**	**1,686**
2012-14	**7,041**	1,017	**17,194**	**1,696**
2013-15	**6,300**	710	**21,272**	**1,639**
Target minima	4,000	10 – 20k	10 – 25k	1.5 – 2.5k

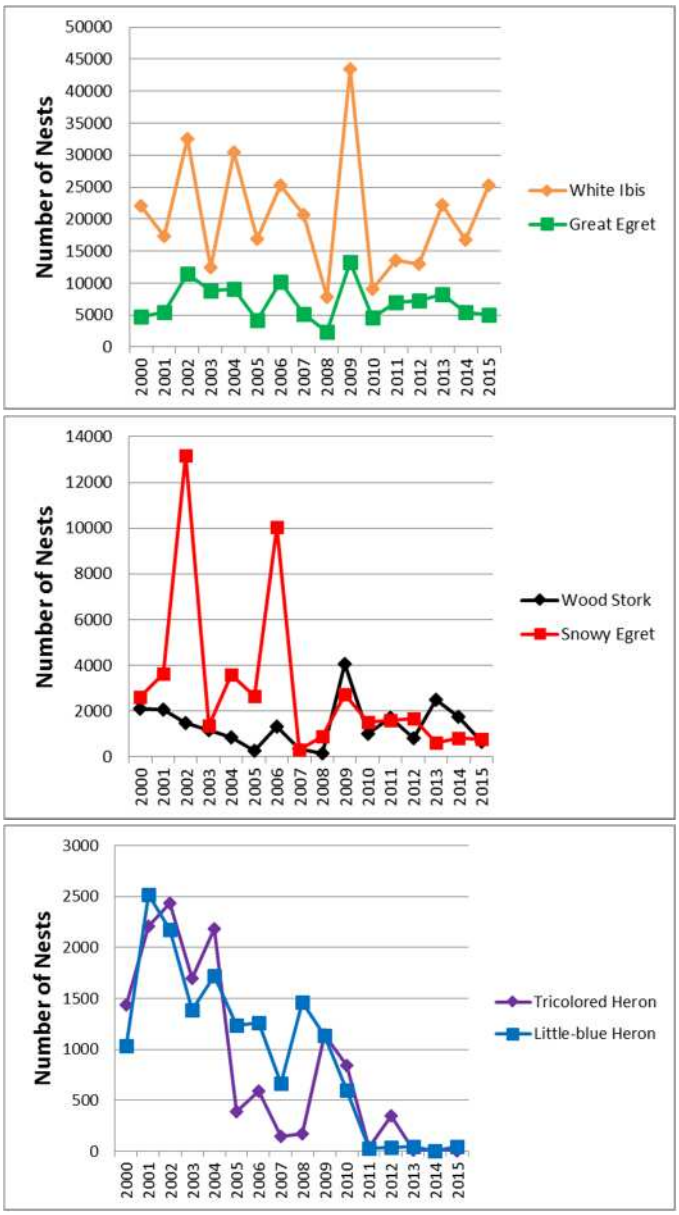

Figure 2. Wading bird nest numbers in the Everglades Protection Area (Water Conservation Areas and Everglades National Park combined) for individual species since 2000.

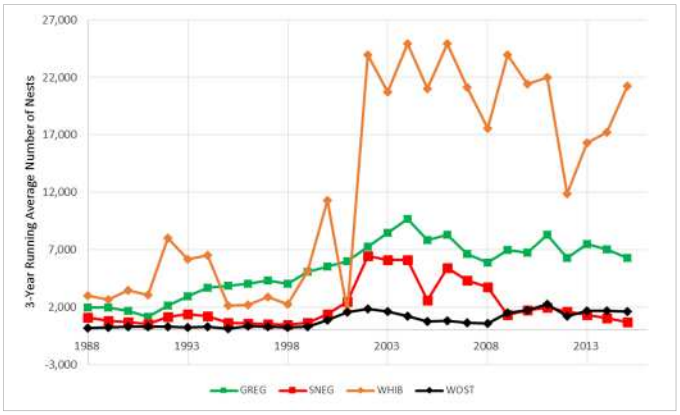

Figure 3. Trends in 3-year running average of nesting pairs of the four target species since 1988.

Spatial Distribution of Nests

The estuarine region of ENP historically supported approximately 90% of all nesting wading birds in the Everglades Protection Area, probably because it was the most productive region of the Everglades ecosystem. In the past 50 years, that productivity has declined due to reduced freshwater flows, and nesting has shifted towards inland colonies in the WCAs. An important goal of the Comprehensive Everglades Restoration Plan (CERP) is to restore the hydrologic conditions that will re-establish prey availability across the southern Everglades landscape to support large successful wading bird colonies at traditional estuarine rookeries. In 2015, ENP supported 18% of wading bird nests, while WCA-3A and WCA-1 supported 60% and 22%, respectively. This represents a slight decrease in the proportion of birds nesting in ENP relative to the decadal average (22%) and falls far short of the 50% restoration target.

The coastal nesting ROSP has shifted the location of its nesting colonies within Florida Bay over the last few years. Birds typically nested on small keys within the bay, but most nesting now occurs on mainland coastal colonies (i.e., Madeira Hammock and Paurotis Pond). The reason for this movement is unclear but might reflect a recent reduction in mammalian predators (e.g., raccoons) on the mainland (Dorcasa et al. 2012) or a reduction in the suitability of nesting habitat on the keys. Other individuals appear to have deserted Florida Bay entirely. The ROSP is primarily a coastal nesting species, but for 3 of the past 4 years, it has nested in relatively large numbers (more than 200 nests) at colonies in central freshwater marshes such as northern WCA-3A. This trend continued during 2015, with 190 nests found at inland colonies.

Timing of Nesting

WOST have a relatively long reproductive period (approximately 4 months), and it is critical they start nesting early in the dry season to ensure nestlings have time to fledge and gain independence prior to the onset of the rainy season in May or June. WOST prey (fish) are easy to find and feed on when concentrated in shallow water during the dry season but are not available in the wet season (summer) after water levels rise because they re-disperse into deeper marsh waters. Without the dry season supply of highly concentrated prey, parent birds are unable to support their offspring.

WOST nesting historically started in November or December, but in recent decades nesting initiation has shifted to January to March. The delay is thought to be because of a reduction in the amount and quality of short hydro-period wetlands, which provide suitable foraging habitat early in the nesting season. In 2015, WOST initiated nesting in late February at the coastal colonies and in late February/early March at the inland colonies. These start times are later than last year (late January), and fall short of the CERP December target date (**Figure 4**).

Other early nesting species, such as GREG, nested approximately 4 weeks later than average. WHIB and *Egretta* herons, which tend to nest later in the season, started nesting at their usual time (March or April), but there also was an unusual late surge of WHIB nesting in May and June that was largely successful due to the late start of the wet season.

ROSP in Florida Bay typically nest very early in the nesting season (November or December) but the mean lay date in 2015 was February 10, 43 days later than last year's mean lay date. Moreover, the timing of laying was considerably more asynchronous than usual, with mean lay dates for individual colonies spanning January through April.

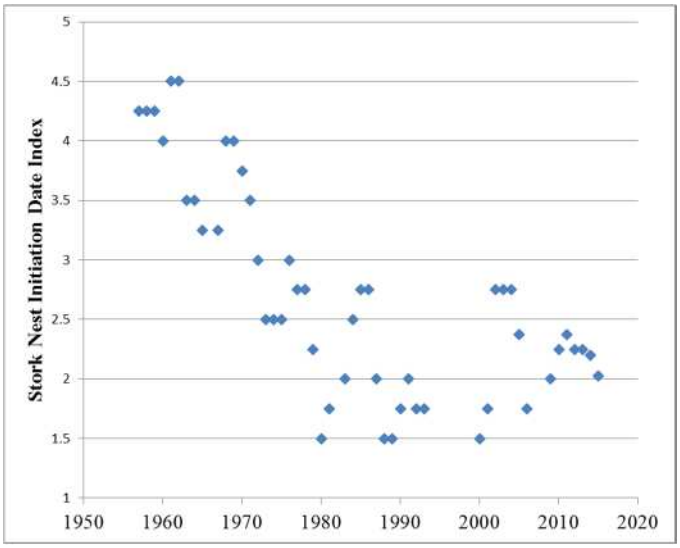

Figure 4. 4-year running average WOST nest initiation date, 1960 to 2015. Stork nest initiation date index: 1 = March; 5 = November. Target nest dates for restored conditions are November to December.

Abbreviations

Bird Species: Anhinga (ANHI, *Anhinga anhinga*), Black-crowned Night Heron (BCNH, *Nycticorax nycticorax*), Brown Pelican (BRPE, *Pelecanus occidentalis*), Cattle Egret (CAEG, *Bubulcus ibis*), Double-crested Cormorant (DCCO, *Phalacrocorax auritus*), Glossy Ibis (GLIB, *Plegadis falcinellus*), Great Blue Heron (GBHE, *Ardea herodias*), Great Egret (GREG, *Ardea alba*), Great White Heron (GWHE, *Ardea herodias occidentalis*), Green Heron (GRHE, *Butorides virescens*), Little Blue Heron (LBHE, *Egretta caerulea*), Reddish Egret (REEG, *Egretta rufescens*), Roseate Spoonbill (ROSP, *Ajaja ajaja*), Snowy Egret (SNEG, *Egretta thula*), Tricolored Heron (TRHE, *Egretta tricolor*), White Ibis (WHIB, *Eudocimus albus*), Wood Stork (WOST, *Mycteria americana*), Yellow-crowned Night Heron (YCNH, *Nyctanassa violacea*)

Regions, Agencies & Miscellaneous: Arthur R. Marshall (A.R.M.), Charlotte Harbor Aquatic Preserves (CHAP), Comprehensive Everglades Restoration Plan (CERP), Everglades National Park (ENP), Everglades Protection Area (EPA), Florida Atlantic University (FAU), Florida Department of Environmental Protection (FDEP), Kissimmee River Restoration Evaluation Program (KRREP), National Geodetic Vertical Datum of 1929 (NGVD29), National Wildlife Refuge (NWR), North American Datum of 1983 (NAD83), Northeast Shark River Slough (NE-SRS), Restoration Coordination and Verification (RECOVER), Solid Waste Authority (SWA), South Florida Water Management District (SFWMD), Water Conservation Area (WCA), Water Year (WY)

Role of Hydrology on Nesting Patterns

Wading bird reproductive patterns in the Everglades are driven principally by hydrology through its influence on aquatic prey production and vulnerability to predation (Frederick et al. 2009). The 2015 breeding season was preceded by drier than average conditions during the 2014 dry season, which kept water levels below ground for extended periods across large areas of the central and southern Everglades. Such conditions limit the production of small fish (Trexler et al. 2005), and a reduction in fish biomass might account for the observed late nesting and decreased nesting effort by the piscivorous WOST in 2015. In contrast to fish, production of the slough crayfish *Procambarus fallax* typically increases after dry conditions via predator release (mortality of predatory fishes) or nutrient pulse mechanisms (Frederick and Ogden 2001; Dorn et al. 2011, Dorn and Cook 2015). The drier conditions during 2014 were conducive for crayfish production and this might explain the increased nesting by the invertivorous WHIB in 2015, which relies heavily on crayfish during reproduction (Boyle et al. 2014).

With regard to prey vulnerability, recession rates and water depths generally were good for wading bird foraging from October 2014 through April 2015; however, rain events in April caused water-level reversals and the dispersal of concentrated prey. This probably accounts for a large proportion of the nest abandonments by various species that started in April shortly after the reversal events. The extended dry conditions and continued water level recessions into July allowed for late nesting by WHIB.

Long-Term Trends

When considering the wading bird nesting data reported here, it is important to remember that large fluctuations in annual nesting effort are a natural and defining feature of Everglades' ecology that reflect yearly variation in hydrologic conditions and availability of aquatic prey (e.g., fish). To understand the status of wading bird populations and how they are responding to changes in water management, restoration efforts, and climate conditions, research needs to go beyond the noisiness of the year-to-year variation and instead focus on long-term (decadal and longer) trends in nesting responses.

These long-term data reveal that several nesting responses have improved over the past 20 years, while others have shown no change or are getting worse. In short, numbers of nests of WHIB, WOST, and GREG generally have increased over the past 15 years and appear to be regularly meeting restoration targets (**Figure 3**). Moreover, the interval between exceptional WHIB nesting years has met the restoration target (<2.5 years) for 8 of the past 10 years (**Figure 5**). There have been some recent improvements in the number of birds nesting at historical coastal colonies, but the proportion remains well below the restoration target (5-year running average of 22% compared to 50% target; **Figure 6**).

Several measures are not improving and are cause for concern. The numbers of SNEG, TRHE, and LBHE are declining sharply (**Figure 2**), and the causes of the declines are unknown. Also, despite improved WOST nesting effort, the timing of their nesting has remained relatively static and their nesting success typically is below that necessary to sustain the population. The ratio of tactile to visual foragers has improved since the mid-2000s, but remains an order of magnitude below the restoration target.

For more information on Everglades restoration performance measures, see the Status of Wading Bird Recovery section at the end of this report. **Figures 3** through **6** were provided by Peter Frederick.

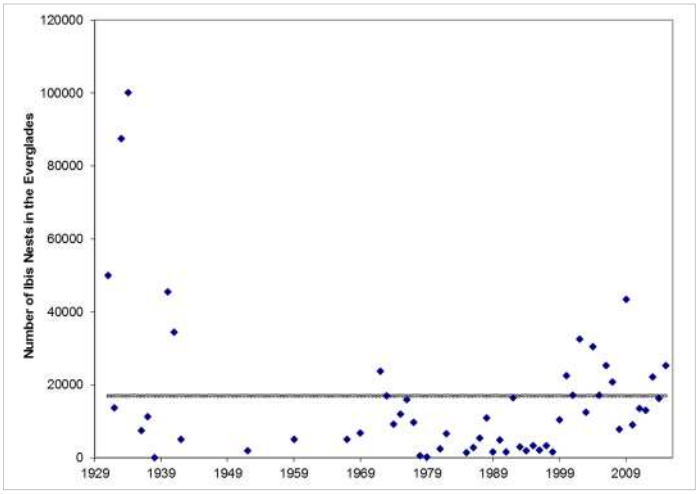

Figure 5. Numbers of WHIB nests in the mainland Everglades, 1930 – 2014. Gray line illustrates the 70th percentile of the period of record, which is used as the criterion for exceptional WHIB nesting events.

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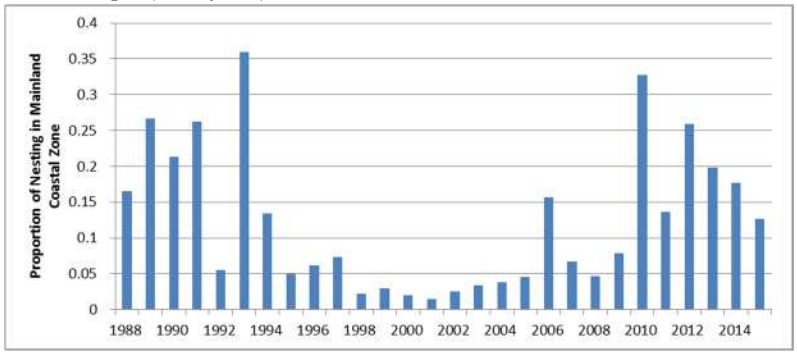

Figure 6. Proportion of all mainland Everglades nesting that is located in the coastal estuarine zone, 1988 to 2015.

EVERGLADES PROTECTION AREA HYDROLOGY

Rainfall in the Everglades Protection Area for Water Year 2015 (WY2015; May 1, 2014 to April 30, 2015) was lower than the long-term average (**Table 2**). This shortfall was greater in the south than in the north of the ecosystem, with Everglades National Park (ENP), Water Conservation Areas (WCAs) 3, 2, and 1 receiving 10.5 inches (19%), 5.8 inches (11%) and 3.5 inches (6%) less rain than average, respectively.

Despite the reduced rainfall, this water year's annual average stages were above historical mean averages (**Table 2**). The elevated stages were due partly to higher than average rainfall during the previous two water years, and also because more water from Lake Okeechobee was diverted away from the coastal estuaries and into the WCAs during WY2015.

Although stages were higher overall, water levels at the tail-end of WY2014 and into the wet season of WY2015 generally were lower than average for most regions of the Everglades Protection Area, with the exception of WCA-1. Lower wet-season water levels reduce the areal expanse of water cover in the marsh, which can limit fish production (Trexler et al. 2005) but enhance crayfish production through predator release (Dorn and Cook 2015). This may account for this year's drop in nesting effort by fish-eating wading birds (e.g., Wood Stork and heron species) but increased nesting by the crayfish-eating White Ibis. Aquatic prey become available to wading birds during the dry season when water levels decline to depths at which birds can forage and the volume of water is reduced such that prey are concentrated at high densities. Appropriate water level recession rates are an important driver for prey availability. In WY2015, recession rates generally were favorable to foraging birds, the exception being a small reversal in the recession rate (a rise in water level) in April when prey availability became limited and caused large numbers of wading birds to abandon nesting.

Figures 7A through **7G** show the average stage changes in each of the WCAs for the last 3 years in relation to historic averages, flooding tolerances for tree islands, drought tolerances for wetland peat, and recession rates and depths that support foraging and nesting needs of wading birds. These indices are used by the South Florida Water Management District to facilitate weekly operational discussions and decisions.

The flooding tolerance of tree islands is exceeded when depths on the islands are above 2.0 or 2.5 feet for longer than 120 days (Wu et al. 2002), depending on the elevation of the tree islands. Drought tolerances are exceeded when water levels are more than 1 foot below ground for more than 30 days (i.e., the criterion for Minimum Flows and Levels in the Everglades). Wading bird foraging habitat suitability is divided into three categories (red, yellow, and green) based on research conducted in the Everglades (Beerens et al. 2011, 2015; Cook et al. 2014). A green label indicates good recession rates and depths for wading birds. A yellow label indicates water levels that are too shallow or too deep and/or recession rates that are slightly too rapid or too slow. A red label indicates poor conditions resulting from poor depths and/or unsuitable recession rates that are rising or falling too rapidly.

WATER CONSERVATION AREA 1

Stages in WCA-1 generally were higher than average in WY2015 (**Figure 7A**). Water level was average at the start of WY2015 then rose rapidly during the wet season to peak approximately 0.5 ft above average in October 2014. Thereafter (from January through May 2015), recession rates were good to fair for wading bird foraging, providing good nesting conditions for thousands of wading birds. The small rain-induced water-level reversal in April resulted in poor foraging conditions and nest abandonment at several WCA-1 colonies, but the extended drydown into July due to the late start of the wet season allowed for additional late and successful nesting for some species.

WATER CONSERVATION AREAS 2A AND 2B

Water levels in WCA-2A were below average at the start of WY2015 but peaked approximately 9 inches above average by October 2014 (**Figure 7B**). This was followed by an initially rapid then gradual recession from January through mid-February, followed by a resumption of good recession rates in March through the end of the dry season. Wading birds started foraging in WCA-2A during March and April once depths and recession rates were optimal.

WCA-2B tends to be used by wading birds only during relatively dry conditions because it usually is deeper for longer periods than the rest of the Everglades Protection Area (**Figure 7C**). This year, rapid recession rates and lower than average water levels provided excellent late-season foraging conditions for wading birds.

Table 2. Average, minimum and maximum stage (feet NVGD29) and total annual rainfall (inches) for WY2015 in comparison to historic stage and rainfall. (Average depths calculated by subtracting elevation from stage.)

Area	WY2015 Rainfall	Historic Rainfall	WY2015 Stage Mean (min; max)	Historic Stage Mean (min; max)	Elevation
WCA-1	48.43	51.96	16.49 (15.18; 17.41)	15.66 (10.0; 18.16)	15.1
WCA-2	48.43	51.96	12.30 (11.20; 14.23)	12.51 (9.33; 15.64)	11.2
WCA-3	45.56	51.24	9.74 (8.58; 10.63)	9.59 (4.78; 12.79)	8.2
ENP	44.68	55.22	6.28 (5.59; 6.92)	6.01 (2.01; 8.08)	5.1

WATER CONSERVATION AREA 3A

Water levels in WCA-3A generally were lower than average in WY2015. Water levels in northern WCA-3A (the area north of Interstate 75; WCA-3AN) at gauge 63 (**Figure 7D**) started at ground level at the beginning of June 2014 and rose relatively quickly through early October, then receded gradually to ground level again by the end of May 2015. This gauge is near the Alley North colony, which is the largest wading bird colony in the Everglades Protection Area most years. Much of WCA-3AN lacks defined ridges and sloughs, and has dense vegetation cover with limited open water areas, which generally is poor foraging habitat for wading birds. Despite the limited available foraging habitat and the relatively dry antecedent conditions that limits fish production, foraging conditions in this area were excellent in 2015. More than 10,000 birds (White Ibis, Glossy Ibis, Great Egret, and Roseate Spoonbill) fed in the area for many consecutive weeks, an unusual behavior not noted previously. During the previous winter, northeastern WCA-3A experienced several large surface fires that thinned the cattails and allowed birds access to prey that were previously unavailable. A second unusual event was that approximately 9,000 White Ibises nested in the cattails adjacent to Alley North colony rather than in the trees of the colony. Despite nesting near the ground, the ibises produced several thousand successful fledglings. While nesting in cattails has been noted previously at this colony and elsewhere, nesting close to the ground like this is rarely so successful because of predation from alligators and mammals.

The hydrologic pattern in southern WCA-3A (the area south of Interstate 75; WCA-3AS) at gauge 64 (**Figure 7E**) was similar to that described for WCA-3AN, except that water levels remained above ground. The reduced depths and associated shorter hydro-periods at the end of WY2014 likely reduced fish production, and slow recession rates from October 2014 to March 2015 likely limited the availability of prey.

WATER CONSERVATION AREA 3B

As in WCA-3A, conditions in WCA-3B generally were drier than average for the first half of WY2015. Water levels were below average from May until mid-December 2014 (**Figure 7F**), and these reduced depths and short hydro-periods likely limited fish production for the 2015 dry season. However, optimal recession rates from October 2014 to March 2015 allowed the limited prey base to become available to birds. Wading bird use was greatest during May and June once recession rates and water depths had become most favorable for foraging.

NORTHEAST SHARK RIVER SLOUGH

Conditions at the start of WY2015 were very dry with a stage of approximately 0.7 feet below ground level in June 2014 (**Figure 7G**). As in most other regions, the wet season in Northeast Shark River Slough started relatively late (late June), but once it began, water levels rose extremely rapidly and by early July water levels exceeded the 31-year average. Water levels remained above average and fell only slightly until January when they rapidly declined. By April, water levels were below ground once more and remained there through the rest of the dry season. Again, the dry conditions during the early wet season were not conducive to fish production and likely limited prey production for wading birds.

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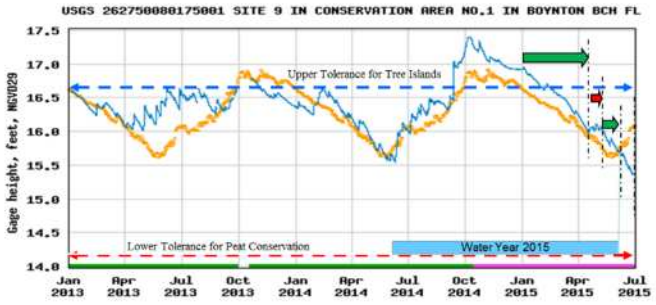
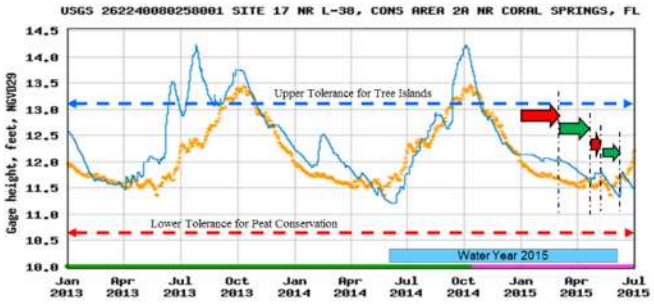
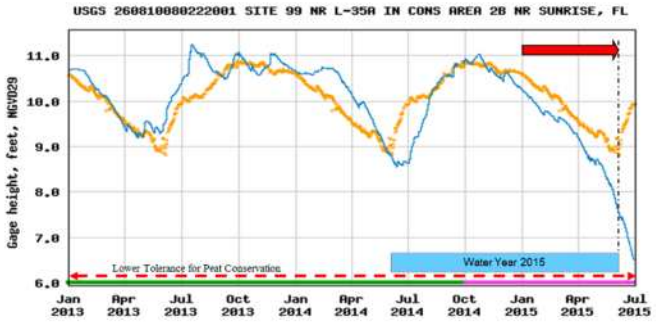
A. WCA-1 – Site 9



B. WCA-2A – Site 17



C. WCA-2B – Site 99



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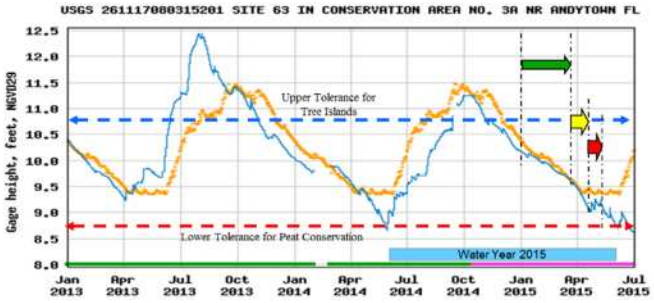

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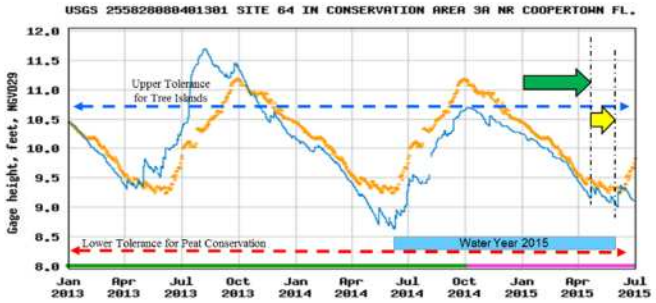

F. WCA-3B – Site 71

G. Northeast Shark River Slough

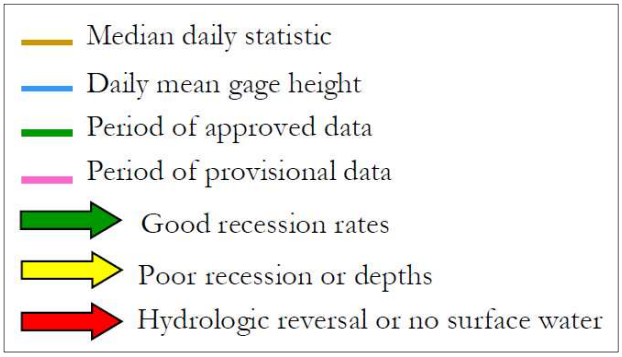

Figure 7. Hydrology in the WCAs and ENP in relation to average water depths (A: 20-year average, B: 20-year average, C: 20-year average, D: 21-year average, E: 21-year average, F: 21-year average, G: 31-year average), and indices for tree island flooding, peat conservation, and wading bird foraging.

REGIONAL NESTING REPORTS

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

The University of Florida Wading Bird Project continued its long-term monitoring of wading bird reproduction throughout Water Conservation Areas (WCAs) 2 and 3 and Arthur R. Marshall Loxahatchee National Wildlife Refuge (A.R.M., includes WCA-1) in 2015. Monitoring focused primarily on counts for Great Egret (GREG), White Ibis (WHIB), Snowy Egret (SNEG), and Wood Stork (WOST), the species that serve as bioindicators for the Comprehensive Everglades Restoration Plan (CERP), and are most readily located and identified through aerial searches. Estimates for these and other species were gleaned from aerial and systematic ground surveys as well as visits to nesting colonies and more intensive studies of nest success.

METHODS

Aerial and ground surveys were performed in 2015 to locate and characterize nesting colonies. On or around the 15th of each month from January through June, aerial surveys were performed to find active colonies using observers seated on both sides of a Cessna 182. Surveys were conducted from an altitude of 800 feet above ground level along east-west oriented flight transects spaced 1.6 nautical miles apart. These techniques have been used since 1986 and they 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, digital aerial photos were taken of all colonies and nesting birds observed in the photos were counted. The reported numbers of nest starts were derived from a combination of information sources, including peak estimates of nests in any colony, supplemental information from monthly South Florida Water Management District surveys staggered by 2 weeks from this survey, ground visits, and inference from observations across the season.

Since 2005, systematic ground surveys have been performed in parts of WCA-3 that give an index of abundance for small colonies and dark-colored species that are not easily located during aerial surveys. During ground surveys, all tree islands within sixteen 500-meter wide belt transects making up a total of 336 km^2 are approached closely enough to flush nesting birds, and nests were counted directly, if visible, or estimated from flushed birds. The totals were added to the numbers derived from aerial estimates. Because ground surveys were conducted on a subset of the total area, the resulting nest estimates should be used mainly for year-to-year comparisons and reflect minimum estimates for the total number of nesting pairs of Little Blue (LBHE), Tricolored (TRHE), and Great Blue (GBHE) herons.

RESULTS

Nesting Effort

An estimated 27,064 wading bird nests were initiated at colonies within WCA-1, WCA-2, and WCA-3 in 2014 (**Tables 3** and **4**). This nesting effort was the largest since 2009. The total number of nests was 8% higher than the average effort recorded over the last 10 years, and 51% above the average of the last 5 years. Nesting effort for WHIB (21,667 nests) was the largest since 2009, being 41% above the 10-year average and 95% above the 5-year average. GREG nesting effort was the lowest recorded in the past 6 seasons, at 71% of the 10-year average and 78% of the 5-year average. WOST were not observed nesting in the WCAs in 2015.

Roseate Spoonbills (ROSP) nested again at 6th Bridge and Alley North (120 nests total) as well as at two new colonies (Lox West and Jetport South). This nesting effort is substantially higher than most years, except for 2011 and 2012 which had exceptionally high nesting.

There has been a clear trend towards much smaller numbers of TRHE and LBHE nests in the study area over the past few years, which continued this year as only 4 TRHE and 42 LBHE were observed during systematic ground surveys. The average number seen in between 2008 and 2015 was reduced by 81% for LBHE and 85% for TRHE by comparison with 1996 to 2007 averages.

Table 3. Number of nesting pairs found in A.R.M. Loxahatchee National Wildlife Refuge (WCA-1) during systematic surveys, February to June 2015.

Colony	Latitude	Longitude	GREG	WHIB	ROSP	SNEG	LBHE	TRHE	Colony Total*
LOX 99	26.43822	-80.39053	221	2,900		400	**		3,521
LOX West	26.55014	-80.44268	60	985	9			**	1,054
New 4	26.5328	-80.2762							0
Lox Ramp	26.49511	-80.22533	78	1,700			**		1,778
LOX 73	26.37187	-80.26597	130	150					280
New Colony 2	26.45857	-80.24032	112						112
103	26.50638	-80.3309				50	**	**	50
Welt	26.46838	-80.37229	218						218
Colonies >50 nests			819	5,735	9	450			7,013
Colonies <50 nests			246	0	0	0			246
Total by Species			**1,065**	**5,735**	**9**	**450**			**7,259**

Note: WOST, GBHE, GLIB, BCNH, unidentified large white birds, unidentified small white birds, unidentified small dark birds, and ANHI were not observed (count = 0).
*Excludes ANHI.
**Present but not counted.

Table 4. Number of nesting pairs found in WCA-2 and WCA-3 during systematic surveys, February to June 2015.

Colony	WCA	Latitude	Longitude	GREG	WHIB	ROSP	SNEG	GBHE	LBHE	TRHE	GLIB	BCNH	Unident. Small White Birds	ANHI	Colony Total*
Rhea	2	26.23782	-80.3128	187											187
Alley North	3a	26.20132	-80.52873	450	15,434	60				**					15,944
6th Bridge	3a	26.12428	-80.54148	533	480	60				**					1,073
Jetport South	3a	25.80510	-80.84902	52		2									54
Horus	3a	25.96052	-80.57207	347											347
Joule	3a	26.01230	-80.63233	75											75
Jerrod	3a	26.00012	-80.59513	90											90
Cypress City	3a	26.12408	-80.50438	61											61
Vacation	3a	25.91565	-80.63022	75											75
Andytown	3a	26.10715	-80.49802	101											101
192	3a	26.47655	-80.28165	32					**	**			30		62
Hidden	3a	25.77353	-80.83722	100											100
Vulture	3a	26.02564	-80.53916	55											55
Colonies >50 nests				2,158	15,914	122	0	0	0	0	0	0	30	0	18,224
Colonies <50 nests***				386	18	0	1	238	42	4	3	867	22	433	2,014
Total by Species				**2,544**	**15,932**	**122**	**1**	**238**	**42**	**4**	**3**	**867**	**52**	**433**	**19,805**

*Excludes ANHI.
**Present but not counted.
***Includes counts of wading bird nesting pairs from ground surveys.

It is clear that the *Egretta* herons are not nesting in their former locations within small discrete willow heads in WCA-3. 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 such as in larger colonies or in coastal areas. For logistical reasons, *Egretta* herons are difficult to count in large colonies. Competing predictions about the declines are being addressed, with major overlapping explanations about the decline or shift in composition of the prey base, displacement by Black-crowned Night Herons, or movement to larger colonies.

Reproductive Success

Nest success was monitored at seven colonies, including four in ENP (Tamiami West, Rookery Branch, Paurotis Pond, and Cuthbert) and three in WCA-3 (Joule, Jerrod, and Alley North). Individual nests of GREG (n = 256, at all seven colonies), WOST (n = 6 at Tamiami West), WHIB (n = 83 at Tamiami West and Alley North), ROSP (n = 11 at Tamiami West and Alley North) BCNH (n = 24 at Tamiami West) and *Egretta* herons (n = 43 at Tamiami West and Rookery Branch) were monitored. Overall nest success for these colonies (P; probability of fledging at least one young, Mayfield method) varied largely by species; GREG (P = 0.645; SD = 0.0346), *Egretta* herons (P = 0.818; SD = 0.0682), WHIB (P = 0.367; SD = 0.0639). Success of each species also ranged widely between various colonies; for example; GREG nest success was 94% at Tamiami West but only 27% at Joule.

Due to lack of significant rain events in the WCAs, a long nesting season was observed, which included large late season nesting effort by *Egretta* herons and WHIB in northern WCA-3 and Arthur R. Marshall (A.R.M.) Loxahatchee National Wildlife Refuge. Some nests were still in the incubation stage as late as mid-June. The lack of rain also had a clear effect on success of earlier nesters. Most observed nest failures were seen during the incubation stage; once hatched, nests appeared to be largely successful across species and colonies, suggesting foraging conditions remained favorable throughout the season. Several early-May rain events farther south correlated with some loss of chicks; however, abandonment appeared to remain minimal.

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EVERGLADES NATIONAL PARK

This summary report addresses colony monitoring within the slough and estuarine areas of Everglades National Park (ENP) during the 2015 wading bird breeding season. Wading bird nesting colonies in 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 of this monitoring are as follows:

- 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 Everglades.

METHODS

Aerial site checks of known colonies were conducted by helicopter from January through June 2015. Flight altitude was maintained at 600 to 800 feet above ground level. During each flight, the observer made visual estimates of nest numbers by species and took photos of colonies using a digital SLR camera with a 70-200 mm lens. Photos were later compared to visual estimates to assist in determining nest numbers, nesting stage, and species composition.

Species monitored include Great Egret (GREG), White Ibis (WHIB), Wood Stork (WOST), Snowy Egret (SNEG*)*, Roseate Spoonbill (ROSP), Tricolored Heron (TRHE), and Little Blue Heron (LBHE). Great Blue Heron (GBHE*)*, Anhinga (ANHI), Cattle Egret (CAEG), and Black-crowned Night Heron (BCNH) also were found nesting in colonies.

Unlike previous seasons, a systematic reconnaissance survey (to find new colonies) was not conducted and nesting islands across Florida Bay were not monitored this season due to unavailability of a fixed-wing aircraft and limited funding for helicopter flights.

RESULTS

Nesting was monitored in 15 colonies during the 2015 nesting season (**Figure 8**). The total estimate for all species pooled was 6,076 nests (**Table 5**), a reduction of 3% from 2014. WOST nesting (648 nests) declined 49% compared to last year, GREG (1,460 nests) and SNEG (315 nests) nesting was down 16% and 54% respectively, while WHIB (3,589 nests) nesting was up 10%.

The first WOST nests were observed on February 27. Tamiami West had approximately 75 WOST nests with most birds incubating and some rearing small young. WOST were also active at Broad River (193 nests) and Cabbage Bay (65 nests), but nesting was less advanced than at Tamiami West with most pairs still nest building and only a few incubating. At Paurotis Pond, 10 WOST were present in the colony, divided between the corner nesting area and the island. In the corner area, where the majority of storks usually nest, 20 or more nests had been built (visible in photos) but were empty, with only 3 birds actually standing at nests. Rodgers River Bay, which is usually one of the first active WOST colony sites in ENP, had no WOST and fewer than usual GREG (only 15 birds incubating on the large island). Cuthbert Lake also had nesting GREG (18 nests) but no WOST.

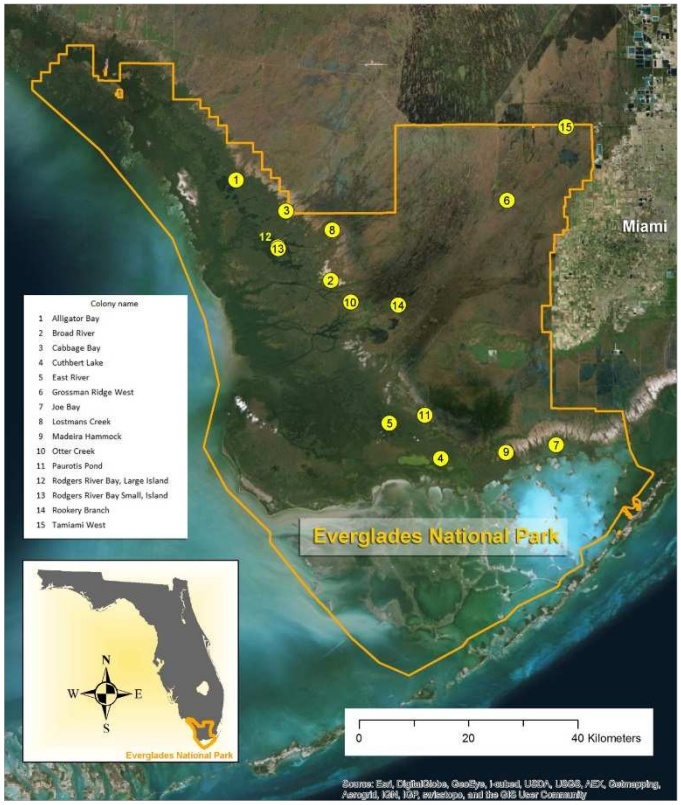

Figure 8. Wading bird nesting colonies monitored in ENP, January through June 2015.

Peak nest numbers for most species were observed on March 23. Cuthbert Lake had approximately 75 GREG nests with eggs or small young, while WOST were just starting to initiate nesting (25 nests). Paurotis Pond had increased to 285 WOST nests with many birds incubating and about a third still nest building. Broad River had 193 WOST nests, with some birds incubating, others paired on empty nests, and more birds roosting in the colony but not paired. Cabbage Bay had 65 WOST pairs incubating, with other birds still paired and standing on empty nests. Cabbage Bay also had approximately 70 ROSP adults and fledged young. Previously, 8 ROSP nests were visible; thus, it appears that more birds had nested here than could be seen from an aerial survey.

Colonies were re-checked on April 24 during drought conditions. WHIB were nesting in peak numbers in most colonies with the exception of Alligator Bay. WOST numbers at Broad River were the same as seen on March 23 and most contained small chicks (2 to 3 young per nest.) Cuthbert increased to 30 WOST nests, with incubating adults on half and the rest unattended by adults and containing small young. Cabbage Bay WOST were brooding small and medium-sized young; however, a few abandoned nests were seen. Paurotis Pond also had some abandoned WOST nests, but most adults were brooding 2 to 3 small young. Tamiami West WOST adults were brooding small and medium-sized chicks and no abandonment was observed.

Table 5. Peak numbers of wading bird nests found in ENP colonies through June 26, 2015.

Colony	Latitude	Longitude	GREG	WOST	WHIB	SNEG	ROSP	TRHE	LBHE	BCNH	GBHE	Total
Alligator Bay	25.67099	-81.14714	40	0	400	+	0	+	+	0	0	440
Broad River	25.50292	-80.97440	70	193	200	100	50	+	+	0	0	613
Cabbage Bay	25.62000	-81.05612	160	65	400	75	8	+	+	0	0	708
Cuthbert Lake	25.20933	-80.77500	75	30	0	0	0	0	0	0	0	105
East River	25.26860	-80.86785	25	0	0	0	0	0	0	0	0	25
Grossman Ridge West	25.63627	-80.65275	130	0	0	0	0	0	0	0	0	130
Joe Bay	25.23205	-80.56455	60	0	0	0	0	0	0	0	0	60
Lostmans Creek	25.58723	-80.97204	130	0	100	+	+	0	0	0	0	230
Madeira Hammock	25.21932	-80.65945	40	0	400	+	+	+	+	0	5	445
Otter Creek	25.46780	-80.93772	175	0	600	20	+	+	+	0	0	795
Paurotis Pond	25.28150	-80.80300	105	285	50	+	+	+	+	0	0	440
Rodgers River Bay Large Island	25.55667	-81.06984	15	0	0	0	0	0	0	0	0	15
Rodgers River Bay Small Island	25.55524	-81.06996	35	0	0	0	0	0	0	0	0	35
Rookery Branch	25.46356	-80.85256	150	0	130	20	+	+	+	+	0	300
Tamiami West*	25.75745	-80.54502	250	75	1,309	100	1	+	+	+	0	1,735
Total			**1,460**	**648**	**3,589**	**315**	**59**	**+**	**+**	**+**	**5**	**6,076**

+Species present and nesting, but unable to determine number of nests.
*Data from the University of Florida.

Colonies were re-surveyed on May 7, shortly after widespread storms and water-level reversals on April 29. Nesting GREG and WHIB did not appear to be affected, but WOST had abandoned all nests at Cuthbert Lake with exception of one adult still tending a nest. At Paurotis Pond, approximately 75% of WOST nests were empty and large chicks were standing on the remaining nests. Approximately two-thirds of the Broad River WOST nests were empty, but the remaining had medium to large-sized chicks with adults tending the nests. Cabbage Bay WOST abandoned approximately 25% to 33% of nests. Remaining nests had medium- to large-sized chicks with attending adults. Tamiami West WOST nests appeared to be unaffected, with attending adults and medium- to large-sized chicks.

Fledged GREG, WHIB, ROSP, and TCHE chicks were seen during the May and June surveys in colonies where they nested. During the two final surveys conducted on June 11 and 26, groups of approximately 50 to 75 WOST chicks were observed standing in the marsh outside Paurotis Pond and Broad River. Cabbage Bay and Tamiami West had fledged and near-fledged WOST young still in the colonies.

For the first time since the early 1990s, no WOST were seen at Rodgers River Bay. A few GREG nested on the large and small islands, but in fewer numbers than past years. No WOST nested this year at Grossman Ridge West. The area was completely dry throughout the nesting season.

Joe Bay

The small diamond-shaped island in Joe Bay (northern Florida Bay) had 18 GREG incubating on nests on January 23, with approximately 35 adult birds roosting. On February 27, 60 GREG were on nests with eggs and small chicks. On March 23, large chicks were on nests. When re-checked on June 11, GREG fledglings were off nests in the colony, and another 30 GREG adults were incubating on new nests. During the last survey on June 26, those nests contained medium-sized chicks. No other birds were seen nesting at this site.

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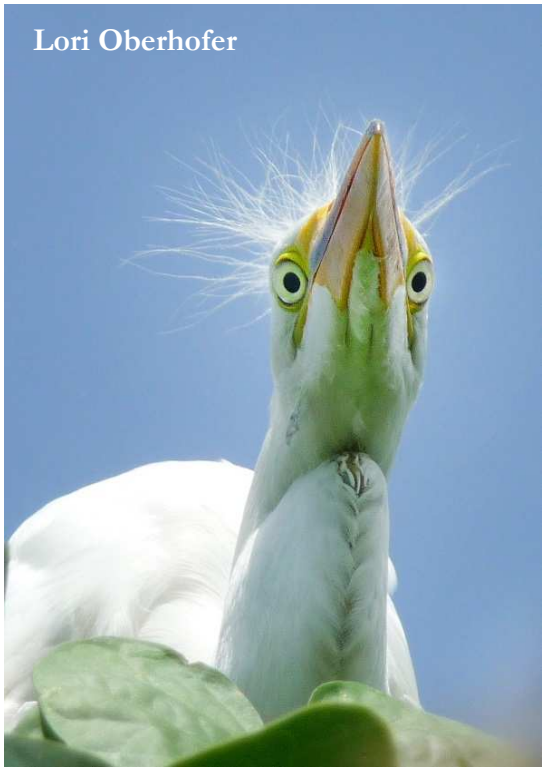

Great Egret chick at the Rookery Branch colony.

BISCAYNE NATIONAL PARK

Nesting colonies of wading birds and seabirds are important indicators of ecosystem health because of their responses to changes in food abundance, food quality, contaminants, invasive species, and disturbances. The acts of selecting mates, building nests, laying eggs, and rearing chicks are energy intensive. If the habitat is insufficient to support these activities, nesting success suffers and may indicate a problem in the ecosystem. The South Florida/Caribbean Inventory and Monitoring Network (SFCN) of the National Park Service (NPS) is monitoring colonial nesting birds in Biscayne National Park (BNP), and this report summarizes the results for the year July 2014 through June 2015 (referred to as "nesting year" in the rest of this report).

The specific objectives of this monitoring program are to determine status and long-term trends in:

- The number and locations of active colonies of colonial nesting birds with a special focus on Double-crested Cormorant (DCCO), Great Egret (GREG), Great White Heron (GWHE), Great Blue Heron (GBHE), White Ibis (WHIB), and Roseate Spoonbill (ROSP).
- The annual peak active nest counts of colonial nesting birds in Biscayne National Park with special focus on the species listed previously (focal species).
- Changes in an annual nesting index (sum of monthly nest counts), especially in the focal species.
- Changes in the timing of peak nest counts for the focal species.

METHODS

The monitoring process consists of an annual aerial survey via helicopter to locate nesting colonies of wading birds and seabirds within BNP. This is followed by monthly aerial surveys of the nesting colonies. Currently, six nesting colonies are photographed during the flights (**Figure 9**). The photographs are geotagged and analyzed to identify active nests by species. Approximately 300 photographs were taken each month during this nesting year's survey. Additionally, nesting and non-nesting birds observed during the flight were counted. Nests were circled on the photographs and then counted from the processed photographs. Peak nest counts were identified for each colony and then summed across colonies to calculate the peak nesting year total across BNP for each species.

In addition, an annual nesting index was calculated by summing monthly nest counts for the entire nesting year. The nesting estimates for months with no sampling were calculated as the average of the months before and after the missing month. SFCN uses the annual nesting index as well as peak nest counts as some species such as DCCO nest in all months and peak nest counts alone are considered insufficient to describe the nesting effort. This year's peak nest counts and nesting index were compared to the means, maxima, and minima of the four previous nesting years.

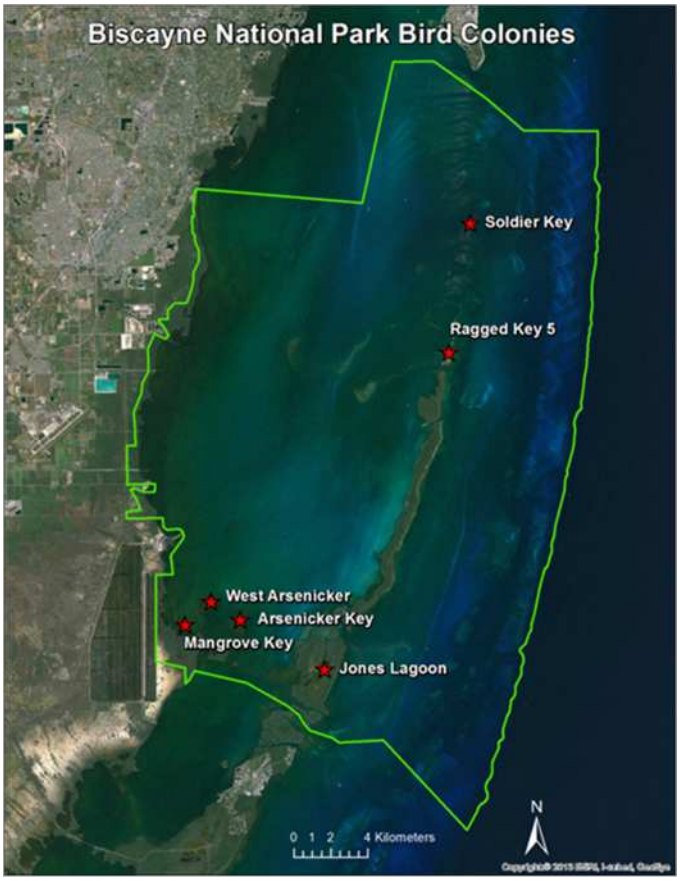

Figure 9. Six island colonies monitored within BNP.

Colony surveys were conducted in 2014 (July to September and December) and 2015 (January through June). Flights were not conducted during October and November because of budget restrictions. The "May" flight occurred on June 3 as contracted helicopters were needed for firefighting. Complete methods are described by Muxo et al. (2015).

RESULTS

The 2014-2015 nesting year, was the fifth consecutive year of monitoring colonial nesting birds in BNP. No new species were detected nesting this year compared to previous years. **Table 6** reports the peak nest and nesting index for BNP by species and colony for the year. **Table 7** provides the total active nests monthly by species.

This nesting year's DCCO peak nest numbers declined 20% compared to the mean, but the nesting index was average (**Table 6**). The peak nest number for GBHE increased 21%; however, GREG, GWHE, ROSP, and WHIB peak nest numbers declined. The nesting index for all these species declined this year (**Table 6**). Especially noticeable was the absence of ROSP nesting, although an adult pair was seen at Jones Lagoon. Overall, the colonial nesting bird community had an average or less than average year compared to previous monitoring results.

Table 6. Peak nest and nesting index for BNP by species and colony for 2014-2015 nesting year.

Species	Peak Nest Count					Nesting Index				
	2014-2015	Mean	% Change	Max.	Min.	2014-2015	Mean	% Change	Max.	Min.
Biscayne National Park										
DCCO	802	1000.50	-20%	1,337	792	5,525	5,537.6	0%	6,287	4,957.5
GBHE	13	10.75	21%	15	6	25	28.8	-13%	44	12
GREG	14	17.50	-20%	24	14	22	54.6	-60%	75.5	41
GWHE	18	22.75	-21%	29	18	70	90.6	-23%	108	68.5
ROSP	0	6.50	-100%	12	3	0	14.5	-100%	25	9
WHIB	38	53.75	-29%	78	28	61	78.3	-22%	110	45
Arsenicker Key										
DCCO	139	180.00	-23%	257	107	521	817.875	-36%	983.5	664
GBHE	0	0.50	-100%	2	0	0	1.25	-100%	5	0
GREG	1	0.75	33%	2	0	1	2.375	-58%	5	0
GWHE	4	3.50	14%	6	2	12	16.25	-26%	26	11.5
ROSP	0	0		0	0	0	0		0	0
WHIB	38	48.00	-21%	60	28	61	72.5	-16%	87	45
Jones Lagoon										
DCCO	100	126.25	-21%	135	113	492	675.75	-27%	905	476
GBHE	10	4.50	122%	8	2	21	14	50%	25.5	6.5
GREG	2	0.67	200%	1	0	2	1	100%	1.5	0
GWHE	6	8.00	-25%	10	7	23	31.625	-27%	36	25
ROSP	0	6.50	-100%	12	3	0	14.5	-100%	25	9
WHIB	0	0		0	0	0	0		0	0
Mangrove Key										
DCCO	9	40.75	-78%	115	0	36	123.63	-71%	309	0
GBHE	0	0		0	0	0	0		0	0
GREG	0	0		0	0	0	0		0	0
GWHE	0	0		0	0	0	0		0	0
ROSP	0	0		0	0	0	0		0	0
WHIB	0	0		0	0	0	0		0	0
Ragged Key 5										
DCCO	329	451.75	-27%	706	294	2,924	2,736.50	7%	3,568	2,163
GBHE	0	0.67	-100%	1	0	0	0.67	-100%	1	0
GREG	0	0.50	-100%	1	0	0	0.50	-100%	1	0
GWHE	2	4.75	-58%	7	3	11	16.88	-35%	23	10
ROSP	0	0		0	0	0	0		0	0
WHIB	0	0		0	0	0	0		0	0
Solider										
DCCO	225	198.75	13%	342	140	1,552	1,179.75	32%	1,531	1,003
GBHE	1	1.25	-20%	2	1	1	4.25	-76%	9	1
GREG	0	1.00	-100%	1	1	0	1.00	-100%	1	1
GWHE	5	2.50	100%	3	2	18	6.63	172%	8	5
ROSP	0	0		0	0	0	0		0	0
WHIB	0	0		0	0	0	0		0	0
West Arsenicker										
DCCO	0	3.00	-100%	10	0	0	4.13	-100%	13	0
GBHE	2	4.00	-50%	5	3	3	8.75	-66%	15	4.5
GREG	11	15.25	-28%	20	11	19	50.50	-62%	73	34
GWHE	1	4.00	-75%	6	1	6	19.25	-69%	29.5	5
ROSP	0	0		0	0	0	0		0	0
WHIB	0	5.75	-100%	23	0	0	5.75	-100%	23	0

Table 7. Total active nests photographed monthly by species; bold values represent the peak monthly count.

Species	July 2014	Aug. 2014	Sept. 2014	Oct. 2014	Nov. 2014	Dec. 2014	Jan. 2015	Feb. 2015	Mar. 2015	Apr. 2015	May 2015	June 2015
DCCO	629	649	368	NS	NS	230	495	316	412	414	650	**764**
GBHE	0	0	0	NS	NS	2	3	1	0	**12**	4	1
GREG	0	0	0	NS	NS	0	3	0	0	**11**	4	4
GWHE	0	0	0	NS	NS	11	6	10	5	**16**	8	3
ROSP	0	0	0	NS	NS	0	0	0	0	0	0	0
WHIB	**38**	2	0	NS	NS	0	0	0	0	0	0	21
Total	667	651	368	NS	NS	243	507	327	417	453	666	793

NS = No Survey.

The DCCO remains the most prominent nesting bird species in this long-term survey effort, as its nests made up more than 91% of peak nest counts and 97% of total nests summed across all months in the nesting index (**Table 6**; **Figures 10** and **11**). DCCO were present at all BNP colony sites except West Arsenicker Key (**Figures 12** and **13**). DCCO nesting returned to Mangrove Key where they were absent last year (**Figures 12** and **13**). There appeared to be a seasonal pattern with spring and summer peaks for nesting (**Figure 14**), but the DCCO clearly nest year-round. This nesting year's monthly peak nest count occurred in June 2015 with 764 nests compared to last year's monthly peak nest count of 1,203 (the highest recorded for the period of record), which occurred in April 2014 (**Figure 14**). DCCO colonies in BNP are variable through time: all the southern colonies (Arsenicker, West Arsenicker, Jones Lagoon, and Mangrove Key) in BNP have shown declines in DCCO peak nest counts and nesting indices whereas the northern colonies (Ragged Key, Soldier Key) have stayed stable or increased over the last 5 years (**Figures 12** and **13**).

GBHE continued to nest at Soldier Key, Jones Lagoon, and West Arsenicker Key, but did not nest at the other colonies this year. GBHE increased in peak nesting (122%) and in the nesting index (50%) at Jones Lagoon while declining at the other colonies (**Table 6**; **Figures 12** and **13**). GREG were most numerous at West Arsenicker, with minimal presence at Arsenicker Key and Jones Lagoon, and none present at the other colony sites (**Table 6**; **Figures 12** and **13**). GWHE were present at all colonies except Mangrove Key, and were most numerous at Jones Lagoon (**Table 6**; **Figures 12** and **13**). ROSP nesting was conspicuously absent from BNP this year. Previously, ROSP nesting had been observed in BNP every year since 2009. WHIB nesting only occurred at the Arsenicker Key colony. WHIB have consistently nested at this colony for the last 5 years.

Overall, although numbers of nests were slightly down compared with the average of the previous 4 years, five of the six focal species peak nest counts and nesting indices fell within the range of variation seen in those years. The exception was ROSP, for which no nests were detected.

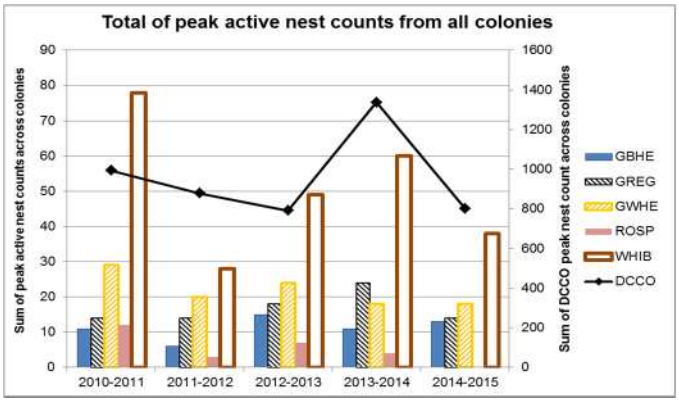

Figure 10. The maximum number of nests detected per colony was summed to create a total of peak nest counts across all colonies for the six focal species.

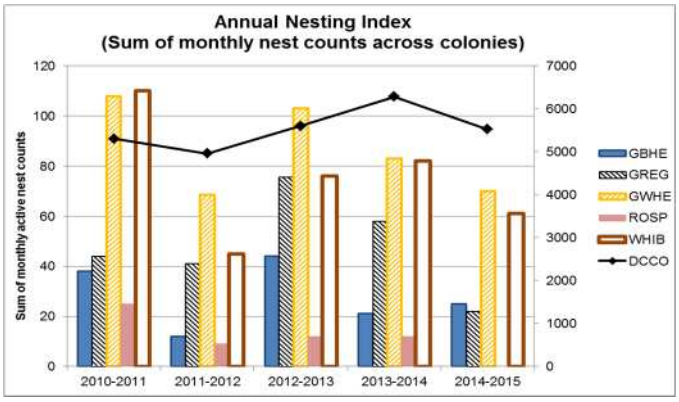

Figure 11. Annual nesting index across colonies by focal species. The number of nests counted at each colony during each month was summed to create an annual nesting index across all colonies for the six focal species. This number exceeds the actual number of nest starts as a single nest could be counted during two or more monthly visits.

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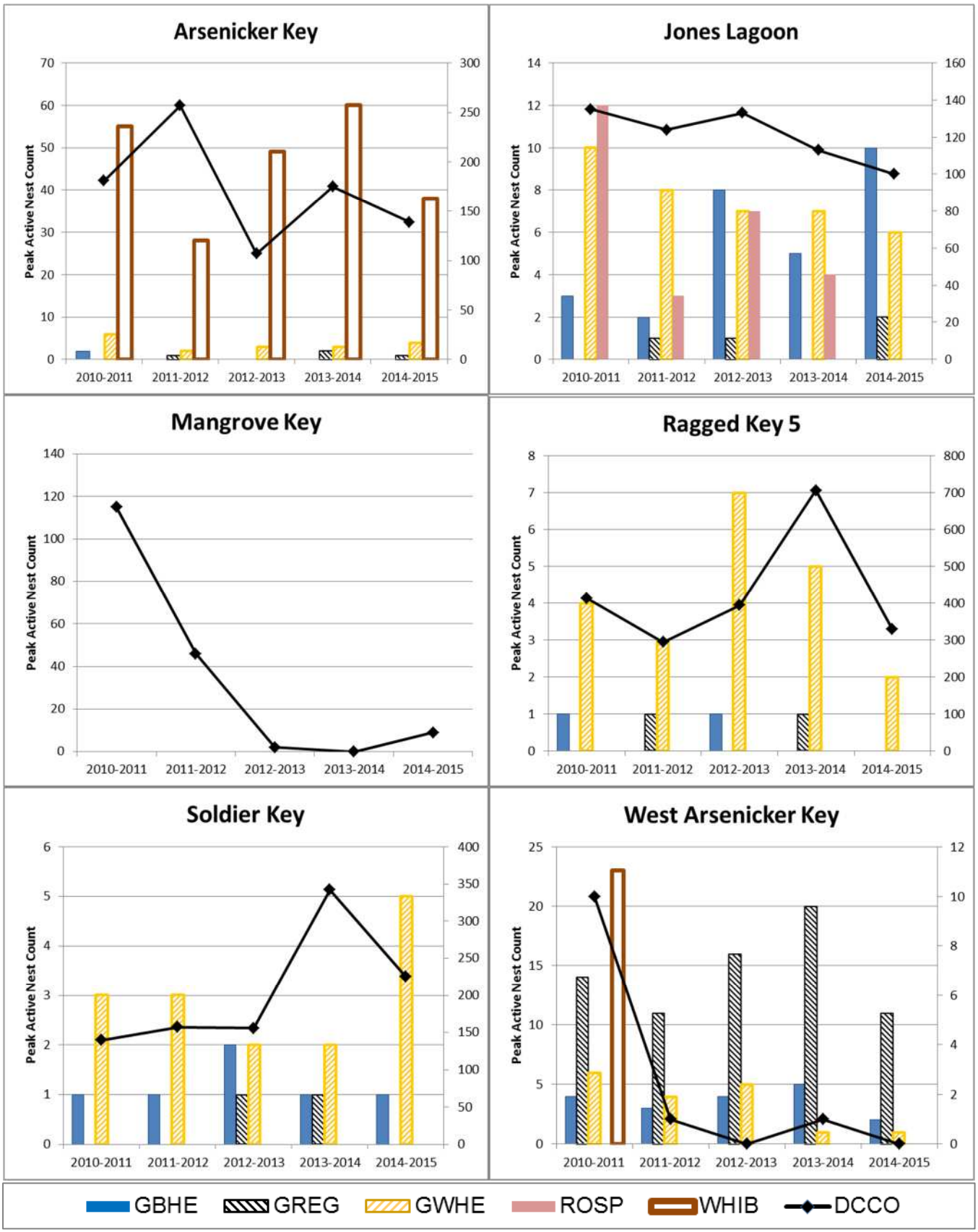

Figure 12. Peak nest counts by colony for the six focal species.

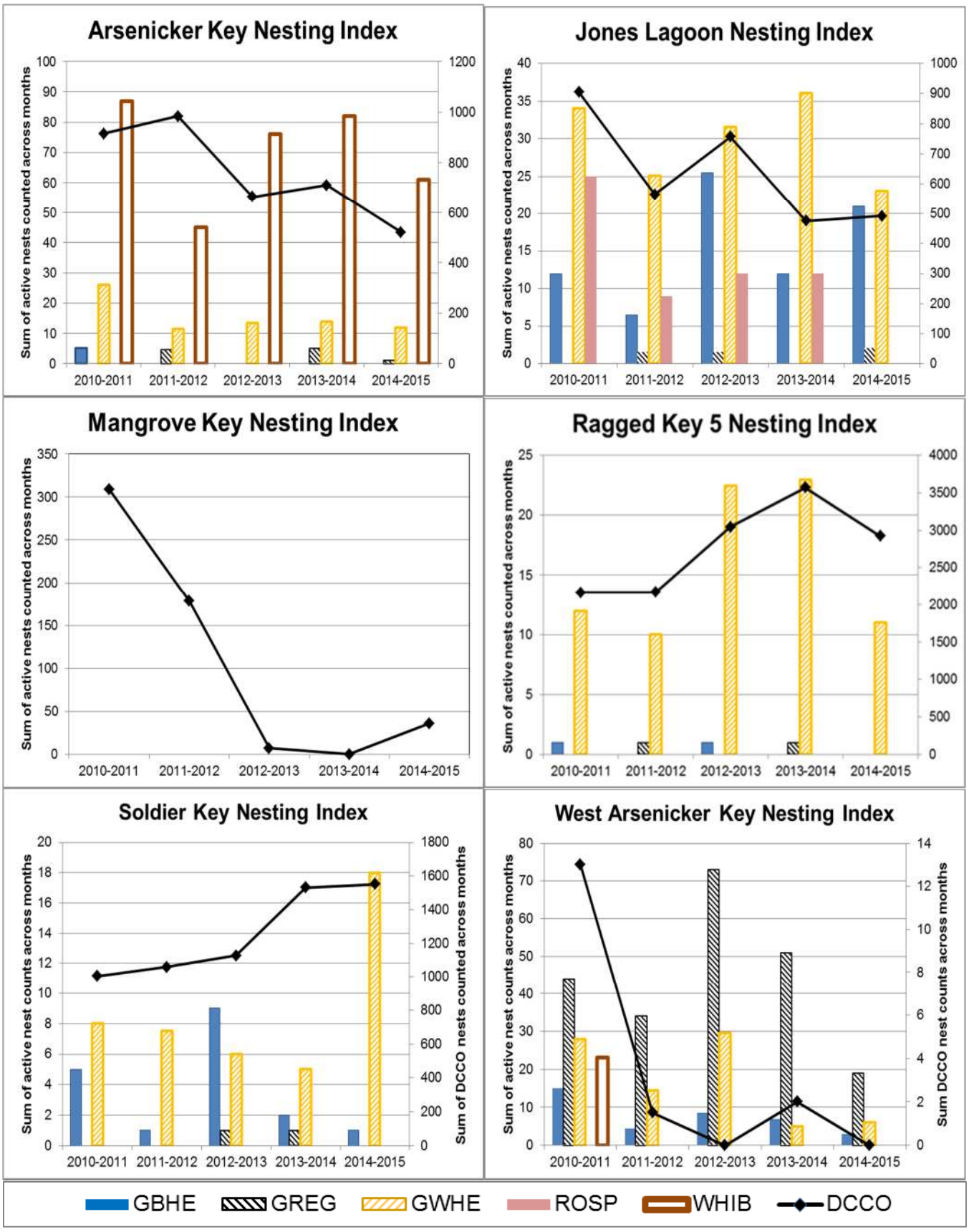

Figure 13. Annual nesting index across colonies by focal species. The annual nesting index is defined as total nests counted across all months and colonies.

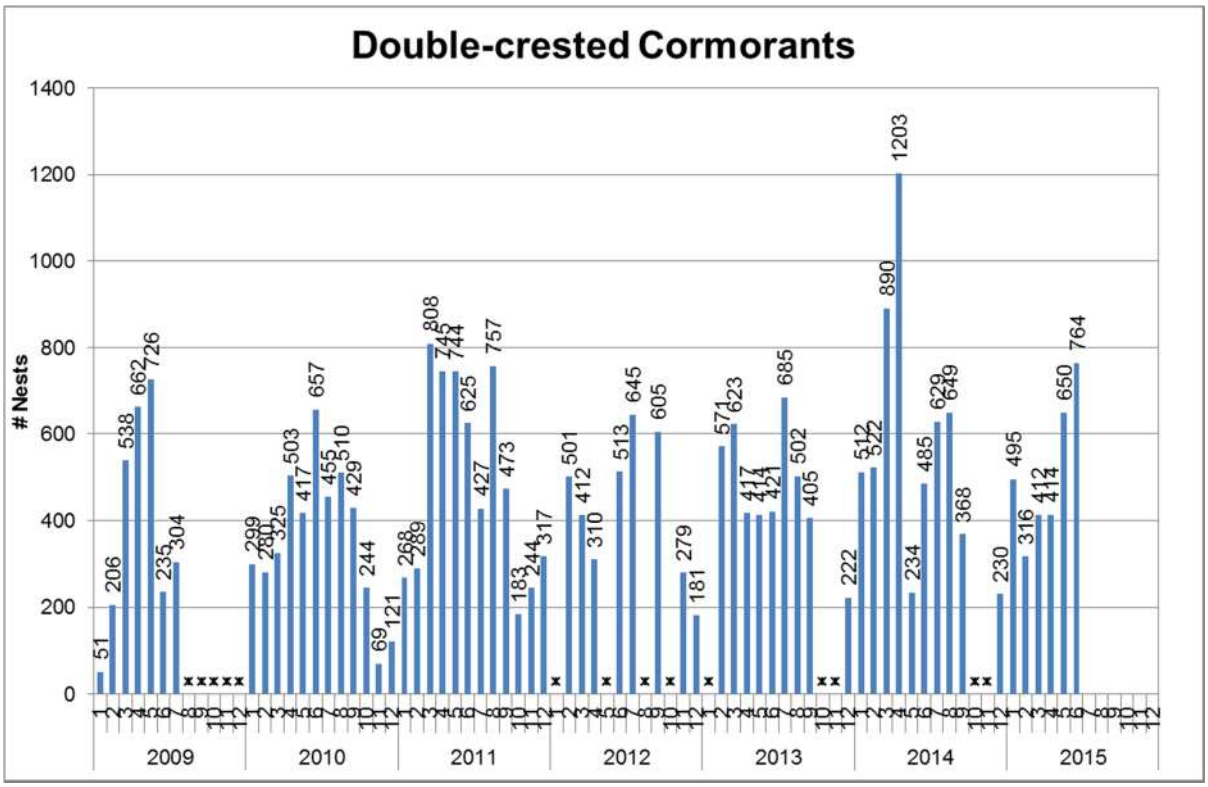

Figure 14. Number of Double-crested Cormorant nests per month and peak nesting periods. An asterisk (*) indicates months not sampled.

SOUTHWEST FLORIDA

Audubon Florida monitored five Southwest Florida wading bird colonies in 2015. Wood Storks (WOST) were the primary focus of the monitoring effort, but data on other wading bird species were collected from colonies where WOST were present.

METHODS

Aerial surveys were conducted from a fixed-wing aircraft at an altitude of 500 to 1,000 feet above ground level on January 29, March 10, and April 9. Photos of colonies were taken using a digital SLR camera with a 70-300 mm image-stabilized lens. Staff were not instructed to record observations or take photographs when WOST were absent. Images were processed by identifying and counting nests using ImageJ software with the cell counter plug-in (National Institute of Health). Heavy vulture activity on the April 9 flight prohibited close approach of monitoring sites, resulting in increased uncertainty in nest identification and in estimations of chick numbers, chick age, and nest fate. All counts are conservative. Concerns with methodology are being examined and will be rectified for the 2016 season.

HYDROLOGY

In Water Year 2015 (WY2015), Corkscrew Swamp Sanctuary recorded 112 cm of wet season rainfall (June to September 2014) and 48 cm of dry season rainfall (October 2014 to May 2015). Compared to the period of record (1969 to present), rainfall totals were higher than normal in the wet season (82nd percentile) and typical in the dry season (40th percentile). However, the distribution of rainfall throughout the dry season was not consistent, with much of the dry season alternating between periods of rapid water-level recession and reversal events. Weekly recession rates were high from October through mid-November (approximately 6.2 mm per day) and more moderate (approximately 3.3 mm per day) from mid-November through January. A reversal event in early February (2.5 cm rainfall, water level +8 cm) was followed by high weekly recession rates (approximately 10.2 mm per day) until a second reversal event in late March (4 cm rainfall, water level +11 cm). Water level then receded very quickly (14.4 mm per day) before going below the ground surface in mid-April. A third reversal event in late April (11 cm rainfall) failed to bring water levels back to the surface at the gauge location.

RESULTS

Corkscrew Swamp Sanctuary

This colony is within an old-growth bald cypress at Audubon's Corkscrew Swamp Sanctuary. No WOST nesting activity was observed in the 2015 season.

Lenore Island

This colony ("Caloosahatchee West" in some previous reports) is on a mangrove island in the Caloosahatchee River. WOST, Great Blue Heron (GBHE), and Brown Pelican (BRPE) were observed roosting in January, but no nesting was apparent in March. Nesting was clearly discernible by April, with 69 active WOST nests and a considerable number of nests from Great Egret (GREG), GBHE, and other white waders (**Table 8**). Noticeably more GREG and GBHE were observed than are reflected in nest counts, as nests were not apparent in photographs.

Caloosahatchee East

This colony is on a mangrove island in the Caloosahatchee River. No WOST nesting activity was observed in the 2015 season. BRPE and GBHE were observed roosting in January but nesting could not be confirmed. No observations were available for March, and minimal wading bird nesting was observed in April (**Table 8**).

Collier/Hendry County Line

This colony is on a cypress head along the border of Collier and Hendry counties. No WOST nesting activity was observed in the 2015 season.

Barron Collier 29

This colony is on a spoil island within a man-made lake in eastern Collier County. Nests are built on non-indigenous Brazilian pepper trees. No observations were recorded of wading bird activity in January, but approximately 11 WOST nest starts were observed in March. In April, 141 active WOST nests and a considerable number of nests from GREG and other white waders were observed (**Table 8**). While many birds on nests could not be discerned, other waders present suggest many of the unknown nests were GREG and Cattle Egret (CAEG).

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Table 8. Peak nest counts in 2015. Counties generally were not surveyed (NS) when WOST were absent.

Colony	Latitude	Longitude	WOST	GREG	GBHE	Unident. White	Total
Barron Collier 29	26.273050	-81.343883	141	21	0	66	228
Caloosahatchee East	26.696583	-81.794950	0	4	3	4	11
Corkscrew Swamp	26.375033	-81.616417	0	NS	NS	NS	0
Collier/Hendry County Line	26.370383	-81.272717	0	NS	NS	NS	0
Lenore Island	26.688867	-81.830150	69	7	4	38	118
Total			**210**	**32**	**7**	**108**	**357**

SOLID WASTE AUTHORITY OF PALM BEACH COUNTY ROOKERY

METHODS

Breeding bird censuses typically are conducted between February and July in the Solid Waste Authority (SWA) Roost by two observers every 8 to 10 weeks, representing approximately 12 man-hours. During the census, all islands in three abandoned shell pits are systematically surveyed from a small boat, and the number of nests from each species are recorded. Surveys are conducted during the morning to minimize any disturbance caused by the observers. The resulting peak nest numbers (**Table 9**) are compiled from early season boat counts and visual counts from observation towers.

LOCATION AND STUDY AREA

The SWA Roost is on spoil islands in abandoned shell pits that were mined in the early 1960s in Palm Beach County (26°46'42.22"N, 80°08'31.15"W NAD83). The spoil islands range from 5 to 367 meters in length, with an average width of 5 meters. Islands are separated by 5 to 6.5 meters with vegetation touching among close islands. The borrow pits are flooded with fresh water to a depth of 3 meters. Dominant vegetation are Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casurina* spp.), and melaleuca (*Melaleuca quinquenervia*). Local features influencing the roost include the North County Resource Recovery Facility and landfill, and the City of West Palm Beach's Grassy Waters Preserve, a 44-km^2 remnant of the Loxahatchee Slough.

Table 9. Peak number of wading bird nests in SWA Rookery from February to July 2015.

GREG	SNEG	CAEG	GBHE	LBHE	WOST	WHIB	ANHI	TRHE	ROSP	GLIB	Total
35	22	148	0	4	255	289	312	58	6	10	1,139

RESULTS

This report presents a partial dataset for the 2015 breeding season. Typically, nesting activities have been observed at this colony from February to September. This year, nest initiation began at the end of January.

There was an estimated total of 1,139 wading bird nests for the SWA Roost, which is similar to the numbers seen last year. There were nests of Great Egret (GREG), Snowy Egret (SNEG), Cattle Egret (CAEG), Little Blue Heron (LBHE), Wood Stork (WOST), White Ibis (WHIB), Tricolor Heron (TRHE), Roseate Spoonbill (ROSP), Glossy Ibis (GLIB), and Anhinga (ANHI). This year's breeding season was relatively dry compared to previous years.

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ROSEATE SPOONBILL NESTING IN FLORIDA BAY

METHODS

Roseate Spoonbills (ROSP) use 44 keys in Florida Bay and 3 mainland sites adjacent to Florida Bay for nesting. This study divided these colonies into five distinct nesting regions based on the primary foraging locations used by the birds (**Figure 15**; Lorenz et al. 2002). During the 2014-2015 nesting season (November 2014 to May 2015), complete nest counts were performed in all five regions of the bay by entering the colonies and thoroughly searching for nests. Mark and revisit surveys were performed at active colonies within each region to estimate nest success. The surveys involved marking as many nests as possible shortly after full clutches had been laid, and then revisiting the colonies on a 10- to 21-day cycle. Nests were monitored until failure or until all surviving chicks reached at least 21 days of age, which is when chicks begin branching and can no longer be assigned to a nest. A colony was considered successful if it averaged at least 1 chick to 21 days per nesting attempt. Mean laying and hatching dates refer to the first egg laid and hatched in each clutch. The results are presented in the context of ROSP nesting activities in Florida Bay since 1984, the year that the South Dade Conveyance System was completed, which has direct water management implications on Florida Bay (Lorenz et al. 2002; Lorenz 2014).

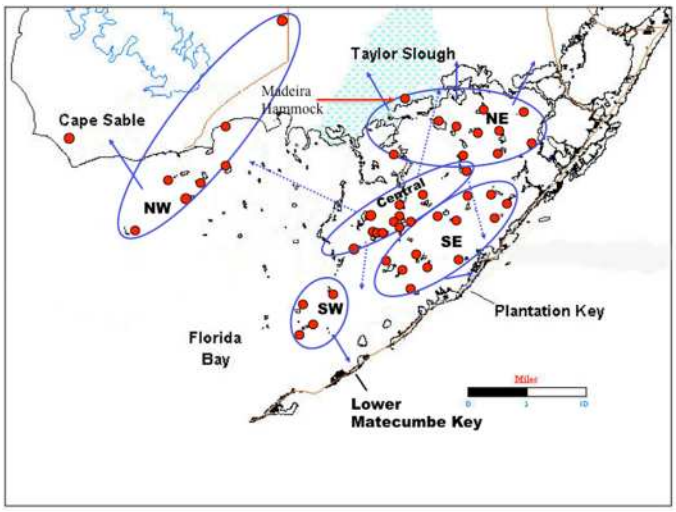

Figure 15. Map of Florida Bay indicating ROSP colony locations (red dots) and nesting regions (blue circles). Arrows indicate the primary foraging area for each region. The dashed lines from the Central region are speculative.

RESULTS

Northwest Region

There were five active colonies in the Northwest region, including Paurotis Pond and Cape Sable, producing a total of 173 nests. This total is double last year's efforts though still slightly below the average of 204 nests for the previous 30 years (**Table 10**). Of the 155 nests with known fate, 140 produced chicks to at least 21 days of age (90.32% success rate), with a mean production of 1.4 chicks per nest (**Table 11**). This is above the long-term mean production rate for the Northwest region (**Table 12**) and above what is considered successful. Total production for the Northwest region was estimated at 235.5 young to 21 days (**Table 11**). The mean lay date was February 3 and the mean hatch date was March 1 (**Table 11**).

Northeast Region

There were five active colonies in the Northeast region this year, including Madeira Hammock, producing 158 nests. This is slightly above the average since 1984-1985 (**Table 10**). Of the 148 nests with known fate, 144 of them were successful (97.3% success rate), producing 155 chicks to 21 days. The production rate was 1.0 chick per nest (**Table 11**). This production rate is above the mean production rate of 0.9 chicks per nest for the region since 1984-1985 and is considered successful. The mean lay date was February 4 and the mean hatch date was February 23 (**Table 11**).

Southeast Region

The Southeast region of the bay produced 4 nests this year, well below the mean of 59 nests since 1984-1985 (**Table 10**). Low Key produced two nests, while Bottle Key and Stake Key each produced one nest. All four nests failed and no chicks were fledged for the region. This is the eleventh time in the last 17 years that the southeastern colonies failed (**Table 12**). The estimated mean lay date was March 3 (**Table 11**).

Central Region

The Central region yielded 24 nests, much lower than the average 44 nests for the region since 1984-1985 (**Table 10**). Estimated total production for the region was 13 chicks fledged. Of the 18 nests with known fate, 38.9% successfully raised chicks to 21 days (**Table 11**). Nine of the 10 chicks to reach 21 days in the region came from Central Bob Allen Key. This colony alone had an estimated production of 1 chick per nest. The regional mean of 0.6 chicks per nest this year is lower than the long-term mean for the area (**Table 12**). This was the tenth year of the last 17 that ROSP were unsuccessful in the region. The mean lay date was February 12, and the mean hatch date was March 3 (**Table 11**).

Southwest Region

All four colonies in the Southwest region were surveyed in 2014-2015. Only Twin Key was active, producing six nests (**Table 10**). Three nests were successful, and three nests were of unknown fate. Twin Key produced six chicks to 21 days, giving the region a success rate of 100% with a production of 2 chicks per nest, and an estimated 12 chicks fledged for the region (**Table 10**). The mean lay date was February 15, and the mean hatch date was March 8 (**Table 11**).

Table 10. Number of ROSP nests in Florida Bay, November 2014 through May 2015, with minima, mean, and maxima summary data since 1984-1985.

Region	Colony	Number of Nests	Minimum	Mean	Maximum
Southeast	M. Butternut	0	0	15.52	66
	Bottle	1	0	8.83	40
	Stake	1	0	4.70	19
	Cowpens	0	0	4.09	15
	Cotton	0	0	0.00	0
	West	0	0	2.10	9
	Low	2	0	0.52	9
	Pigeon	0	0	8.04	56
	Crab	0	0	1.45	8
	East	0	0	2.83	13
	Crane	0	0	8.96	27
	E. Butternut	0	0	4.50	27
	Region Subtotal	**4**	**4**	**59.43**	**117**
Central	E. Bob Allen	1	0	10.08	35
	W. Bob Allen	3	0	4.25	9
	C. Bob Allen	9	2	6.25	12
	Manatee	0	0	0.13	3
	Jimmie Channel	6	0	15.76	47
	Calusa	0	0	8.47	21
	Pollock	0	0	1.38	13
	S. Park	2	0	8.52	39
	Lil Jimmie	0	0	1.33	12
	First Mate	3	0	2.78	15
	N. Jimmie	0	0	0.43	2
	Captain	0	0	3.33	13
	Region Subtotal	**24**	**3**	**44.67**	**96**
Northeast	Tern	0	0	80.17	184
	N. Nest	0	0	0.52	8
	S. Nest	13	0	15.57	59
	Porjoe	1	0	21.30	118
	N Park	0	0	12.96	50
	Duck	3	0	10.78	100
	Pass	0	0	0.65	7
	Deer	0	0	3.10	15
	Lil Betsy	0	0	3.13	21
	Madeira	140	0	22.52	164
	Eagle	1	1	5.67	8
	Region Subtotal	**158**	**3**	**156.64**	**333**
Southwest	E. Buchanan	0	0	4.26	27
	W. Buchanan	0	0	2.32	9
	Barnes	0	0	0.18	3
	Twin	6	0	1.82	8
	Region Subtotal	**6**	**0**	**7.59**	**35**
Northwest	Sandy	23	23	130.93	250
	Frank	0	0	37.63	125
	Clive	2	2	21.29	52
	Oyster	0	0	4.33	45
	Palm	19	0	26.75	87
	Han Van	0	0	6.60	18
	Paurotis	128	2	43.80	128
	Cape Sable	1	1	4.50	8
	Region Subtotal	**173**	**65**	**204.75**	**325**
Florida Bay Total		**365**	**112**	**474.00**	**880**

Table 11. Breakdown of colonies by region of all monitoring data collected.

Region	Colony	Number of Nests	Number of Chicks to Branchling	Number of Nests with Known Fate	Estimated Production per Nest	Estimated Number of Chicks Fledged	Number of Nests with at Least One Branchling	% Success	Mean Lay Date	Mean Hatch Date
Northwest	Clive	2	0	2	0.0	0.0	0	0.0%	1/10/15	N/A
	Palm	19	4	8	0.5	9.5	2	25.0%	3/7/15	3/26/15
	Sandy	23	15	17	0.9	20.3	10	58.8%	1/11/15	1/23/15
	Cape Sable	1	U/K	0	U/K	U/K	U/K	U/K	U/K	U/K
	Paurotis	128	192	128	1.5	192.0	128	100.0%	2/20/15	3/13/15
	Region Subtotal	**173**	**211**	**155**	**1.4**	**235.5**	**140**	**90.3%**	**2/3/15**	**3/1/15**
Northeast	Duck	3	3	3	1.0	3.0	2	66.7%	1/29/15	2/19/15
	Porjoe	1	0	1	0.0	0.0	0	0.0%	3/10/15	N/A
	South Nest	13	1	3	0.3	4.3	1	33.3%	1/24/15	3/14/15
	Eagle	1	1	1	1.0	1.0	1	100.0%	1/15/15	2/5/15
	Madeira Hammock	140	150	140	1.1	150.0	140	100.0%	2/7/15	2/28/15
	Region Subtotal	**158**	**155**	**148**	**1.0**	**165.5**	**144**	**97.3%**	**2/4/15**	**2/23/15**
Southeast	Low	2	0	2	0.0	0.0	0	0.0%	2/15/15	U/K
	Stake	1	0	1	0.0	0.0	0	0.0%	3/20/15	N/A
	Bottle	1	0	1	0.0	0.0	0	0.0%	N/A	N/A
	Region Subtotal	**4**	**0**	**4**	0.0	**0.0**	**0**	**0.0%**	**3/3/15**	**U/K**
Central	E. Bob Allen	1	0	1	0.0	0.0	0	0.0%	2/5/15	N/A
	First Mate	3	0	3	0.0	0.0	0	0.0%	4/1/15	4/5/15
	Central Jimmie	6	U/K	0	U/K	U/K	0	U/K	--	--
	South Park	2	0	2	0.0	0.0	0	0.0%	1/15/15	U/K
	W. Bob Allen	3	1	3	0.3	1.0	1	33.3%	2/9/15	2/5/15
	C. Bob Allen	9	9	9	1.0	9.0	6	66.7%	2/6/15	2/24/15
	Region Subtotal	**24**	**10**	**18**	**0.6**	**13.3**	**7**	**38.9%**	**2/12/15**	**3/3/15**
Southwest	S. Twin	6	6	3	2.0	12.0	3	100.0%	2/15/15	3/8/15
	Region Subtotal	**6**	**6**	**3**	**2.0**	**12.0**	**3**	**100.0%**	**2/15/15**	**3/8/15**
Baywide Total		**365**	**382**	**328**	**1.2**	**425.1**	**294**	**65.3%**	**2/10/15**	**2/28/15**

N/A = not applicable; U/K = unknown.

Table 12. Mean number of chicks to 21 days per nesting attempt and the percentage of nests that were successful. Summary data indicate the overall minimum, mean, and maximum production rates (chicks per nest) to 21 days of age as well as the percentage of years that the region has been successful since 1984-1985. Success is defined as a mean of at least 1 chick to 21 days per nesting attempt. Summary figures refer to the focal colony or colonies surveyed in each year.

Region	2014-15 Nesting Season		Summary Since 1984-85			
	Mean Production per Nest	% Successful Nests	Minimum	Mean	Maximum	% Years Successful
Northeast	1.05	97.30%	0	0.928194	2.2	51.85%
Northwest	1.36	90.32%	0	1.244248	2.5	60.71%
Southeast	0	0	0	0.821055	2.09	35.29%
Central	0.56	38.89%	0	0.816696	1.857143	37.50%
Southwest	2	100%	--	--	--	--

-- Nest production was not measured in the Southwest region.

BAYWIDE SYNTHESIS

ROSP nest numbers in 2014-2015 were higher than last year and seemed to have stabilized in recent years at approximately 400 nests per year (**Figure 16**; note that counts in 2009-2010 and 2010-2011 were underestimated because ROSP nests observed at Madeira Hammock in those years were not counted). Although this is a positive result given the rapid decline in nesting effort from the early 1990s through 2008-2009, current counts remain much lower than historic nesting patterns of the 1970s to the 1990s (**Figure 16**) and remain a concern. Similarly, numbers in northeastern Florida Bay are higher than they were in the 2000s but still much lower than historic numbers (**Figure 16**).

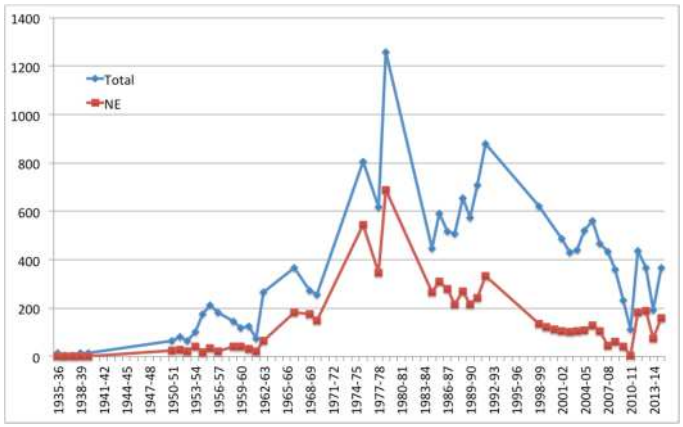

Figure 16. Total ROSP nests in Florida Bay and in the northeastern subregion of Florida Bay. Note that nests were undercounted in 2009-2010 and 2010-2011 because the Madeira Hammock Colony was active both years but not counted. Prior to 2009-2010, Madeira Hammock had never been an active ROSP colony.

Throughout the regions, the average nest production was 1.2 chicks per nest with 65.3% of nests successfully raising at least 1 chick to 21 days (**Table 11**). This means that 2014-2015 was a relatively successful year for nesting ROSP. However, the timing of nesting was atypical this year. The mean lay date for Florida Bay was February 10, which is 43 days later than last year. Moreover, lay dates within and among colonies were highly asynchronous, spanning January through April. These results suggest that the important environmental cues that promote breeding were lacking or weaker than normal. Indeed, water levels were abnormally high until very late in the year and did not fall to the critical level (13 cm) at which prey begin to concentrate (Lorenz 2014) until March. The delay in nesting and the fact that the majority of nesting occurred in two mainland colonies (Madeira Hammock and Paurotis Pond) suggest that conditions have deteriorated for nesting ROSP within Florida Bay. This is further supported by the near-complete abandonment of nesting on keys in northeastern Florida Bay (**Table 10**). ROSP nesting is just one of many environmental indicators suggesting that the health of Florida Bay is continuing to decline and is exhibiting dramatic and rapid changes in ecology.

Mean sea level in the Gulf of Mexico has a profound impact on water levels in ROSP foraging habitats north of Florida Bay. As cooler temperatures prevail in the dry season, Gulf waters cool and contract, thereby lowering water levels. This contraction draws water out of the coastal wetlands, lowering water levels and concentrating fish in the remaining wetted habitat. This makes the fish highly available to ROSP, who time their nesting cycle with the low water and high fish concentration period. In recent years, higher mean sea level in the Gulf of Mexico has resulted in higher water levels on foraging grounds, causing reduced and delayed nesting in Florida Bay's ROSP population. This likely explains the low nesting effort, delayed nesting, changes in nesting location, and relatively low productivity of ROSP in 2014-2015, and ultimately may change the way ROSP can be used as an indicator for Everglades restoration in the future.

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NESTING ACTIVITY OF WATER BIRDS ON SPOONBILL COLONY KEYS IN FLORIDA BAY 2014-2015

While surveying known Roseate Spoonbill (ROSP) colonies throughout Florida Bay, other water bird nesting activity on the keys was investigated. Seventeen species of water bird nesting was encountered on the keys and nests were counted to the extent possible (**Table 13**). These findings should not be treated as a thorough or exhaustive survey of water birds in the bay. Many keys were not surveyed because ROSP did not nest on them. Also, areas beyond where ROSP nested were observed on a given key were not searched.

However, this study attempted to thoroughly find all Reddish Egret (REEG) nests. REEG have recently become a species of interest at the state and local levels and are now being treated the same as ROSP (i.e., attempts are made to find all nests and document productivity). The REEG estimates likely are an accurate representation of effort for this species in Florida Bay.

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Table 13. Number of water bird nests in Florida Bay, November 2014 through May 2015

Colony	OSPR	GBHE	GWHE	GREG	LBHE	GRHE	BRPE	DCCO	SNEG	TRHE	BAEA	WHIB	ANHI	YCNH	WOST	GLIB	REEG	Total
Clive		12	24					12										48
Palm		1						30									12	43
Sandy	2		12	6			20	30				5					7	82
Murray	5																	5
Deer	1																	1
Duck			15	6				15		50							26	112
Little Betsy			1			5												6
North Nest	1																	1
Lake											1							1
South Nest	1		1															2
Tern	2									50								52
Eagle	1		6														4	11
Bottle	3																	3
Cotton			6															6
Cowpens			4					25										29
Crab														2				2
Crane	1									25							1	27
East	1		1															2
Low	1		1														1	3
Middle Butternut	1																	1
Pigeon			5	6		1		70									1	83
Stake	1									12							4	17
West	1		1															2
Captain	1																	1
East Bob Allen	1		1															2
First Mate								15		6							2	23
Central Jimmie	1									60							6	67
Little Jimmie	1																	1
North Jimmie	1		1															2
South Park							8										1	9
West Bob Allen	1		1														1	3
Central Bob Allen										15								15
Barnes	1																	1
East Buchanan							20	20										40
North Twin	1		1															2
South Twin								30										30
Arsenicker	1						20											21
West Joe Bay Island			5	75	1				30	200			25					336
Peterson			5															5
Black Betsys	3		1+			2+												3
Madeira Hammock			4	40					4	100		60	30			3		241
Paurotis					20	1			50	200		100	50		100			521
Nest Total	**34**	**13**	**95**	**133**	**21**	**7**	**68**	**247**	**84**	**718**	**1**	**165**	**105**	**2**	**100**	**3**	**66**	1,862

Note: The following colonies had no recorded nests: Frank, Han Van, Oyster, North Park, Pass, Porjoe, East Butternut, Calusa, Manatee, Pollock, West Buchanan, and Green Mangrove.

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

For eight consecutive years, staff at Charlotte Harbor Aquatic Preserves (CHAP), a field site of the Florida Coastal Office of the Florida Department of Environmental Protection (FDEP), and J.N. "Ding" Darling National Wildlife Refuge (NWR) have conducted colonial nesting bird surveys within the Ding Darling NWR Complex, the Matlacha Pass, Pine Island Sound, Gasparilla Sound-Charlotte Harbor, Cape Haze, and Lemon Bay Aquatic Preserves (**Figure 17**). Colonial wading and diving bird nest monitoring began with 9 islands in 2008 and expanded to 34 islands in 2011. This year, 32 islands were monitored and 26 were identified as active wading and diving bird nesting sites. Goals of this study include documenting population trends, avian biodiversity, and shifts in avian nesting effort. Future goals include a detailed trend analysis of nesting efforts by species throughout the greater Charlotte Harbor estuarine system.

Figure 17. Locations of monitored bird colonies in the CHAP and Ding Darling NWR Complex.

METHODS

The study area was divided between the two agencies based on location. Ding Darling NWR 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 employed 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 (an adult was sitting on the nest in a crouched position shading the nest), chicks (juvenile birds were observed in or near the nest) or unknown (nesting stage could not be determined). The "chicks" category was counted as a nesting stage and was not used as a measure of productivity. Data collected from March through June 2015 were analyzed for this report. Peak numbers reflect the highest number of individuals per species throughout the survey period. The total number of peak nests was calculated for each island as well.

RESULTS

The peak estimate for 14 species of colonial nesting birds from all islands combined was 1,531 nests (**Table 14**). Approximately 27% (420) of the nests documented were wading bird nests while the remaining 73% (1,111) were diving bird nests. This peak nesting effort is 520 more nests than last year (1,011 nests).

Double-crested Cormorant (DCCO)

DCCO nesting peaked at 630 nests, accounting for approximately 41% of nests in the 2015 season. Nesting was documented on 22 islands, with the highest nest count (172) occurring on Hemp Key.

Brown Pelican (BRPE)

BRPE nesting peaked at 466 nests and was documented on 13 islands. This was an increase of 127% from 2014. The highest peak nest count of 88 occurred at Broken Islands in June.

Anhinga (ANHI)

ANHI nesting occurred on eight islands with a peak count of 15 nests. The highest nest count was five and occurred on N. of York Island.

Great Blue Heron (GBHE)

GBHE nesting was documented on 26 islands. The peak nest count for GBHE was 114, a 56% increase from 2014.

Tricolored Heron (TRHE)

TRHE nests were documented on 10 islands with a peak count of 57 nests. Approximately 51% of the nesting effort occurred on Broken Islands and Pirate Harbor SE in May.

Table 14. Colonial nesting bird peak counts for the CHAP and Ding Darling NWR Complex between February and June 2015.

Colony (Island)	Lat.	Long.	GBHE	TRHE	LBHE	SNEG	GREG	REEG	CAEG	YCNH	BCNH	GRHE	WHIB	BRPE	DCCO	ANHI	Total
Bird Rookery Keys	26.6742	-82.0897	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bodifer Key	26.4977	-82.1124	4	5	2	1	5	1	0	0	1	0	0	59	27	0	105
Broken Islands	26.6777	-82.1940	4	13	2	8	1	1	0	0	0	0	14	88	77	0	208
Burnt Store Marina N	26.7625	-82.0669	4	0	0	0	0	0	0	0	0	0	0	1	4	0	9
Burnt Store Marina S	26.7611	-82.0660	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Clam Key	26.5063	-82.1128	2	0	0	0	0	0	0	0	0	0	0	0	23	0	25
Cork Island	26.5742	-82.1273	2	0	0	0	0	0	0	0	0	0	0	0	4	0	6
Crescent Island	26.5979	-82.0639	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. of Chadwick Cove	26.9289	-82.3511	16	0	1	1	10	0	0	0	0	0	0	0	9	0	37
Fish Hut Island	26.5467	-82.1245	2	5	0	1	7	1	2	0	0	0	0	1	43	1	63
Gasparilla Marina S	26.8269	-82.2625	4	5	0	7	4	0	0	0	1	1	0	12	18	0	52
Givney Key	26.5145	-82.0553	3	0	0	0	0	0	0	0	0	0	0	0	1	1	5
Hemp Key	26.5999	-82.1532	17	0	0	0	32	0	0	0	0	0	0	60	172	0	281
Lumpkin Island	26.6015	-82.0526	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Lower Bird Island	26.5125	-82.0330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Masters Landing	26.5666	-82.0749	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. of Mason Island	26.5581	82.1219	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2
N. of York Island	26.4945	82.1043	3	1	3	0	0	0	0	0	0	0	0	22	10	5	44
N. Regla	26.5422	82.1227	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. of Big Smokehouse	26.0000	-82.1225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE. of York Island	26.4940	-82.1021	1	1	2	0	0	0	0	0	0	0	0	31	15	2	52
NW of Mason Island	26.5543	82.125	1	0	0	0	0	0	0	0	0	0	0	0	29	3	33
NW. of Pumpkin Key	26.5660	-82.1279	2	0	0	0	0	0	0	0	0	0	0	0	1	0	3
Pirate Harbor N	26.8052	-82.0597	6	8	0	12	9	1	1	0	0	0	0	31	12	0	80
Pirate Harbor SE	26.8037	-82.0565	5	16	0	10	1	0	28	0	0	0	0	28	37	1	126
Skimmer Island	26.5104	-82.0250	5	2	0	1	11	1	0	0	0	0	15	40	20	0	95
SW. of Mason Island	26.5534	-82.1250	3	0	0	0	0	0	0	0	0	0	0	0	5	0	8
SW. of Pumpkin Key	26.5640	-82.1275	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tarpon Bay Keys	26.4577	-82.0744	7	1	0	2	17	2	1	0	0	1	0	20	32	1	84
Upper Bird Island	26.5592	-82.0714	5	0	0	0	0	0	0	0	0	1	0	21	18	0	45
Useppa Oyster Bar	26.6513	-82.2134	2	0	0	0	1	0	0	0	0	0	0	52	67	0	122
White Pelican Island	26.7905	-82.2463	11	0	3	7	7	4	0	0	4	0	0	0	6	0	42
Total			**114**	**57**	**13**	**50**	**105**	**11**	**32**	**0**	**6**	**3**	**29**	**466**	**630**	**15**	**1,531**

Little Blue Heron (LBHE)

LBHE nesting peaked at 13 nests. Nests were documented on 6 of the 32 islands monitored. The highest nest count (3) occurred on N. of York Island.

Snowy Egret (SNEG)

SNEG nesting occurred on 10 islands with a peak nest count of 50 nests. Pirate Harbor N and Pirate Harbor SE accounted for 44% of the nesting effort.

Great Egret (GREG)

GREG nesting peaked at 105 nests, a 72% increase from 2014. GREG nested on 12 islands with approximately 30% of nests on Hemp Key peaking in May.

Reddish Egret (REEG)

REEG nested on seven islands with a peak count of 11 nests. White Pelican Island had the highest nest count (4), which occurred in May.

Yellow-crowned Night Heron (YCNH)

No YCNH nesting effort was recorded during the 2015 survey period.

Black-crowned Night Heron (BCNH)

BCNH nesting was documented on three islands and peaked at six nests. Four of the nests were found on White Pelican Island.

Green Heron (GRHE)

A peak of three GRHE nests were observed on Gasparilla Marina S, Tarpon Bay Keys, and Upper Bird Island.

White Ibis (WHIB)

WHIB nesting occurred on two islands with a peak count of 29 nests. Fourteen of the nests were located on Broken Islands, all identified as "chicks". A caveat to this count is that most nesting probably occurred in the interior of N. Broken Island, which could not be observed with the current survey method. As such, the majority of the nesting effort for this species may have been missed.

Cattle Egret (CAEG)

CAEG nesting peaked at 32 with approximately 88% (28) documented on Pirate Harbor SE. This species was found nesting on four islands.

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Pelican chicks on Hemp Key.

ESTERO BAY AQUATIC PRESERVE COLONIAL NESTING WADING AND DIVING BIRD MONITORING AND PROTECTION PROGRAM

Estero Bay Aquatic Preserve was designated in 1966 as Florida's first aquatic preserve. Established by law, aquatic preserves are submerged lands of exceptional biological, aesthetic, and scientific value that are to be maintained in their natural or existing conditions for the benefit of future generations. Estero Bay Aquatic Preserve covers 11,000 acres in Lee County, bordered on the east by Fort Myers, Estero, and Bonita Springs, and on the west by Estero Island, Long Key, Lovers Key, Black Island, Big Hickory Island, and Little Hickory Island. Estero Bay is a shallow estuary fed by five minor tributaries that contains extensive seagrass beds and oyster reefs as well as hundreds of islands dominated by mangroves. The islands provide roosting and nesting habitat for wading and diving birds; nesting has been documented on 25 islands.

METHODS

Surveys between 2008 and 2015 were conducted once a month throughout the nesting season. Each year, surveys were initiated when birds were observed carrying nesting materials and concluded when all chicks had fledged. Since 2012, surveys were conducted year-round due to the extended period of nesting. Surveys were conducted by boat using a direct count method as described by Paul and Paul (2004). Islands were surveyed at a distance of 30 to 45 meters by two observers; nests were documented by species and nesting stage. The primary observer, an aquatic preserve staff member, was consistent throughout the study period. Trained volunteers conducted secondary observer counts. The average of the two observers' counts is reported here. Monthly counts from 2015 are compared with those from 2008 through 2014. Mean peak nest counts for surveys conducted from 2008 to 2014 represent the 7-year average for Estero Bay.

In 2015, surveys were conducted January 6, 12, 13; February 5, 10, 11, 12; March 10, 11, 12; April 7, 9, 21; May 5, 7, 12, 14; June 15, 16, 17; and July 6, 7, 8.

RESULTS

In January, eight islands were active with Double-crested Cormorant (DCCO; n = 27), Brown Pelican (BRPE; n = 10), Great Blue Heron (GBHE; n = 40), and Great Egret (GREG; n = 2). Between January (n = 79) and July 2014 (n = 205), 20 of the 25 islands monitored were active with a total peak nest count of 377 (**Table 15**). Nest counts peaked in May (n = 277). The Matanzas Pass colony had the greatest nesting concentration in the bay, with an annual peak count of 132 active nests. Overall, nesting colonies saw a 9% decline in nesting effort from the 7-year average; however, Snowy Egret (SNEG), Tricolored Heron (TRHE), Reddish Egret (REEG), and Yellow-crowned Night Heron (YCNH) showed an increased nesting effort (**Table 15**).

DCCO nests were found on six islands with nesting activity recorded from January (n = 27) through July (n = 33); nesting peaked in May (n = 57). DCCO peak nesting numbers for 2015 (n = 64) were 9% below the 7-year average.

BRPE nests were documented from January (n = 10) through July (n = 78) on three islands. Peak nest counts were recorded in May (n = 93), with a season peak of 98 active nests. BRPE peak nesting was 10% below the 7-year average.

GBHE nests were found from January (n = 40) through July (n = 19) on 13 islands. Nesting effort peaked in April (n = 44) with a season peak of 55 nests, 24% below the 7-year average. White morphs were documented on four nests at three separate nesting colonies.

GREG nests were documented from January (n = 2) through July (n = 15) on three islands. Nesting peaked in April (n = 22) and the annual peak was 25 nests, a 55% decrease in nesting compared to the 7-year average.

SNEG nests were documented from March (n = 1) through July (n = 14) with the peak count in June (n = 30). SNEG nests were documented on four islands with an annual peak count of 32 nests, a 37% increase over the 7-year average.

Little Blue Heron (LBHE) nested on three islands from April (n = 5) through July (n = 3) and peaked in June (n = 9). The peak counts for 2015 (n = 9) represented a 43% decrease in nesting effort from the 7-year average.

TRHE nests were documented on three islands between April (n = 4) and July (n = 23) with peak nesting effort in June (n = 27). The peak count (n = 28) represented a 13% increase in nesting effort compared to the 7-year average.

REEG nests were documented from March (n = 2) through July (n = 7) on three islands. The annual peak nest count (n = 7) represented a 14% increase over the 7-year average.

Black-crowned Night-Heron (BCNH) nests were documented on five islands with an annual peak of 12 nests, which is consistent with the 7-year average. Nesting was documented in January and April (n = 6) through July (n = 9).

YCNH nesting was documented on four islands from March (n = 1) through July (n = 2) and nesting effort peaked in May (n = 18). The annual peak nest count was 34 nests, an 80% increase in nesting effort over the 7-year average.

Green Heron (GRHE) nests were documented on five islands between April (n = 6) and June (n = 7), with nesting peaking in June. The annual peak count was 12 nests, which represented a 155% increase in nesting effort over the 7-year average.

Anhinga (ANHI) and Cattle Egret (CAEG) nests were not observed during 2015 surveys.

Between January and July 2015, volunteers contributed 198 hours of service to monitoring and protecting wading and diving bird colonies in Estero Bay. Staff and volunteers removed 615 feet of fishing line and 25 hooks from nesting islands during this time period. Five bird fatalities were documented due to fishing line entanglement.

Table 15. Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and July 2015.

Colony	Latitude	Longitude	DCCO	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	BCNH	YCNH	GRHE	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	2	0	2
Big Bird Island	26.38286	-81.84995	0	0	2	0	0	0	0	0	0	0	0	2
Big Carlos Pass M-43	26.43155	-81.90066	1	0	2	0	0	0	0	0	0	3	0	6
Big Carlos Pass M-48	26.42771	-81.90050	0	0	1	0	0	0	1	0	0	4	0	6
Big Carlos Pass M-50 and 52	26.42244	-81.89527	0	0	0	0	0	0	0	0	0	1	0	1
Big Carlos Pass S of M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-46	26.42926	-81.90137	0	0	1	0	0	0	0	0	0	0	0	1
Big Carlos Pass W of M-52	26.42469	-81.89359	9	18	5	10	7	1	9	2	5	3	0	69
Big Hickory E of M-85	26.35315	-81.84164	3	0	6	2	0	0	0	1	1	0	0	13
Big Hickory M-83	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	1	0	1
Big Hickory M-49 2NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 3NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0
Coconut Point East	26.38411	-81.84905	26	38	8	6	1	0	0	0	2	0	0	81
Coconut Point West	26.38111	-81.84976	0	0	1	0	0	0	0	0	0	0	0	1
Denegre Key	26.43772	-81.86728	0	0	4	0	0	0	0	0	0	5	6	15
Estero River M-30	26.43029	-81.86113	0	0	0	0	0	0	0	0	0	0	1	1
Estero River North	26.43653	-81.86091	0	0	0	0	0	0	0	0	0	7	4	11
Estero River South	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	1	0	1
Hogue Channel M-78	26.34988	-81.84644	0	0	0	0	0	0	0	0	0	4	0	4
Matanzas Pass	26.46092	-81.95717	22	42	16	3	16	7	17	5	3	1	0	132
New Pass M-21	26.38865	-81.85925	0	0	0	0	0	0	0	0	0	0	0	0
New Pass M-9	26.40465	-81.86816	3	0	4	0	0	0	0	0	0	0	0	7
North Coconut E of M-3	26.41131	-81.85486	0	0	4	4	8	1	1	0	1	2	0	21
North Coconut M-4	26.40737	-81.85998	0	0	0	0	0	0	0	0	0	0	0	0
Ruth's Island	26.40783	-81.85302	0	0	1	0	0	0	0	0	0	0	1	2
Total			**64**	**98**	**55**	**25**	**32**	**9**	**28**	**8**	**12**	**34**	**12**	**377**

DISCUSSION

Estero Bay nesting activity exhibits annual variation. However, the annual peak nest count this season was below the 7-year average and overall annual peak nest counts show a declining trend in the bay (**Table 16**). This trend is not consistent across species. While all four of the canopy nesting species (DCCO, BRPE, GBHE, and GREG) showed declines in nesting activity in 2015 compared to the 7-year average, only two (LBHE and CAEG) of the eight interior nesting species showed a decline in nesting activity.

The highest concentration of BRPE, REEG, and LBHE nesting activity has been concentrated on three islands: Matanzas, Coconut Point East, and Big Carlos West of 52. These islands also represented the highest concentration of fishing line fatalities and human disturbance concerns. Estero Bay Aquatic Preserve staff, in conjunction with stakeholders and the Florida Fish and Wildlife Conservation Commission, completed the Estero Bay Wading and Diving Bird Management Strategy in June 2015. The Management Strategy outlines management efforts and needs based on scientific data and stakeholder input.

Table 16. Mean nest count, standard error, and percent mean differences by species for mean peak nest counts (2008 to 2014) and current (2015).

Species	Mean (2008-2014)	Standard Error	Peak (2015)	Percent Change
DCCO	71	187	64	-9
BRPE	109	289	98	-10
GBHE	72	192	55	-24
GREG	56	148	25	-55
SNEG	23	62	32	37
LBHE	16	42	9	-43
TRHE	25	65	28	13
REEG	7	19	8	14
BCNH	12	32	12	0
YCNH	19	50	34	80
GRHE	5	12	12	155
CAEG	1	3	0	-100
Total	**416**	**1,101**	**377**	**-9**

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WADING BIRD NESTING AT LAKE OKEECHOBEE

Since 1977, wading bird colonies on Lake Okeechobee have been monitored most years by monthly systematic aerial surveys during the nesting season. The South Florida Water Management District (SFWMD) flew the surveys from 1977 to 1992 (David 1994; Smith and Collopy 1995), and Florida Atlantic University (FAU) has flown the surveys since 2005.

An estimated 4,615 nests were initiated in 2015, which is 18% above the long-term mean of 3,765 ± 503 nests. The number of nest initiations increased and peaked during a period of rapid water recession, but this trend was interrupted by a reversal in the receding water level during the last 2 weeks of April. Notably, a Roseate Spoonbill (ROSP) nest on Little Bear Beach Island successfully fledged 3 chicks – the first documented ROSP nest to do so since 1874 (Oder 1874).

METHODS

From February through June 2015, FAU personnel assessed the location, timing, and nesting effort of wading bird nesting colonies. At several of the locations, estimates of nest initiations obtained during aerial surveys were validated during separate ground surveys. Detailed methods are described in previous editions of the *South Florida Wading Bird Report* (2010).

Rainfall and lake stage data were obtained from SFWMD's DBHYDRO database. The lake stage is calculated as the mean of four gauges (L001, L005, L006, and LZ40) in the pelagic zone of Lake Okeechobee. 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 present, which corresponds to the time period of systematic aerial wading bird nesting surveys.

Hydrology

A graph of Lake Okeechobee's stage shows four distinct periods during the 2015 nesting season (**Figure 18**). During the first period (February 1 to March 5), the lake stage was relatively stable (4.45 to 4.50 m). From March 6 to April 15, the lake stage receded below the long-term average. From April 16 to 29, there was an increase in rainfall and lake stage rose on 11 out of 14 days – a pattern that is atypical during the dry season. From April 30 to June 30, lake stage steadily receded, ending the month 33 cm below the long-term average.

RESULTS

Colony Location and Size

Ten colonies were observed during nesting surveys (**Figure 19**). Two of the colonies were off-lake and one of the on-lake colonies (Moore Haven East 4) was apparently abandoned before chicks began hatching. The estimated number of nests initiated during the surveys, not including Cattle Egret (CAEG) and Anhinga (ANHI) nests, was 4,615 nests, 18% above the long-term average number of nests (3,765.41 ± 503.26 nests; **Table 17**). Liberty Point was the largest colony by far, with 2,813 nests (**Table 17**). The most prevalent species were the Great Egret (GREG; 1,440), Snowy Egret (SNEG; 1,431), and White Ibis (WHIB; 1,290) (**Table 18**). The number of nests initiated by Little Blue Heron (LBHE), Tricolored Heron (TRHE), and Glossy Ibis (GLIB) likely were underestimated, because these dark-colored species are difficult to detect during aerial surveys.

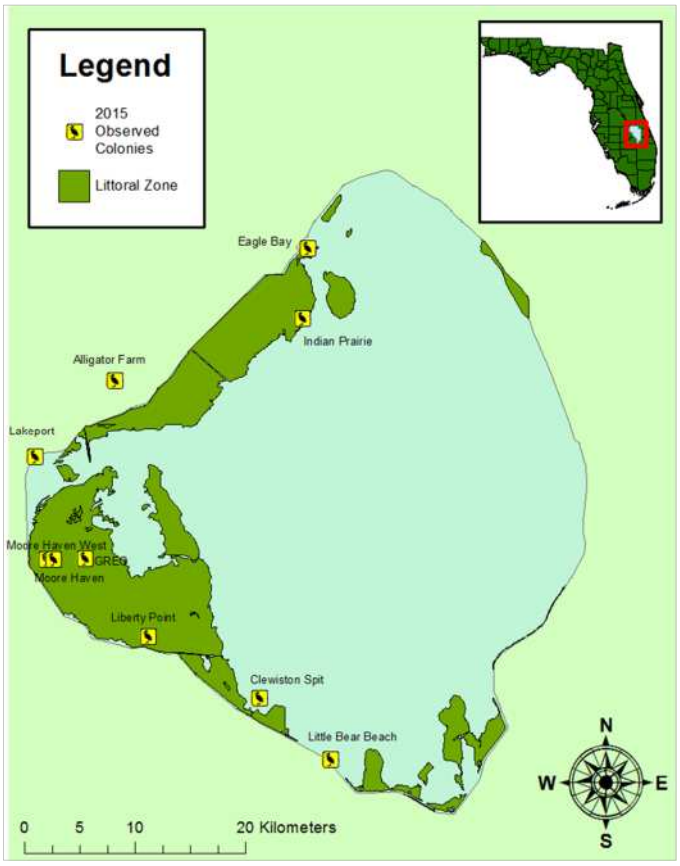

Figure 18. Map of wading bird colonies observed on Lake Okeechobee from March to June 2015.

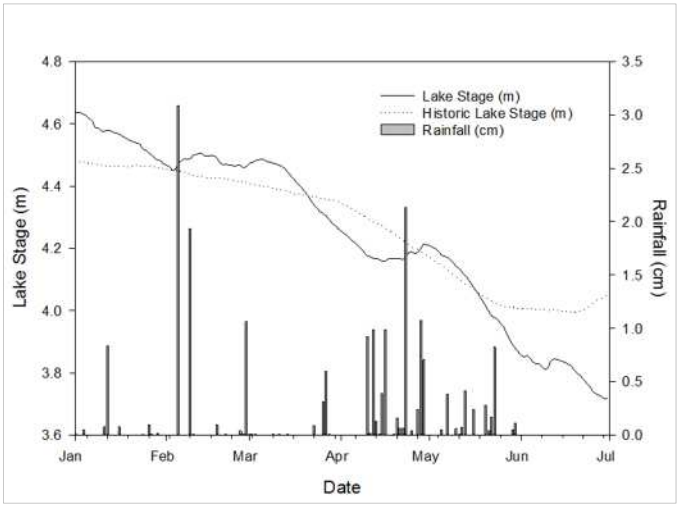

Figure 19. Hydrograph of Lake Okeechobee, including from January to June 2015, historic lake stage (1977 to present), and rainfall.

Table 17. Timing and nest effort for species breeding in wading bird colonies at Lake Okeechobee in 2015. Bold values highlight peak nest effort for species included in the total. WOST were not detected during monthly surveys.

Month	GREG	GBHE	WHIB	SNEG	LBHE	TRHE	GLIB	ROSP	CAEG	ANHI	Peak Nest Effort[1]
January	--	--	--	--	--	--	--	--	--	--	--
February	145	--	13	25	--	--	--	--	--	--	183
March	1,135	**8**	1,030	415	3	53	--	--	3	15	2,644
April	**1,178**	--	**1,200**	1,054	8	145	**101**	--	42	20	**3,686**
May	939	--	1,129	**1,056**	**36**	**272**	29	1	**1,070**	--	3,462
June	409	--	112	779	2	18	--	1	890	--	1,321

[1] Does not include CAEG or ANHI.

Table 18. Geographic coordinates (NAD 83) and species-specific peak nest efforts in detected colonies during the 2015 breeding season at Lake Okeechobee. WOST were not detected during monthly surveys.

Colony	Peak Month[1]	Latitude	Longitude	GREG	GBHE	WHIB	SNEG	LBHE	TRHE	GLIB	ROSP	CAEG	ANHI	Total[1]
Clewiston Spit	May	26.77573	-80.90938	80	--	--	45	3	35	--	--	--	--	163
Eagle Bay Trail	May	27.18791	-80.8317	4	2	10	125	21	59	25	--	650	--	246
Gator Farm	May	27.02278	-81.06084	160	--	--	125	--	--	--	--	200	--	285
Indian Prairie East	May	27.07852	-80.86883	250	2	--	15	--	--	--	--	290	6	267
Lakeport Marina	April	26.9726	-81.1144	85	26	--	--	--	10	--	--	220	--	121
Liberty Point 2	April	26.81752	-80.99675	650	1	1,200	750	12	100	100	--	--	15	2,813
Little Bear Beach	April	26.72139	-80.84222	50	--	--	60	3	30	--	1	--	--	144
Moore Haven	May	26.88058	-81.08236	155	--	80	160	1	53	5	--	--	--	454
Moore Haven East 4	April	26.89336	-81.05337	5	--	--	--	--	--	--	--	--	--	5
Moore Haven West	May	26.88826	26.88826	6	--	--	120	3	--	--	--	--	--	129

[1] Does not include CAEG or ANHI.

Timing and Success

The median nest initiation date was March 21 for GREG, April 5 for SNEG, and April 19 for TRHE. Nest initiations peaked for all species between March 22 and April 13, which coincides with the first prolonged water-level recession of the breeding season. The number of nests initiated dropped sharply after April 13, which corresponds with a reversal that began around the same time (**Figure 20**). A preliminary examination of the data showed that nests failed at a higher rate earlier in the season than later, and failure rate did not appear to increase with the reversal in April. Although the recession rate increased again in May, it was too late in the season to induce an increase in nesting effort.

Eight transects (50 m long) at four nesting colonies (2 transects in each) were monitored from the ground to estimate nesting success. The percentage of nests to fledge chicks varied among transects but ranged from 28% to 67%. It is notable that the two transects with the highest fledge rate were located at Liberty Point 2, which was the largest natural wading bird colony on Lake Okeechobee in 2015.

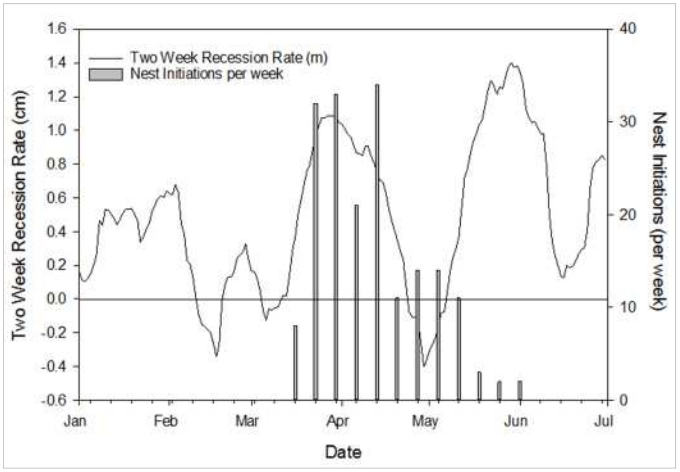

Figure 20. The number of total nest initiations on Lake Okeechobee plotted against 2-week recession rates (cm). Positive recession rates indicate falling water levels.

Wood Storks and Roseate Spoonbills

No Wood Storks (WOST) nested on Lake Okeechobee in 2015, but there were consistently small numbers of WOST (1 to 6) observed foraging along the Moore Haven canal and in the Eagle Bay region. Larger numbers (3 to 76) of Roseate Spoonbills (ROSP) were observed foraging in the same regions. A pair of ROSP successfully fledged three young from a nest on Little Bear Beach, a spoil island on the northwest edge of the South Bay region. The nest was initiated approximately April 15, and chicks were successfully fledged by June 11. This is a remarkable record because it was the first documented successful ROSP nest on Lake Okeechobee since 1874 (Oder 1874; Allen 1942), although there were unsuccessful nesting attempts on the lake in 2009 and 2013 (Chastant and Gawlik 2015).

ACKNOWLEDGMENTS

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KISSIMMEE BASIN

WADING BIRD NESTING

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 et al. 2005a,b). To date, approximately 7,710 acres of wetland habitat (approximately half of the project total) has been restored, and the interim response of foraging wading birds has exceeded the restoration expectation when averaged over the interim period (2001 to 2015) (Cheek et al. 2014). 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 historic levels (Williams et al. 2005a).

While foraging conditions on the floodplain can become optimal for wading birds during parts of the year (see *Foraging Abundance*), the current timing and magnitude of floodplain inundation and recession is not optimal for rookery formation due to constraints and other demands on water control operations that limit prey availability. All restoration construction is scheduled to be complete by 2019, when implementation of the Headwaters Revitalization Schedule 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. Wading bird responses to the river restoration project will be monitored through 2024.

Detailed information regarding the breadth of the avian evaluation program and the initial response of avian communities to Phase I restoration can be found in Volume I of the 2005 *South Florida Environmental Report* (Williams et al. 2005b) and in Cheek et al. (2014).

Methods

As part of the KRREP, the SFWMD performed four aerial surveys (March 6, April 15 and 29, and May 28, 2015) to visit known wading bird nesting colonies and search for others in the Kissimmee Basin and Lake Istokpoga. The survey area was reduced this season due to several weather-related flight cancellations. Nesting colonies were recorded, when encountered, during separate aerial surveys of foraging wading birds on November 20 and December 10, 2014, and January 21, February 11, March 18, April 8, and May 4, 2015. Known colonies in Lake Mary Jane, Lake Kissimmee (Rabbit Island), and Lake Istokpoga (Bumblebee Island) were surveyed at least once.

Observers sat on both sides of a helicopter flying at an altitude of 244 m while flying between known colonies within the Kissimmee Basin. Once a colony was located, the principal observer recorded nesting species and the number of active nests while another observer took photos. Nest counts were obtained from the digital photos to improve the accuracy of initial counts made from the air. The numbers of nests reported here represent the maximum number of observed nests for each species. It is likely that nests for a small number of dark-colored wading birds such as Little Blue Heron (LBHE), Glossy Ibis (GLIB), Tricolored Heron (TRHE), Yellow-crowned Night Heron (YCNH) and Black-crowned Night Heron (BCNH) were undercounted because of their lower visibility from the air (Frederick et al. 1996). Thus, the colony totals presented in **Tables 19** through **23** are considered conservative. Nest fate and nesting success were not monitored.

Results

Twenty-three colonies were surveyed during the 2015 season, 15 of which were active (**Tables 19** to **23**; **Figures 21** and **22**). The inactive colonies were Cat Island (Lake Conlin), Lake Russel, Orange Grove SW, S-65C Structure, S-65C Boat Ramp, two colonies on Lake Marian (Lake Marian North and South), and C-38 Caracara Run. However, all but two colonies (Rabbit Island (Lake Kissimmee) and Bumblebee Island (Lake Istokpoga) were surveyed only once in 2015, and four (Lakeshore and Indian Lakes Estates colonies on Lake Weohyakapka, Lake Arbuckle, and Arbuckle Creek) were not surveyed at all due to multiple flight cancellations. Thus, the peak of nesting activity (April-May) for some colonies, in particular Lake Mary Jane, may not have been observed and so the seasonal total is likely a conservative estimate.

In 2015, all Kissimmee Basin colonies combined were dominated by nearly equal numbers of Cattle Egret (CAEG; 1,198), White Ibis (WHIB; 1,161), and Great Egret (GREG; 1,132), followed by smaller numbers of Great Blue Heron (GBHE; 145) and Wood Stork (WOST; 83). The largest colony to form in Kissimmee Basin this season was on Rabbit Island (1,523 nests), followed by Bumblebee Island (1,443 nests) and Lake Mary Jane (445 nests) (**Figures 21** and **22**). The peak number of wading bird nests (excluding CAEG) documented throughout the basin was 2,521.

Of the 21 active colonies reported in last year's report, 10 were active this season, 7 were inactive, and 4 were not surveyed so their status was unknown. Similar to last season, none of the colonies occurred within 3 km of the partially restored portions of the Kissimmee River, but several did occur in unrestored portions of the river north, east, and south of the restoration area (**Figures 21** and **22**). The Orange Grove NW colony was inactive during the March 6 survey, but a long-dormant colony (Orange Grove) was active this season slightly more than 1 mile to the southeast (**Figure 22**).

Discussion

Most nesting of aquatic wading bird species and CAEG occurs outside of the KRREP area on islands in Upper Kissimmee Basin and Lake Istokpoga. To date, only one colony of aquatic bird species (S-65C Boat Ramp Colony) has formed within 3 km of the partially restored portion of the Kissimmee River, and during most years it contains less than 50 nests of aquatic bird species. 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 wetland-dependent birds. Survey efforts next season will focus primarily within 10 km of the Kissimmee River Restoration Project Area and the Kissimmee River Headwaters.

Table 19. Peak number of wading bird nests within the Upper Kissimmee Basin Lakes (2010 to 2015; sites surveyed in March only during 2015).

Year	CAEG	GREG	WHIB	GBHE	SMDH	GLIB	BCNH	SMWH	WOST	Total Nests	Total Colonies	Nests of Aquatic Species
2010*		250					1		100	351	1	351
2011*		200							200	400	1	400
2012*	235	176	119					25	172	727	1	492
2013	100	376	566	1	50				172	1,265	2	1,165
2014**		343	1,254	40	53	2	15	35	282	2,024	8	2,024
2015		416		65					83	564	4	564

Upper Kissimmee Basin includes Cat Island (Lake Conlin), Lake Marian (East, North, and South), Lake Russell, Lake Mary Jane, Lake Rosalie, Lake Marion (Twin Islands), and all Upper Basin Lakes excluding KCH.
*Only active colony was Lake Mary Jane.
**Survey effort was expanded in 2014 to include all Central and South Florida water bodies in the Upper Kissimmee Basin.

Table 20. Peak number of wading bird nests within the Kissimmee River Headwaters (Lakes Kissimmee, Hatchineha, and Cypress) and Pool A (2003 to 2015; sites surveyed during March, April, and May 2015).

Year	CAEG	GREG	WHIB	GBHE	SMDH	GLIB	BCNH	SMWH	Total Nests	Total Colonies	Nests of Aquatic Species
2003*									0	0	0
2004*									0	0	0
2005*	400								400	1	0
2006*									0	0	0
2007*	193	1		1	5		1		201	1	8
2008*	325	30		10	29			7	401	1	76
2009	740	150	75	50	129	10	3	10	1,167	1	427
2010	200	249	1,156	59					1,664	3	1,464
2011	350	250	540	75				75	1,290	1	940
2012	645	252	156	89				195	1,337	3	692
2013	675	152	95	28	36	5	5	7	1,003	3	328
2014	85	211	157	82				15	550	3	465
2015	764	442	332	49					1,587	6	823

Headwaters include Rabbit Island, East Lake Kissimmee, Kissimmee East Shore, Melaleuca Island, Brahma Island NW, River Ranch C-38 Island, Three Lakes Ranch, and 42W.
*Lakes Kissimmee, Hatchineha, and Cypress were not surveyed during these years: surveys started on these lakes in 2009.

Table 21. Peak number of wading bird nests within the Kissimmee River Restoration Project Area* (2003 to 2015; sites surveyed during March and May 2015).

Year	CAEG	GREG	GBHE	SMDH	SMWH	Total Nests	Total Colonies	Nests of Aquatic Species
2003	20					20	1	0
2004						0	0	0
2005		81				81	2	81
2006	500	133	9			642	4	142
2007	226			1		227	1	1
2008		2	4			6	1	6
2009	240	126	27	14		407	3	167
2010	891	35	31	37		994	2	103
2011	751	14	35	35	8	843	2	92
2012	1202		18	108	18	1346	2	144
2013	599	33	37			669	5	70
2014**	5	23	28	1		57	5	52
2015		94	31			125	4	125

*Kissimmee River Restoration Project Area sites include colonies within approximately 10 km of the C-38 Canal backfill: multiple Kissimmee Prairie sites, Bluff Hammock, Cypress West, Oak Creek Marsh, C-38 Caracara Run, Chandler Slough East, Chandler Slough New, Chandler Slough, Cypress West, Orange Grove, Orange Grove NW, Orange Grove SW, Pine Island Slough, S-65C Boat Ramp, S-65C Structure, S-65D Boat Ramp, Seven Mile Slough, Pool E Spoil Island, and S-65E.
**Expanded survey effort in 2014.

Table 22. Peak number of wading bird nests within Lake Istokpoga (Bumblebee Island) (2010 to 2015; sites surveyed during April and May 2015).

Year	CAEG	GREG	WHIB	GBHE	Total Nests	Total Colonies	Nests of Aquatic Species
2010	103	325	110	75	613	1	510
2011	381	200	50	45	676	1	295
2012	75	175		75	325	1	250
2013	250	343		55	648	1	398
2014	658	210	75	55	998	1	340
2015	434	180	829		1,443	1	1,009

Table 23. Number of wading bird nests within the Lake Weohyakapka, Lake Arbuckle, and Arbuckle Creek in 2014. (Sites not surveyed in 2015.)

Year	GREG	GBHE	Total Nests	Total Colonies	Nests of Aquatic Species
2014	18	24	42	4	42

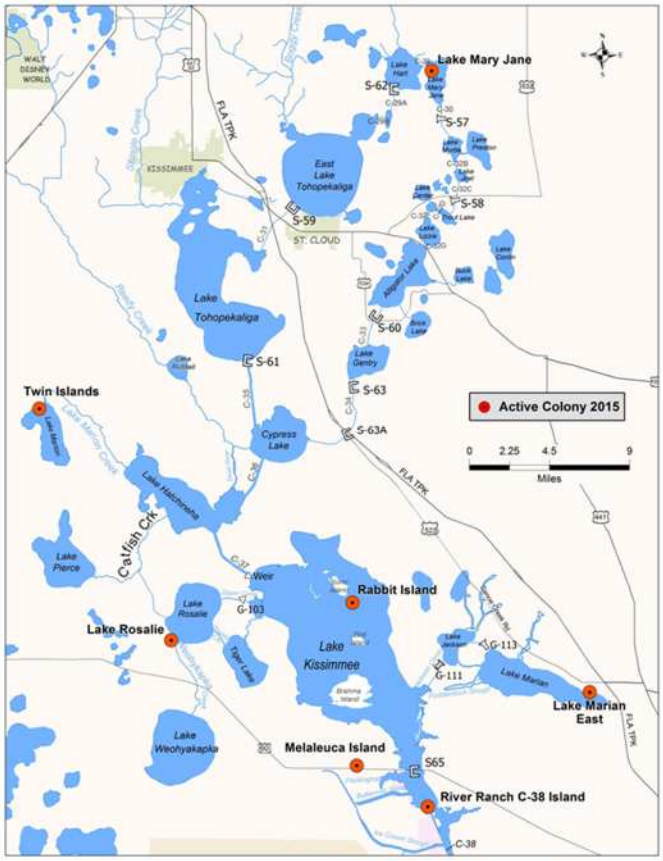

Figure 21. Map of active 2015 colonies in the Upper Kissimmee Basin.

Figure 22. Map of active 2015 colonies in the Lower Kissimmee Basin.

FORAGING ABUNDANCE

As part of KREPP, the following restoration expectation was developed for the abundance of foraging wading birds on the floodplain post construction:

- Mean annual dry season density of long-legged wading birds (excluding CAEG) on the restored floodplain will be ≥30.6 birds/km² (Williams et al. 2005a).

Detailed information regarding the interim response of wading birds and waterfowl to Phase I restoration can be found in Cheek et al. (2014).

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. Each month, a minimum of 20% of the 100-year floodplain was surveyed in the restored and unrestored portions of the river/floodplain. Surveys were conducted via helicopter 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 TRHE from adult LBHE during aerial surveys, the two are lumped together as "small dark herons". Likewise, SNEG and immature LBHE were classified as "small white herons".

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, annual abundance has ranged from 102.3 ± 31.7 birds/km² to 11.0 ± 1.9 birds/km² (mean 2001 to 2015 = 42.4 ± 6.8 birds/km²) (**Figures 23** and **24**). Mean monthly wading bird abundance within the restored portions of the river during the 2014-2015 breeding season was 57.9 ± 31.7 birds/km², bringing the 3-year (2013 to 2015) running average to 37.1 ± 10.5 birds/km². The mean annual 3-year running mean (2001 to 2015) is 41.7 ± 4.7 birds/km², significantly greater than the expected value of 30.6 birds/km² (one-sample t-test, $p<0.04$, SAS Version 9.3; Williams et al. 2005a), although the individual 3-year running means were not significantly different from the restoration target of 30.6 birds/km² when examined on an annual basis (one-sample t-test, SAS Version 9.3).

The 2015 seasonal mean was greatly affected by the large number of birds observed in March, which increased the mean during what would have otherwise been a below-average season had the March survey been closer to the long-term average. Wading bird foraging conditions were relatively poor in November following a relatively short and discontinuous period of floodplain inundation (69 days total ≥1 ft deep) during the preceding wet season (June to October 2014). Conditions improved slightly with a water-level recession during December before water depths again became too deep for foraging (>1.3 ft) throughout most of the floodplain by the end of January through March (SFWMD 2015).

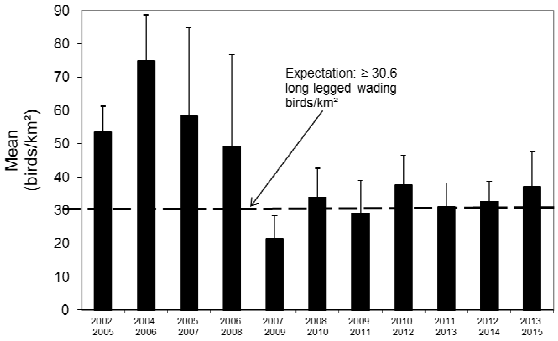

Figure 23. Post-restoration abundance as 3-year running averages ± SE of long-legged wading birds/km², excluding CAEG during the dry season (December to May) within the Phase I, IVa, and IVb restoration areas of the Kissimmee River. Each 3-year running mean was not significantly different from the restoration target of 30.6 birds/km² when examined on an annual basis (TTEST; SAS Institute 2011).

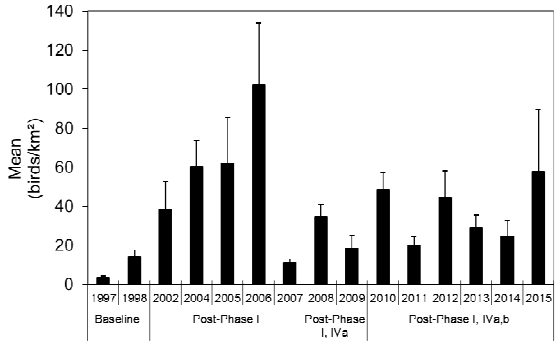

Figure 24. Baseline and post-Phases I, IVa, and IVb mean abundance ± SE of long-legged wading birds/km² (excluding CAEG) during the dry season (December to May) within the 100-year floodline of the Kissimmee River.

Water depth peaked on approximately March 6 (2.8 ft) before receding quickly (approximately 1.6 ft/13 days) prior to the March survey, when over 214 birds/km² were recorded; one of the largest monthly bird abundances observed since 2001. Water levels then stabilized between the March 18 and April 8 surveys at a depth of approximately 1 ft. Average water depth began to increase again on April 13 through April 26 to approximately 2 ft, then receded to approximately 1.6 ft deep by May 4. The relatively deep foraging conditions in April and May were reflected in the relatively low bird counts in those months.

WHIB dominated the surveys numerically, followed in order of abundance by GLIB, GREG, CAEG, small white herons, GBHE, small dark herons, WOST, Roseate Spoonbill (ROSP), and BCNH.

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J.W. CORBETT WILDLIFE MANAGEMENT AREA

This year, J.W. Corbett Wildlife Management Area (WMA) initiated formal monitoring of wading bird colonies to determine their location and size as part of the Florida Fish and Wildlife Conservation Commission's Wildlife Conservation Prioritization and Recovery Program (WCPR). One colony was identified containing more than 50 nests and one colony containing fewer than 50 nests (**Table 24**). A single Great Egret (GREG) nest with eggs also was identified in another area of Corbett WMA at the end of March, but this did not appear to be active during later aerial surveys.

From 2006 to 2010, wading bird colonies were noted as incidental observations. Five different colony locations were identified during this time period (including the large colony identified this year) with relatively small numbers of nesting adults (2 to 40 per observation) and nests (20 or fewer per observation). It is unclear whether the increase in wading bird nests at the large colony this year is due to an increase in wading bird breeding or increased monitoring efforts, or both.

METHODS

From late February through early June, five systematic aerial surveys were conducted to locate colonies and estimate numbers of nesting wading birds. Two observers sat on either side of a helicopter traveling at an altitude of 300 to 400 feet and a speed of 40 to 60 knots. Transects were spaced 1.25 km apart and oriented in an east-west direction. Due to unexpectedly large numbers of nesting birds seen in April, digital aerial photos of colonies were taken to help obtain accurate estimates of numbers of birds. Ground surveys were conducted in May and August (post-nesting) to increase the accuracy of estimates from aerial surveys; nests were counted along a transect and extrapolated to estimate the number of nests for the entire island.

RESULTS

Peanut Pond

This colony occupies a willow head covering approximately 1.23 acres. Based on aerial surveys and ground transect counts, an estimated 450 to 500 nests were initiated at the Peanut Pond colony. The majority of these were GREG nests. Tricolored Heron (TRHE), Snowy Egret (SNEG), Little Blue Heron (LBHE), and Cattle Egret (CAEG) also were seen nesting; Black-crowned Night Heron (BCNH) and Anhinga (ANHI) were detected during aerial surveys but were not seen nesting.

FUTURE WORK

There are plans to continue annual aerial surveys, incorporating digital photography that will assist in obtaining more accurate counts of each species' numbers of nesting adults and chicks. The goal, as described in the WCPR and related standard monitoring protocol, is to provide a basic summary of the distribution and status of wading bird colonies within Corbett WMA.

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Table 24. Species-specific number of nests in colonies during the 2015 breeding season at Corbett WMA.

Colony	Latitude	Longitude	GREG	SNEG	CAEG	LBHE	TRHE	BCNH	ANHI	WOST	Unident. White	Unident. Dark	Total
Peanut Pond	26.84195	-80.3225	385	+	27	40	+	*	2		59	2	515
Trail 7	26.84347	-80.3565	+	+		15	+				5	2	22
Total			**385**	**+**	**27**	**55**	**+**	*****	**2**	*****	**64**	**4**	**537**

+ Present and nesting, but unable to determine numbers.
* Species detected but never seen nesting.

SOUTHEAST COAST

METHODS

The Florida Fish and Wildlife Conservation Commission (FWC) conducted nest counts at four rookeries in 2015.

- Bird Island (27.190281°, -80.187908°) is a spoil island in the Indian River Lagoon in Martin County. It is cooperatively managed and monitored on a monthly basis throughout the year with Martin County. Counts are conducted from a boat circling the island so it is possible that some interior nests are not counted.
- BallenIsles (26.830148°, -80.109158°) is a small island located within the BallenIsles Country Club, Palm Beach County. Counts are conducted on foot from the north and south sides of the island.
- Sawgrass Ford, Broward County (26.149837°, -80.337621°) is a spoil island behind the Sawgrass Ford Dealership. It was accessed only once in May by kayak to post signs to prevent disturbance and to conduct a count.
- Wakodahatchee Wetlands, Palm Beach County (26.479889°, -80.142326°) is a created wetland where many avian species breed. Only Wood Storks were counted during a visit in May.

RESULTS

Bird Island was designated an FWC Critical Wildlife Area in 2014 and "No Entry" signs were posted surrounding the island in January of this year. While there has been higher nest counts in the past, this year had much higher chick counts for Wood Storks since monitoring began 10 year ago; 138 juveniles and chicks were observed in July. Peak nests counts for each species in each rookery are provided in **Table 25**.

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Table 25. Peak number of nests at various locations from January to July 2015.

Colony	ANHI	BRPE	CAEG	DCCO	GREG	ROSP	SNEG	TRHE	WHIB	WOST
Bird Island	1	48	1	10	19	2	1	0	1	37
BallenIsles	5	0	0	17	13	0	1	0	0	34
Sawgrass Ford	3	0	0	11	3	0	1	2	0	74
Wakodahatchee	--	--	--	--	--	--	--	--	--	28
Total	**9**	**48**	**1**	**38**	**35**	**2**	**3**	**2**	**1**	**173**

-- Species was not counted.

CORKSCREW REGIONAL ECOSYSTEM WATERSHED MANAGEMENT AREA

The Florida Fish and Wildlife Conservation Commission (FWC) started monitoring wading bird nesting colonies on 170 km^2 (41,910 acres) of Corkscrew Regional Ecosystem Watershed (CREW) Management Area and Audubon's Corkscrew Swamp Sanctuary (CSS) in January 2013. The objective was to locate and monitor trends in wading bird nesting by documenting species composition and nesting effort. This report describes wading bird nesting activity during the 2015 nesting season and compares these observations with those of the previous two years.

METHODS

Monthly systematic aerial surveys of CREW were performed in a Cessna 182 from November 2014 through July 2015. To locate active colonies, transects spaced 1.48 km (0.8 nautical miles) apart and oriented northeast to southwest (**Figure 25**) at an altitude of 244 m (800 ft). Once a colony was located, altitude was reduced to 152 m (500 ft), the GPS coordinates were recorded, and digital photos were taken using a Canon EOS 7D with a 70-300 mm lens with image stabilization. Nests were counted from the photos by digitally marking nests using Adobe Photoshop Elements 9. Peak nest counts (the highest nests count for the season) are reported for each species within each colony.

Total rainfall (102.0 cm) at the CREW field office (Estero, FL) from June to October 2014 was slightly higher than average (97.2 cm). Water levels began to recede in October 2014 and continued through March 2015.

RESULTS

A total of 507 nests were counted from three active wading bird colonies in CREW during 2015 (**Table 26**). This is a 22% increase relative to nesting effort in 2013 (416 nests; **Table 27**) and a 45% decrease from 2014 (914 nests; **Table 28**). No Wood Stork (WOST) nests were observed in 2015; however, species richness increased for these three colonies relative to previous years.

In the Orange Grove colony, a 54% decrease in nest numbers (36 nests) was observed relative to 2013 (78 nests), which was mainly attributed to a 67% decline in nesting Great Egret (GREG) (**Tables 27** and **28**). In two of the last three years, nesting effort in this colony begin in April, with GREG and Anhinga (ANHI) being the first to nest.

Nesting effort in the Sod Farms colony has remained relatively stable from 2013 to 2015 (**Tables 26** to **28**), with observed annual changes of up to 25% due largely to variation in Cattle Egret (CAEG) nesting. The peak count for CAEG at this colony was the highest for all species in all three colonies (n = 319) in 2015. A substantial increase in nesting Little Blue Heron (LBHE) (66 nests) and Tricolored Heron (TRHE) (7 nests) was observed at this colony in 2015.

Nest numbers (57 nests) in the Cypress East colony in 2015 increased 613% relative to 2013 (8 nests) but decreased 41% relative to 2014 (97 nests). Annual variation in nesting effort was largely attributed to annual differences in GREG nesting effort (**Tables 26** to **28**). Unlike 2014, no Roseate Spoonbill (ROSP) nested here this year.

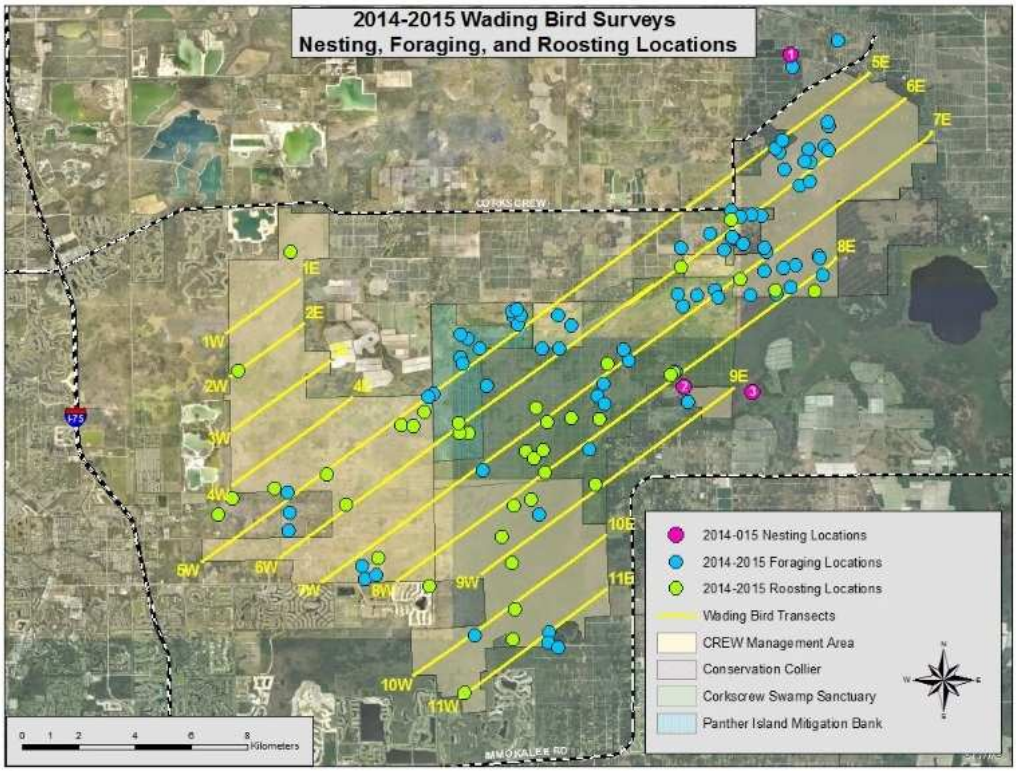

Figure 25. Locations of nesting, foraging, and roosting wading birds on CREW Management Area and Corkscrew Swamp Sanctuary, November 2014 through July 2015. Colony 1 is Orange Grove, colony 2 is Sod Farms, and colony 3 is Cypress East.

Table 27. Peak numbers of wading bird nests found in and around CREW Management Area and Corkscrew Swamp Sanctuary, 2013.

Colony #	Colony Name	Owner	Latitude	Longitude	GREG	SNEG	CAEG	TRHE	LBHE	ANHI	SMWH	SMDA	Total
1	Orange Grove	Alico	26.50038	-81.54436	56	1	12	0	0	2	7	0	78
2	Sod Farms	CREW	26.393501	-81.57576	0	0	198	3	10	1	116	2	330
3	Cypress East	Private	26.39051	-81.55288	8	0	0	0	0	0	0	0	8
	Total				**64**	**1**	**210**	**3**	**10**	**3**	**123**	**2**	**416**

Colony # corresponds to nest location icons in **Figure 25**.

Table 28. Peak numbers of wading bird nests found in and around CREW Management Area and Corkscrew Swamp Sanctuary, 2014.

Colony #	Colony Name	Owner	Latitude	Longitude	WOST	GREG	SNEG	CAEG	WHIB	ROSP	GRHE	GBHE	TRHE	LBHE	ANHI	LGWH	SMWH	Total
	CSS WOST 1*	CSS	26.3816	-81.61930	37	0	0	0	13	0	0	0	0	0	0	0	0	50
	CSS WOST 2*	CSS	26.3892	-81.61700	125	70	0	0	0	11	0	0	0	0	0	12	0	218
	CSS WOST 3*	CSS	26.3816	-81.60860	73	5	0	0	0	0	0	0	0	0	0	0	0	78
	BRS WOST*	CREW/CSS	26.3651	-81.61390	59	0	0	0	0	0	0	0	0	0	0	0	0	59
3	Cypress East	Private	26.3929	-81.55680	0	90	0	0	0	7	0	0	0	0	0	0	0	97
	HQ WOST*	CSS	26.3695	-81.61280	39	0	0	0	0	0	0	0	0	0	0	0	0	39
1	Orange Grove	Alico	26.5004	-81.54440	0	49	1	1	0	0	1	0	0	0	6	0	5	63
	PI	CSS	26.4192	-81.65080	0	2	0	0	0	0	0	1	0	0	0	0	0	3
2	Sod Farms	CREW	26.3931	-81.57710	0	0	1	251	0	0	0	0	1	18	0	0	33	304
	CSS SMWH	CSS	26.3897	-81.61230	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	CSS GREG	CSS	26.4047	-81.59860	0	2	0	0	0	0	0	0	0	0	0	0	0	2
	Total				**333**	**218**	**2**	**253**	**13**	**18**	**1**	**1**	**1**	**18**	**6**	**12**	**38**	**914**

*Subcolonies are part of the main Corkscrew Swamp Wood Stork nesting colony.
Colony # corresponds to nest location icons in **Figure 25**.

Table 26. Peak numbers of wading bird nests found in and around CREW Management Area and Corkscrew Swamp Sanctuary, 2015.

Colony #	Colony Name	Owner	Latitude	Longitude	GREG	SNEG	CAEG	ROSP	GRHE	TRHE	LBHE	ANHI	LGWH	SMWH	SMDA	Total
1	Orange Grove	Alico	26.50040	-81.54440	18	4	2	0	0	2	2	5	2	1	0	36
2	Sod Farms	CREW	26.39442	-81.57841	2	16	319	0	0	7	66	2	0	1	1	414
3	Cypress East	Private	26.39290	-81.55680	53	1	0	0	0	0	0	2	1	0	0	57
	Total				**73**	**21**	**321**	**0**	**0**	**9**	**68**	**9**	**3**	**2**	**1**	**507**

Colony # corresponds to nest location icons in **Figure 25**.

In summary, WOST did not nest in the Corkscrew Watershed this year, which led to fewer nesting colonies and lower overall nesting effort compared to 2014. The three colonies reported here have attracted nesting wading birds for the last 3 years, although nesting effort has fluctuated. Nesting in Orange Grove and Cypress East colonies began later in 2015 compared to 2014. Despite having lower overall nesting in 2014, the greatest species richness was recorded in each of the three nesting colonies this year. Plans are in place to continue building on these baseline data to produce trend information for future reports.

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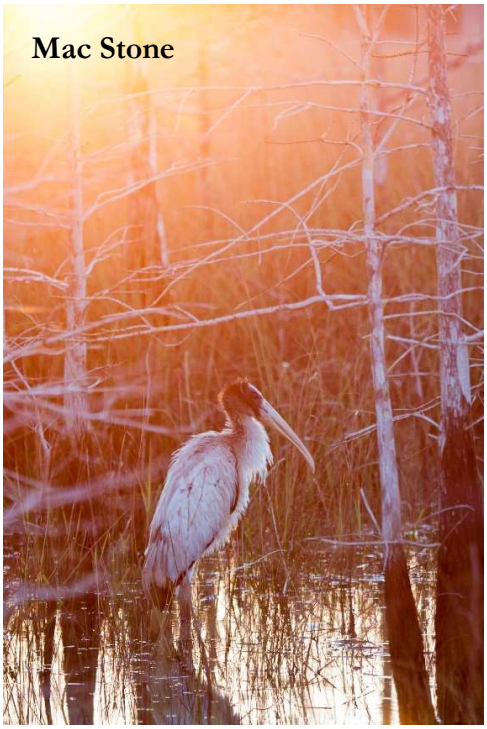
Mac Stone

STATUS OF WADING BIRD RECOVERY

The sustainability of healthy wading bird populations is a primary goal of the Comprehensive Everglades Restoration Plan (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. 2009. There are at least two overlapping sets of measures for 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 (http://www.evergladesplan.org/pm/recover), including the 3-year running average of the numbers of nesting pairs of key avian species in the mainland Everglades, the timing of Wood Stork (WOST) nesting, and the proportion of the population that nests in the coastal ecotone (Ogden et al. 1997). In addition to these, 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 (WHIB) 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). This section reports on the long-term trends and current status of these measures. When thinking about progress towards these restoration measures, it should be noted that the hydrological system is not yet restored to provide anything like the ecological functions expected in a completed CERP. Based on the current status of the hydrological system, restored or partially restored wading bird population indicators would not be expected.

The main indicator species are Great Egret (GREG), Snowy Egret (SNEG), WHIB, and WOST. Although the Tricolored Heron (TRHE) was originally included in this list (Ogden et al. 1997), the 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 TRHE and SNEG population targets (i.e., 10,000 breeding pairs), and it is difficult to derive an expected number for SNEG 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 (SNEG: TRHE). In practice, the distinction is unimportant because both species appear to be declining and are nowhere near any of the population restoration targets. This section summarizes data for the three Water Conservation Areas (WCAs) and mainland Everglades National Park (ENP).

RESULTS

Numbers of Nesting Pairs

The 3-year running averages for nesting pairs (2013 to 2015) are as follows:

- 6,300 pairs of GREG
- 710 pairs of SNEG
- 21,272 pairs of WHIB
- 1,639 pairs of WOST

Trends for GREG over time (**Figure 26**; also **Figure 3** at the beginning of this report) for this measure increased markedly from 1988 to 2004, and have been stable or slightly declining since then, with the 3-year running average meeting or exceeding restoration criteria for 19 consecutive sampling periods since 1996 (**Figure 26**; **Table 27**, also **Table 1** at the beginning of this report). Trends for SNEG also increased markedly between 1986 and 2004, but have dropped dramatically since 2005, with the 2015 season showing continued declines compared to the previous 3 years (now at 710 pairs). Three-year running averages of breeding SNEG have consistently been well below the target restoration goal in the time they have been monitored since 1986. The 3-year running average markedly increased (2.7 times) for WHIB between 1986 and 2001, and then remained variable but arguably stable for nearly a decade (2002 to 2011). The final period in this record (2011 to 2015) showed substantial decreases in WHIB nesting (approximate 50% reduction in three of the years), with three of the five years in that period being well below the average of the previous decade. However, the 2015 season showed similar numbers to the 2002 to 2011 average. WHIB nesting populations have met or exceeded the breeding population criterion during all of the past 14 years. WOST showed a marked increase from averages in the 2 to 300 pairs range (1986 to 1992) to averages above 1,000 pairs after 1999. WOST have equaled or exceeded the restoration population criterion during 5 of the last 12 years. Together, these statistics illustrate that there has been a substantial increase in numbers of GREG, WOST, and WHIB since 1986, followed by a period of relative stability during which each of these species has met restoration targets in the majority of years. SNEG, 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* (TRHE and Little Blue Heron [LBHE]) also are sharply declining in the Everglades.

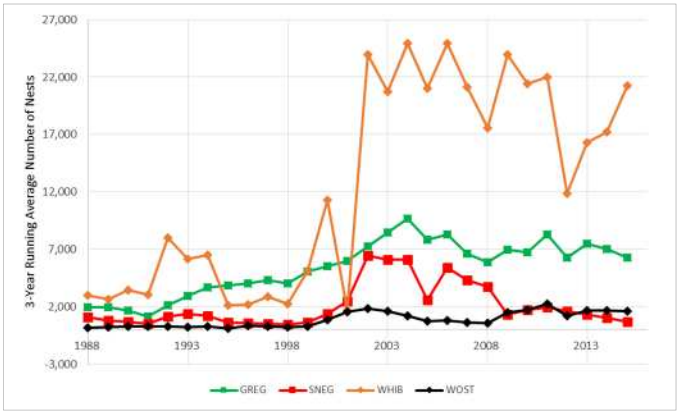

Figure 26. Trends in 3-year running average of nesting pairs of the four target species since 1988.

Table 27. 3-year running averages of the number of nesting pairs for the four indicator species in the Everglades. Bold values are those that meet minimum criteria.

Period	GREG	SNEG	WHIB	WOST
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
2011-13	**7,490**	1,299	**16,282**	**1,686**
2012-14	**7,041**	1,017	**17,194**	**1,696**
2013-15	**6,300**	710	**21,272**	**1,639**
Target minima	4,000	10 – 20k	10 – 25k	1.5 – 2.5k

Colony Location

It is estimated that more than 90% of indicator species nesting occurred in the southern ecotone region of ENP during the 1930s and early 1940s, likely 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 2000s (2% to 10%) (**Figure 27**; also **Figure 6** earlier in this report), and during the last several years has ranged between 15% and 33%. In 2015, the proportion was 12.7%.

Ratio of Visual to Tactile Foragers

The ratio of visual to tactile foragers measure recognizes that the breeding wading bird community has shifted from being numerically dominated by tactile foragers (storks and ibises) during the pre-drainage period to one in which visual foragers such as GREG 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 larger forage fishes (for WOST) and crayfishes (for WHIB). These conditions also seem to favor species like GREG that are less reliant on the entrapment of prey and forage in groups or solitarily under a variety of circumstances. Restoration targets are set at 32 breeding tactile foragers to each breeding visual forager, characteristic of the 1930s breeding assemblages. While this measure has shown some improvement since the mid-1990s (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 2015 was 3.09.

Timing of Nesting

The timing of nesting parameter applies only to the initiation of nesting for WOST, which has shifted from November-December (1930s through 1960s) to January-March (1980s to 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 WOST population being a source or sink population. This measure has shown a consistent trend towards later nesting between the 1930s and 1980s (**Figure 28**; also **Figure 4** earlier in this report), with variation around a February mean initiation date since the 1980s. Although some years in the mid-2000s stimulated earlier nesting, there has been no lasting improvement. The 2015 season start (late February) was late compared to recent years (late January) and to the November-December benchmark.

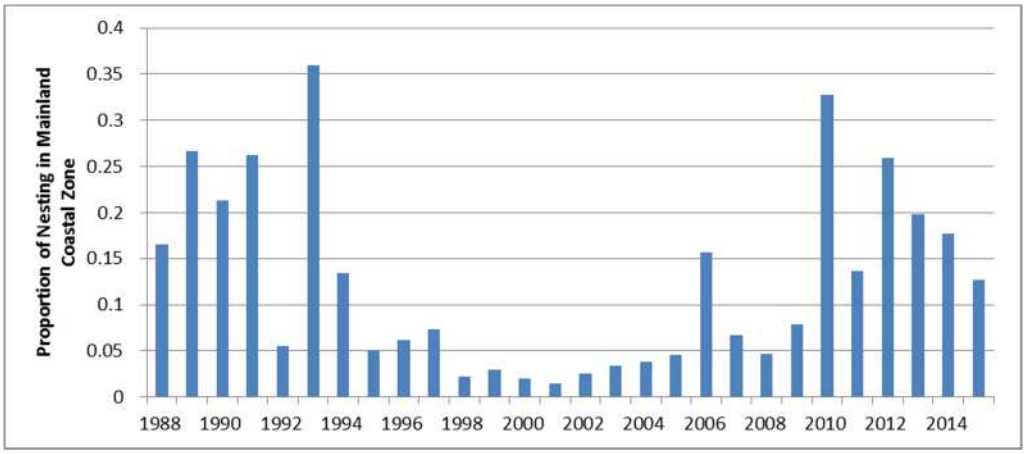

Figure 27. Proportion of all mainland Everglades nesting that is located in the coastal estuarine zone, 1988 – 2015.

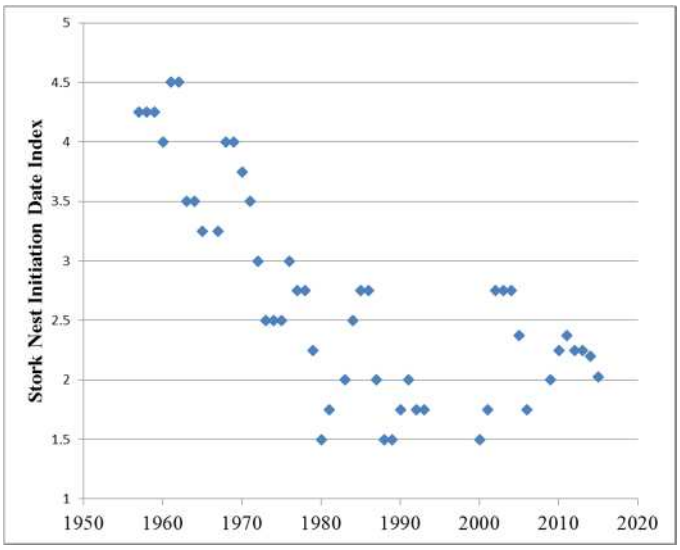

Figure 28. 4-year running average WOST nest initiation date, 1960 to 2015. Stork nest initiation date index: 1 = March; 5 = November. Target nest dates for restored conditions are November to December.

Exceptionally Large Ibis Aggregations

Exceptionally large breeding aggregations of ibises were characteristic of the pre-drainage 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 those with more than 16,977 nests each year, defined as the 70th percentile of the entire period of record of annual nestings. The interval between large WHIB nestings in the pre-drainage period was 1.6 years and this serves as the target for restoration. This measure has markedly improved since the 1970s, with the target achieved in 8 of the last 10 years (**Figure 29**; also **Figure 5** earlier in this report). The 2015 WHIB nesting reached the criterion, and the interval averaged over the last 5 years is 1.4 years, slightly less than in the 1930s.

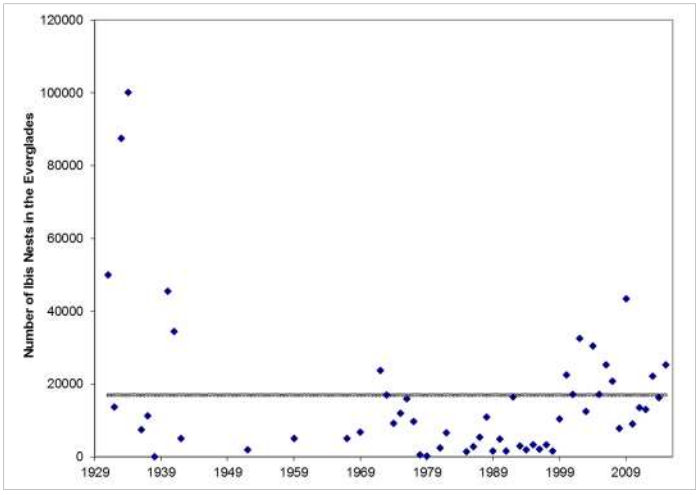

Figure 29. Numbers of WHIB nests in the mainland Everglades, 1930 – 2014. Gray line illustrates the 70th percentile of the period of record, which is used as the criterion for exceptional WHIB nesting events.

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 two decades, several key measures are stalled and not showing further improvement. Two measures are genuinely hopeful: numbers of nesting pairs of WHIB, WOST, and GREG in the system seem to be regularly achieving the restoration targets, and the interval between exceptional WHIB 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 18% compared to 50% target), and there is room for improvement. Several measures are not improving. The numbers of SNEG are declining and remain far from restoration targets. There is little evidence that the timing of nesting for WOST is improving, and this measure may be getting worse. The ratio of tactile to visual foragers has improved since the mid-2000s but remains an order of magnitude below the restoration target.

This picture clearly illustrates that in the last two decades wading birds have responded to a combination of altered water management regimes, good weather, and hydropatterns by nesting more consistently in the coastal zone, and by increasing populations of WGIB and WOST. 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 alter the timing of nesting, ratio of tactile foragers, or numbers of nesting SNEG further. While this illustrates an apparent stasis, 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.

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