SOUTH FLORIDA WADING BIRD REPORT

Volume 26 Mark I. Cook and Michael Baranski, Editors July 2021

SYSTEMWIDE SUMMARY

NESTING IN SOUTH FLORIDA

An estimated 43,860 wading bird nests (excluding Cattle Egrets [CAEG], which do not rely on wetlands) were initiated in South Florida during the 2020 nesting season (November 2019 to July 2020). This is a relatively average nesting effort compared to recent years. It is slightly shy of the 10-year average annual number of nests (46,841 nests) and almost 3.2 times smaller than the banner nesting effort of 2018 (138,834 nests), which was the largest nesting effort observed since comprehensive systemwide nesting surveys began in South Florida in 1996.

Several wading bird species exhibited moderately or slightly reduced nesting effort during 2020 relative to 10-year annual averages. White Ibis (WHIB) nesting effort (21,849 nests) was reduced by 20% (more than 5,000 nests) compared to the 10-year average, and it was more than 4 times lower than the 2018 count (95,728 nests). Given the WHIB is the most numerous nesting species in South Florida (typically between 45% and 78% of all wading bird nests) this decrease accounted for much of the reduction in the 2020 total nest count compared to recent years. Great Egrets (GREG) produced 6,893 nests during 2020, which is almost double the low count of 2019 (3,487) but is a 20% decrease compared to the 10-year average (8,698.8 nests). The federally threatened Wood Stork (WOST) has exhibited an increase in nesting effort in recent years, but produced only 1,795 nests in 2020, which is fewer than the 10-year average (2,490.7 nests). Roseate Spoonbills (ROSP) produced 1,262 nests, a considerable improvement on recent years and more than double the decadal average (514.3 nests).

The smaller *Egretta* heron species have exhibited consistent and steep declines in nest numbers over recent years, such that very few of these birds now nest in South Florida. In 2020, 2,068 Tricolored Heron (TRHE) and 761 Little Blue Heron (LBHE) nests were counted, representing a 1.9 times and 1.8 times increase in nesting effort, respectively, relative to the 10-year annual averages. While this is a moderate improvement, the counts remain considerably lower than the 10,000 or so pairs of each species that historically nested in South Florida (Frederick et al. 2009). The exception to the improved nesting effort in 2020 was the Snowy Egret (SNEG; 2,271 nests), which declined by 27% compared to the 10-year average. However, a relatively large number of small heron nests (4,064 nests) could not be identified to species this year (they were either LBHE, SNEG, or CAEG nests), such that the estimated counts for LBHE, SNEG, or both are relatively conservative.

Wading bird nesting is not evenly distributed in South Florida (**Figure 1**). The most important area in terms of numbers of nests from a regional perspective is the Everglades Protection Area (hereafter Everglades), which comprises the water conservation areas (WCAs) and Everglades National Park (ENP) and supports between 75% and 95% of all nests annually. Wading birds initiated an estimated 37,645 nests in the Everglades during 2020, 85.8% of all nests in South Florida. This nesting effort is within 2% of the decadal average (37,172.1 nests), but 22% lower than the 5-year average (48,246.6 nests) and 69.3% lower than the 2018 banner nesting effort when a record 122,571 nests were produced. The next most important nesting area is Lake Okeechobee, which typically supports approximately 10% of South Florida's nests. This year, the lake produced an estimated 1,951 nests, less than a half of the 10-year average (5,319.1 nests) and the second consecutive year of limited nesting on the Lake (see *Wading Bird Nesting at Lake Okeechobee* section). The lake accounted for 4.4% of the nests in South Florida. Another regionally important nesting area during 2020 was Florida Bay (2,485 nests). The Kissimmee Lakes area also is an important nesting region but was not surveyed in 2020.

In terms of the spatial distributions of individual species in South Florida, the Everglades supported most of the nesting WHIB, GREG, WOST, SNEG, and LBHE (96%, 88%, 72%, 49%, and 76**%** of their total nests, respectively), but only a small proportion of the TRHE nests (16% of their nests). Florida Bay supported most of the nesting TRHE (64% of their nests), but relatively few SNEG or LBHE nests (9% and 0.8% of nests, respectively). A nesting area that has experienced substantially reduced nesting activity in recent years is Audubon Florida's Corkscrew Swamp Sanctuary. This historically important nesting area, which supported up to 7,000 WOST nests per year in the 1960s and often more than 1,000 nests per year in the early 2000s, has failed to support nesting during 8 of the past 10 years. WOST did not nest at Corkscrew Swamp Sanctuary in 2020. The loss of critical WOST foraging habitat in southwestern Florida and reduced hydroperiods in the sanctuary itself may be responsible for this dramatic decline.

INSIDE THIS ISSUE

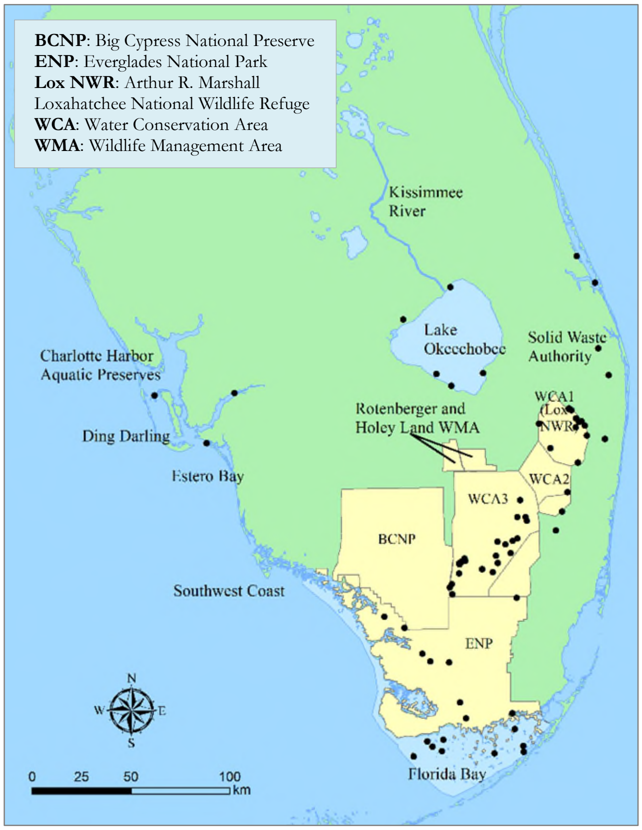


Figure 1. Locations of wading bird colonies with 50 or more nests in South Florida, 2020.

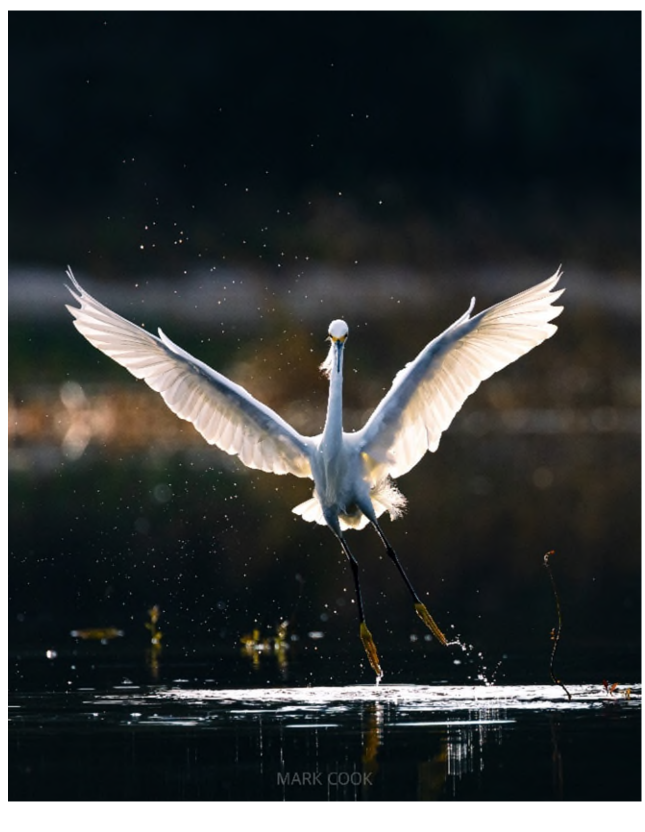
NESTING IN THE EVERGLADES

A primary goal of the Comprehensive Everglades Restoration Plan (CERP) and other restoration programs in South Florida is the return of healthy populations of breeding wading birds to the Everglades. CERP predicts that restoration of historical hydropatterns will result in the return of large, sustainable breeding wading bird populations, reset the historical timing of nesting, and encourage birds to nest again at the large colonies in the coastal region of ENP (Frederick et al. 2009). There are two sets of performance measures aimed at assessing these responses, based on historical ecological conditions and the hydrology-prey-foraging relationships that govern wading bird reproduction in South Florida. CERP's performance measures (http://www.evergladesplan.org/pm/recover) include the 3-year running averages of the number of nesting pairs of key wading bird species, the timing of WOST nesting, and the proportion of the population that nests in the coastal ecotone (Ogden et al. 1997). In addition, the annual Stoplight Reports have added two other measures: 1) the ratio of visual to tactile wading bird species breeding in the Everglades, and 2) the frequency of exceptionally large WHIB breeding events (Frederick et al. 2009).

Nest Numbers

Annual nesting effort is assessed using the average nest count from three successive nesting seasons to account for large natural fluctuations in annual nesting effort. The primary indicator species are GREG, WHIB, WOST, and SNEG (Ogden et al. 1997) for mainland Everglades and ROSP for Florida Bay. TRHE originally was included among the mainland species but has proven difficult to monitor during aerial surveys due to its cryptic plumage and tendency to nest below the tree canopy. GREG, WHIB, and WOST exhibited reduced nesting effort in the Everglades during 2020 relative to the decadal average (**Figure 2**), but all three species met their CERP numeric restoration targets based on the 3-year running averages (**Table 1**). In terms of long-term trends, GREG and WHIB have exceeded target counts every year since 1996 and 2000, respectively, while WOST have exceeded their target 11 times since 2000. SNEG nesting effort in 2020 was below the average of the last decade and has not exceeded its target since 1986 (**Table 1**).

The regional declines of *Egretta* herons over the last decade have been particularly acute in the Everglades (**Figure 2**). This year's nesting effort was an improvement compared to recent years but remained considerably lower than historical numbers (approximately 10,000 nests per year for each species). The number of SNEG nests in 2020 (1,127 nests) was slightly below the annual average of the last 10 years (1,362.8 nests), but only about a quarter of the average from 1999 to 2008 (3,948.8 nests). TRHE produced 338 nests, which is almost double the decadal average (183.2 nests) but almost four times lower than the average from 1999 to 2008 (1,297.7 nests). The cause of the sharp declines in *Egretta* nesting has yet to be determined.



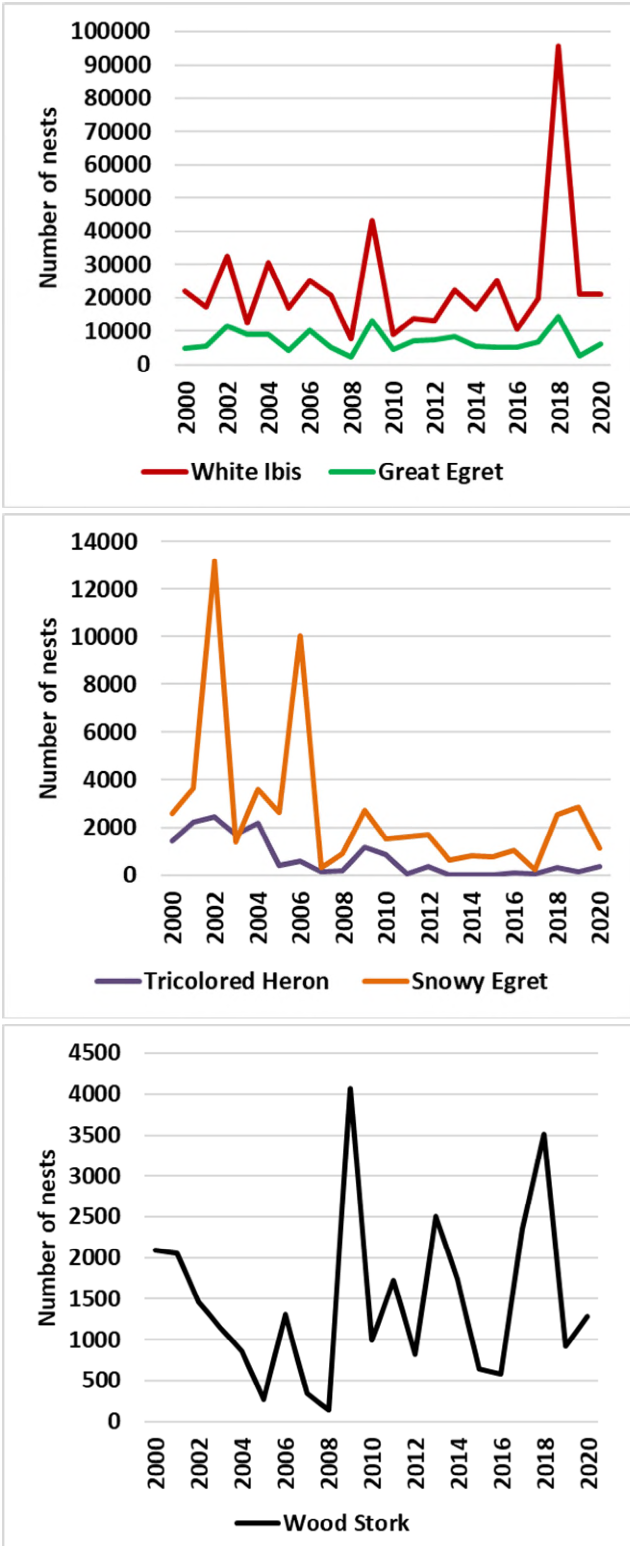


Figure 2. Wading bird nest numbers in the Everglades Protection Area (water conservation areas and Everglades National Park) for individual species from 2000 to 2020.

Table 1. Three-year running averages of the number of nesting pairs for the four indicator species in the mainland Everglades (Provided by: Peter Frederick). Bolded years are those that meet minimum criteria.

Period	GREG	SNEG	WHIB	WOST
1986-1988	1,946	1,089	2,974	175
1987-1989	1,980	810	2,676	255
1988-1990	1,640	679	3,433	276
1989-1991	1,163	521	3,066	276
1990-1992	2,112	1,124	8,020	294
1991-1993	2,924	1,391	6,162	250
1992-1994	3,667	1,233	6,511	277
1993-1995	3,843	658	2,107	130
1994-1996	**4,043**	570	2,172	343
1995-1997	**4,302**	544	2,850	283
1996-1998	**4,017**	435	2,270	228
1997-1999	**5,084**	616	5,100	279
1998-2000	**5,544**	1,354	**11,270**	863
1999-2001	**5,996**	2,483	**1,655**	**1,538**
2000-2002	**7,276**	6,455	**23,983**	**1,868**
2001-2003	**8,460**	6,131	**20,758**	**1,596**
2002-2004	**9,656**	6,118	**24,947**	1,191
2003-2005	**7,829**	2,618	**20,993**	742
2004-2006	**8,296**	5,423	**24,926**	800
2005-2007	**6,600**	4,344	**21,133**	633
2006-2008	**5,869**	3,767	**17,541**	552
2007-2009	**6,956**	1,330	**23,953**	1,468
2008-2010	**6,715**	1,723	**21,415**	**1,736**
2009-2011	**8,270**	1,947	**22,020**	**2,263**
2010-2012	**6,296**	1,599	**11,889**	1,182
2011-2013	**7,490**	1,299	**16,282**	**1,686**
2012-2014	**7,041**	1,017	**17,194**	**1,696**
2013-2015	**6,300**	710	**21,272**	**1,639**
2014-2016	**5,328**	837	**17,379**	995
2015-2017	**5,655**	639	**17,974**	1,195
2016-2018	**8,803**	1,224	**41,465**	**2,152**
2017-2019	**7,966***	1,840*	**44,967**	**2,282**
2018-2020	**7,806**	2,191	**46,347**	**1,911**
Target Minima	4,000	10 – 20k	10 – 25k	1.5 - 2.5k

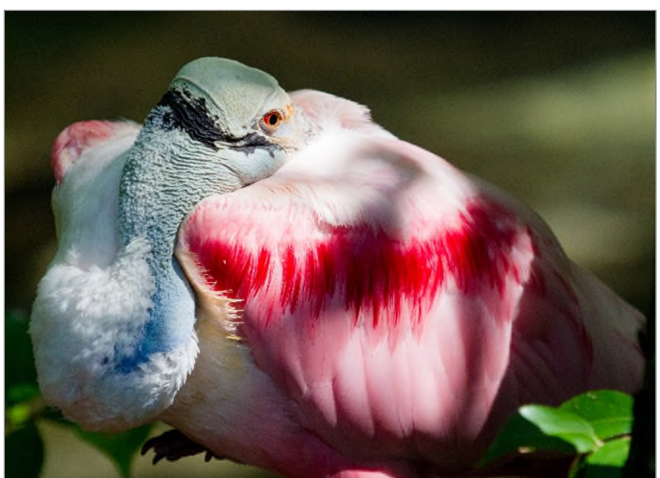
* Average has been corrected as erroneous data were reported for the 2019 report (Volume 25).

In Florida Bay, ROSP produced 203 nests during 2020, which is 73% of the 10-year average (276.5 nests) and only 16% of the target 1,258 nests per year. From a historical perspective, this is only 45% of the 34-year mean (445.8 nests) and far below the mid-20th century nesting effort when more than 1,000 nests per year occurred (J. Lorenz, personal communication). In the WCAs and mainland ENP, ROSP nested in record high numbers (986 nests). This nesting effort is almost double the previous high nesting year of 2018 when 524 nests were recorded, and it is more than four times the 10-year average (226.7 nests).

Spatial Distribution of Nests

The coastal region of ENP historically supported approximately 90% of all nesting wading birds in the Everglades, probably because it was the most productive region of the Everglades ecosystem. During the past 50 years, productivity has declined because of reduced freshwater flows to the coast and nearby marshes, and the location of nesting has shifted to inland colonies in the WCAs or elsewhere in the southeastern United States. An important goal of CERP is to restore the hydrologic conditions that will re-establish prey availability across the southern Everglades landscape, which in turn will support the return of large successful wading bird colonies to the traditional estuarine rookeries. In 2020, ENP supported 27% of nests (25% in the coastal region), while WCA-3A and WCA-1 supported 53% and 20%, respectively. The proportion of nests in the estuarine region in 2020 declined compared to recent years (e.g., 47% in 2019) but remains relatively high compared to the lows of the 1990s and early 2000s (2% to 10%).

The locations of ROSP nesting colonies within the Florida Bay area have shifted in recent years. Most nesting historically occurred on small keys within the bay itself; however, during the past decade many birds have moved to mainland colonies adjacent to the coast (e.g., Madeira Hammock and Paurotis Pond colonies supported 150 nests in 2016, 41% of all nests in the region). However, this year, fewer birds nested at these two colonies (14 nests), and a greater proportion nested on small keys within the bay. Other individuals have deserted Florida Bay entirely. ROSP started nesting in the freshwater Everglades in the early 2000s in very small numbers (fewer than 50 pairs). Since 2010, an average of 220 ROSP pairs have nested at colonies in northern WCA-3A and along the Gulf coast of ENP. This nesting effort increased considerably in 2020, with 986 nests found in Everglades colonies.



Mark Cook

Timing of Nesting

WOST nesting success is highly dependent on the availability of aquatic prey (fish), which are easy to find and feed upon when concentrated at high densities in shallow water during the dry season (winter-spring), but are not available in the wet season (summer-fall) when they move into deeper waters and disperse across the landscape. To successfully fledge their young, WOST require a continuous supply of abundant and concentrated fish throughout the reproductive period. WOST have a relatively long reproductive period (approximately 4 months), so 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 when fish availability declines. WOST nesting historically started in November or December; however, since the 1970s, nesting initiation gradually has shifted to January to March (Ogden 1994). This delay is associated with reduced nesting success (Frederick et al. 2009) and is thought to occur because of a reduction in the amount and quality of the high-elevation (short-hydroperiod) wetlands that provide foraging habitat early in the nesting season. In 2020, WOST nesting started relatively early, with a possible first lay date in mid-January. While this is a little later than the December/early January start dates from 2017 and 2018, it is considerably earlier than in 2016 (late March) and 2015 (early February).

ROSP in Florida Bay also have exhibited a recent shift towards later nesting. For more than 70 years (1936 to 2009), ROSP nest initiations in the northeast region of the bay consistently fell between October 1 and December 31. However, as of 2010, nesting began to start increasingly later in the season; from 2010 to 2014, nesting started between January 1 and 10; in 2015, it began on January 24; and in 2016, it began on February 5, the latest start date ever recorded. Moreover, the timing of laying appeared to be getting considerably more asynchronous both within and among colonies. While nest initiations within the bay historically would span a few weeks, lay dates during the past 2 years have extended from January through April. These changes in the phenology and synchrony of nesting might suggest that the timing of optimal foraging conditions for ROSP is changing both temporally and spatially within Florida Bay. However, 2017 and 2018 were notable for a complete reversal of this trend, with most nest initiations starting in November/December. In 2019 and 2020, nest initiations in the northeast region of the bay were relatively late again, with the first eggs laid in early January and laying continuing through March. The reasons for these patterns are unclear, but they likely relate to changes in where and when optimal foraging conditions become available, possibly as a result of sea level rise (see *Roseate Spoonbill Nesting in Florida Bay* section).

Reproductive Success

Nest success of CERP indicator species in the Everglades often is low and highly variable in time and space, with average probabilities of fledging at least one offspring ranging between 35% and 49% for the four indicator species (derived from 2010 to 2015 data). During 2020, the University of Florida monitored nest success (probability of fledging at least one nestling, Mayfield method) at 401 nests. Nest success was quite consistent throughout the season but varied considerably by species; GREG (P=0.667; SD=0.034), small heron (SMHE; P=0.788; SD=0.040), WHIB (P= 0.504; SD=0.038), WOST (P=0.468; SD=0.0742), and ROSP (P=0.799; SD=0.093). Foraging conditions were moderate for much of the nesting season, but the availability of prey ended early and abruptly after a significant rainfall event caused a reversal in water level in early May. At this point, many ROSP, GREG, and WHIB nests had fledged their young, but most WOST nests contained older nestlings that were just a week or two from fledging. District survey flights of WOST colonies in the weeks after the reversal revealed that all these remaining WOST nestlings died because of the subsequent loss of food. In total, only about 5% of WOST nests fledged young (see *Water Conservation Areas 2 and 3, and A.R.M. Loxahatchee National Wildlife Refuge* section).

Role of Hydrology and Food Availability on Nesting Patterns

The most important process affecting wading bird nesting in the Everglades is the availability of prey (fishes and aquatic invertebrates). Prey availability is a function of prey production (the amount and size of prey animals) and vulnerability to capture by birds, with both components strongly affected by hydrologic conditions (Frederick and Ogden 2001, Herring et al. 2011). In a hydrologically fluctuating wetland such as the Everglades, prey production is influenced largely by the duration and frequency of wetland flooding and drying, with optimal conditions for population growth varying by species. Most fish populations peak after extended periods (multiple years) of relatively deep, flooded conditions over extensive areas of wetland (Trexler et al. 2005), while some invertebrate populations grow best during moderate hydroperiods punctuated by periodic dry conditions (Dorn and Cook 2015).

A particularly important prey group in the Everglades are the crayfish, which are critical for fueling WHIB nesting colonies (Boyle et al. 2014). Crayfish populations are strongly limited by predatory sunfishes such as warmouth that eat the small (young-of-the-year) juveniles. Once crayfish grow beyond a certain size, they are less sensitive to this fish predation. During periodic dry conditions, predatory fish populations decline, but crayfish can survive in their burrows until the rains return and water levels rise again during the wet season. At this point, adult crayfish emerge and release their young into a marsh habitat that is largely free of fish predators, allowing for a temporary (1 to 2 years) boost in crayfish populations (Dorn and Cook 2015).

Prey vulnerability to capture is determined largely by water depth and whether the water level is rising or falling. Prey become easiest to capture during drying conditions when water levels decline to depths at which birds can forage effectively (5 to 30 cm) and the areal coverage of water shrinks such that prey become concentrated at relatively high densities (Gawlik 2002, Cook et al. 2014). Conversely, prey vulnerability declines when water levels rise and concentrated prey can disperse into the marsh. Prey availability, therefore, is naturally variable among years depending on antecedent and current water conditions. Accordingly, wading bird nesting effort and success fluctuate considerably from year to year.

From a prey production perspective, the 2020 nesting season was preceded by generally dry conditions (below average stages from July to October 2019) over relatively large areas of the ecosystem. Wet season water levels generally peaked early, though those peaks were lower than average, and by the start of the nesting season in December 2019, depths were below to considerably below average, depending on the region. This led to relatively short hydroperiods and a small spatial extent of flooded habitat, which limited prey (fish and crayfish) production across the Everglades landscape, particularly in critical foraging habitats of the higher elevation marshes (marl prairies in ENP and Big Cypress Basin) that currently tend to be over-drained. WCA-3B and ENP were the exceptions to this pattern and retained relatively high or average stages throughout the preceding wet season and early dry season. November 2019 through April 2020 was characterized by a continuous drop in water level across the Everglades landscape that led to relatively dry but moderate foraging conditions throughout. The relatively high stages in ENP coupled with optimal recession rates likely allowed for the early WOST nesting in this area. However, a systemwide, rain-driven reversal event in May 2020, when water levels rapidly increased by more than 1 foot in some regions, led to the almost complete abandonment of the nesting WOST at colonies throughout the Everglades, and moderate levels of abandonment for other species.

Long-Term Trends

To understand the status of wading bird populations and how they are responding to climatic conditions, water management, and restoration efforts, it is important to look beyond the annual fluctuations in nesting responses and instead consider longer-term (decadal and longer) trends in nesting responses. 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 WHIB, WOST, and GREG nests have increased over the past 20 years and appear to frequently meet restoration targets (**Table 1**). Moreover, the interval between exceptional WHIB nesting years has met the restoration target (<2.5 years) for 12 of the past 13 years. There have been some recent improvements in the number of birds nesting at historical coastal colonies, but the proportion remains below the 50% restoration target (25%).

Several measures are not improving and are cause for concern. Despite slight improvements in recent years, the numbers of SNEG, TRHE, and LBHE have been sharply declining (**Figure 2**), and the causes of the declines are unknown. Also, despite improved WOST nesting effort, the late timing of their nesting (with the exception of the last 3 years) has remained relatively static, and their nesting success often is below that necessary to sustain the local population. The ratio of tactile (WOST, WHIB, and ROSP) to visual (herons and egrets) 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.

Mark I. Cook and Michael Baranski
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406
(561) 686-8800 ext. 4539
mcook@sfwmd.gov
mbaranski@sfwmd.gov

Abbreviations

Bird Species: American Flamingo (AMFL, *Phoenicopterus ruber*), 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, *Platalea 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*), Unidentified Small White Herons (SMWH, either Snowy Egret or juvenile Little Blue Heron), Unidentified Small Dark Herons (SMDH, either Little Blue Heron or Tricolored Heron), Small Heron (SMHE)

Regions, Agencies, and Miscellaneous: Arthur R. Marshall (A.R.M.), chicks per nest (c/n), Charlotte Harbor Aquatic Preserves (CHAP), Comprehensive Everglades Restoration Plan (CERP), Corkscrew Regional Ecosystem Watershed (CREW), Corkscrew Swamp Sanctuary (CSS), Estero Bay Aquatic Preserve (EBAP), Everglades National Park (ENP), Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FWC), National Geodetic Vertical Datum of 1929 (NGVD29), National Wildlife Refuge (NWR), North American Datum of 1983 (NAD83), prey concentration threshold (PCT), Restoration Coordination and Verification (RECOVER), South Florida Water Management District (SFWMD), standard deviation (SD), unmanned aerial vehicle (UAV), Water Conservation Area (WCA), Water Year (WY)

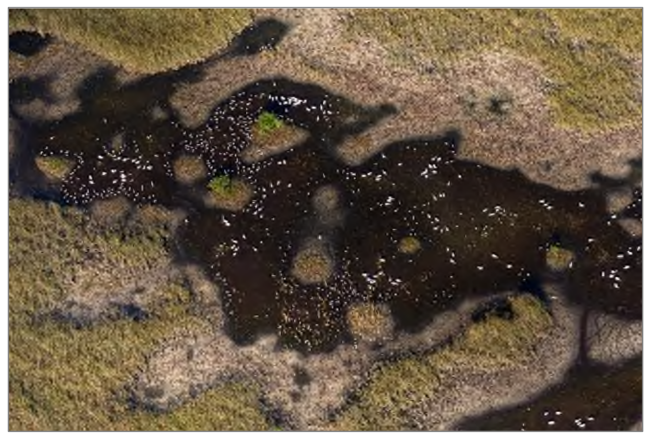
HYDROLOGIC PATTERNS FOR WATER YEAR 2020

WATER CONSERVATION AREAS AND NORTHEAST SHARK RIVER SLOUGH HYDROLOGY

Annual rainfall totals in the Everglades during Water Year 2020 (WY2020; June 2019 through May 2020) were below average historical conditions across all regions, while annual mean stages varied by region in relation to average historical conditions. Rainfall for the year was approximately 6.6 inches below historical averages in Water Conservation Areas (WCAs) 1 and 2, 8.9 inches below average in WCA-3, and 9.6 inches below average in Everglades National Park (ENP). Annual average stage was 0.7 feet above average in WCA-1, 0.4 feet below historical average in WCA-2, and comparable to average in WCA-3 and ENP (**Table 2**).

Figures 3A to **3G** show stage data in the Everglades (WCAs and ENP) during the last 2.5 years relative to historical average stages and ground elevation (in feet National Geodetic Vertical Datum of 1929 [NGVD29]), and also the water level recession rates and depths that support foraging and nesting needs of wading birds. Wading bird foraging habitat suitability is determined by a combination of water depths and recession rates and is divided into three categories (poor, moderate, and good) based on foraging requirements of wading birds in the Everglades (Beerens et al. 2011, 2015; Cook 2014). A green arrow on the hydropattern figures indicates a period of good recession rates and depths for wading birds. A yellow arrow indicates water levels that are too shallow or too deep and/or recession rates that are slightly too rapid or too slow. A red arrow indicates poor conditions resulting from unsuitable depths (too high or low) and/or recession rates (rising or falling too rapidly). The arrows correspond to foraging conditions at a specific gauge and do not represent conditions at the landscape scale. For a spatially explicit representation of the suitability of foraging habitat (habitat suitability indices) as water levels change throughout the nesting season, see **Figures 4A** to **4I**. These habitat suitability index maps represent the suitability of water depths across the Greater Everglades landscape on the first day of each month from October through June. Water depths are categorized to represent conditions that are optimal (green), too dry (brown), or too wet (blue) for wading bird foraging based on the same criteria as above (i.e., Beerens et al. 2011, 2015; Cook et al. 2014), and are calculated at a 400-meter by 400-meter scale using the Everglades Depth Estimation network (https://sofia.usgs.gov/eden/wadingbirds/index.php). The maps reveal how foraging conditions change across the landscape through the nesting season as the ecosystem slowly dries and then rewets at the beginning of the WY2021 wet season.

Water depths in the Everglades at the beginning of WY2020 (June 2019) were generally at or slightly above historical stages. Thereafter, below-average summer rainfall (the WCAs and ENP received between 75% and 81% of the historical averages; **Table 2**) led to low stages at the peak of the wet season (October 2020) in the WCAs but not in ENP where stages peaked at about a foot above average. The relatively dry wet season conditions in the WCAs with reduced hydroperiods (the duration that water remains above ground elevation) and a small spatial extent of flooded marsh (e.g., **Figure 4A**) likely limited wading bird prey availability because such conditions are associated with decreased fish and crayfish production (Trexler et al. 2005). The WY2020 dry season (November 2019 to May 2020; **Figures 3A** to **3G**) experienced stages close to average or below average across the Everglades and a relatively consistent drydown throughout the dry season that was generally conducive to foraging wading birds (**Figures 4B** to **4I**); however, a large and unseasonal rainfall event in early May 2020 caused a sharp reversal in water level, resulting in above-average stages across all regions of the Everglades (**Figure 4I**). The rapid increases in water levels allowed prey that previously were concentrated at high densities in shallow pools to re-disperse into the wider landscape, thereby severely limiting the birds' access to food resources. Unfortunately, this rainfall event occurred just before the end of the nesting season and resulted in widespread starvation of many nestlings that were only a week or two away from fledging. Regional accounts of hydrologic patterns in WY2020 are summarized below.



Water Conservation Area 1

Water levels in WCA-1 (part of the Arthur R. Marshall Loxahatchee National Wildlife Refuge) at the start of WY2020 (June 2019) were elevated compared to the 25-year daily median (**Figure 3**). Depths rose and fell unevenly through the wet season but remained above the median until September. These above-average depths likely were conducive for aquatic prey production. Stages peaked in November and remained high, with no drop in depth until February, which limited accessibility of prey to birds early in the nesting season (the red arrow in **Figure 3**). Thereafter, through early May 2020, water levels receded at a constant rate, providing excellent foraging conditions, especially in April and May (**Figures 3A**, **4G**, and **4H**). This foraging was cut short before the end of the nesting season by a large rainfall event and subsequent reversal in water levels in early May (**Figures 3A** and **4I**). Wading bird foraging and nesting effort was moderately high, but nest success was low because of the reversal. Nesting colonies of small herons were noted along the eastern boundary of WCA-1 for the second consecutive year and were relatively successful.

Table 2. Average, minimum, and maximum stage (in feet NGVD29) and total annual rainfall in inches for WY2020 compared to historical water depth stages and rainfall.[a] (Average depths calculated by subtracting elevation from stage.)

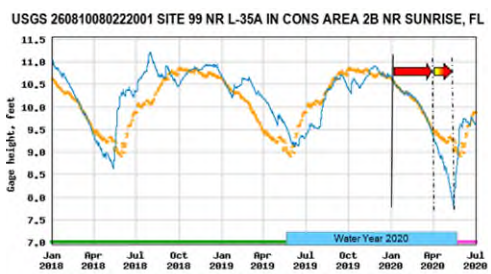
Area	Rainfall (inches)		Mean (min.; max.) Stage		Elevation
	WY2020	Historical/Period	WY2020	Historical/Period	
WCA-1	45.49	52.10 WY1958-WY2019	16.43 (15.58; 16.94)	15.73 (10.00; 18.16) WY1960-WY2020	15.1
WCA-2	45.49	52.10 WY1958-WY2019	12.16 (10.92; 13.26)	12.52 (9.33; 15.64) WY1961-WY2020	11.2
WCA-3	42.63	51.52 WY1958-WY2019	9.56 (8.46; 10.59)	9.62 (4.78; 12.79) WY1962-WY2020	8.2
ENP, Slough at P33	44.81	54.40 WY1942-WY2019	6.25 (5.08; 7.09)	6.05 (2.01; 8.08) WY1952-WY2020	5.1

a. Historical averages are based on varying lengths of records at gauges.

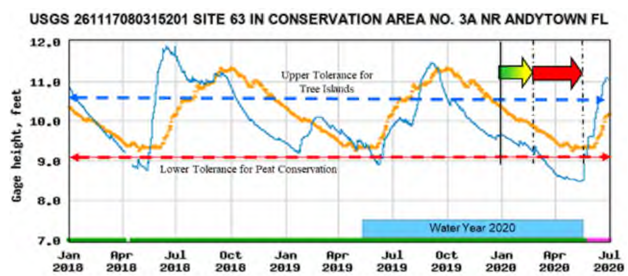
A. WCA-1 – Site 9

B. WCA-2A – Site 17

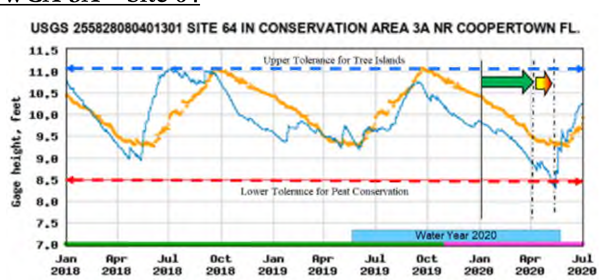
C. WCA-2B – Site 99



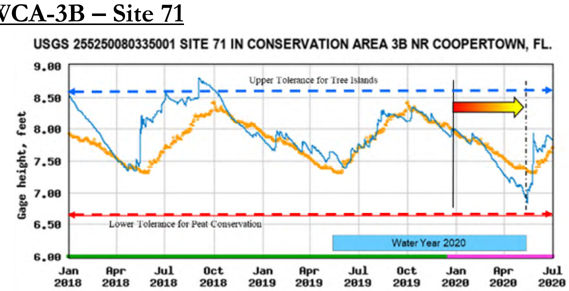
D. WCA-3A – Site 63



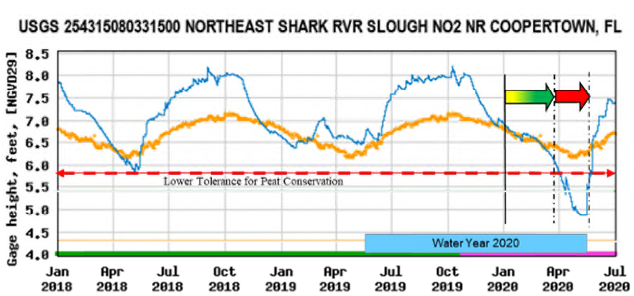
E. WCA-3A – Site 64



F. WCA-3B – Site 71



G. Northeast Shark River Slough



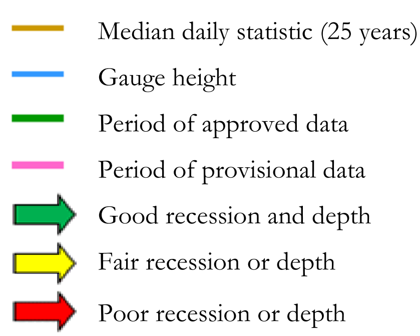


Figure 3. Hydrology in the WCAs and ENP in relation to average water depths (A: 25-year average, B: 25-year average, C: 24-year average, D: 24-year average, E: 26-year average, F: 25-year average, G: 34-year average), and indices for wading bird foraging.

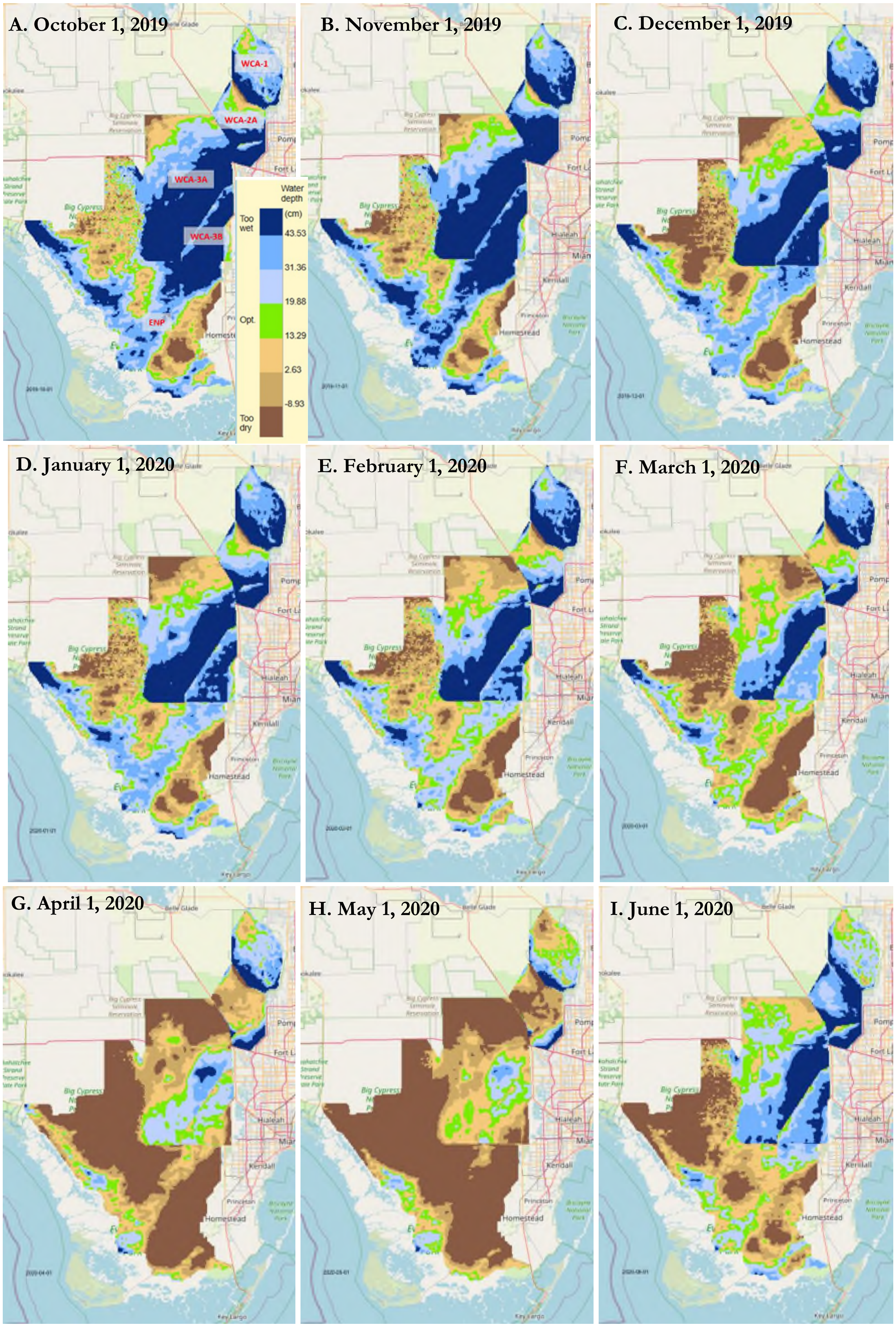


Figure 4. Habitat suitability index maps representing the suitability of water depths for wading bird foraging across the Greater Everglades landscape on the first day of each month from October 2019 through June 2020. Water depths are categorized to represent conditions that are optimal (green), too dry (shades of brown), or too wet (shades of blue) for foraging and are calculated at a 400-meter by 400-meter scale using the Everglades Depth Estimation network.

Water Conservation Area 2A

Stages in WCA-2A at the start of the WY2020 wet season began close to the historical median (**Figure 3B**) and remained close to average depths until a period of unseasonably dry conditions in September. Depths fell well below the median in September but recovered by November with additional rainfall. These conditions were moderate for aquatic prey production. Stages dropped at a relatively constant rate through April, providing excellent foraging conditions in February and March (**Figures 4E** and **4F**). By mid-April, stages were too low for foraging (**Figures 3B** and **4G**) and fell below ground over much of the region, at which point foraging was finished for the year.

Water Conservation Area 2B

Unlike the rest of the Everglades, WCA-2B tends to be too deep for foraging most of the year. During WY2020, water depth at gauge 99 remained close to the historical average until April when it fell almost 1.5 feet below average and provided excellent foraging conditions for a brief time in May (**Figures 3C** and **4H**).

Water Conservation Area 3A

At the start of WY2020 (June 2019) northeastern WCA-3A was relatively dry, with the depth at gauge 63 below the historical median (**Figure 3D**). Thereafter, with the onset of the wet season, the stage rose slowly and peaked in early September. It then fell quickly below the historical median and remained below it for the rest of the water year. The dry conditions were not conducive to aquatic prey production, but the extended water level recession was moderately beneficial for prey accessibility from November to March, after which depths fell too low for foraging (**Figures 4B** to **4F**). Initiation of nesting at the large Alley North colony in WCA-3A depends on relatively wet conditions (target of >9.5 feet at gauge 63 on March 15, the approximate initiation date of White Ibis nesting) because water in the marsh limits predatory mammals (e.g., raccoons) from accessing the colony. This target depth was not achieved, and very few birds nested at this colony in WY2020.

The hydrologic pattern in central WCA-3A at gauge 64 (**Figure 3**) was comparable to that at gauge 63, with stages remaining below the historical median for most of the water year. Stage was well below the median at the start of wading bird nesting season, peaked in mid-September, and then receded through the dry season to early May. The dry conditions did not benefit prey production, but the continuous water level recession was conducive for prey concentration from February to early May, and moderate numbers of birds fed in this region until the large rain-driven reversal event in early May (**Figures 4E** to **4I**).

Water Conservation Area 3B

Water levels at site 71 at the start of WY2020 were close to the historical median (**Figure 3F**). Stages climbed sporadically through the wet season and peaked in August and October, providing moderate conditions for prey production. At the start of the dry season (November 2019), depths were close to average and thereafter fell consistently until May. Optimal foraging depths were available from March through early May (**Figures 4F** to **4H**).

Northeast Shark River Slough

At the beginning of WY2020, water levels in Northeast Shark River Slough were just below the historical average (**Figure 3**). Water levels rose rapidly through the early wet season and peaked in October above 8.0 feet NGVD29, well above the 36-year median. This is the fourth year in a row and only the fifth time in the last 20 years that stage at this location has exceeded that depth (WY2019, WY2018, WY2017, and WY1999). These wet conditions were excellent for aquatic prey production. Water depths slowly declined from November to May, providing excellent foraging conditions across the landscape of ENP throughout the nesting season until the rain-driven reversal in early May. Nesting effort, accordingly, was relatively high compared to other regions of the Everglades, although the reversal led to relatively poor nesting success overall.

Eric A. Cline, Fred Sklar, and Mark I. Cook
Everglades Systems Assessment Section
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406
(561) 686-8800 ext. 6614
mcook@sfwmd.gov

REGIONAL NESTING REPORTS

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

The University of Florida Wading Bird Project continued its long-term monitoring of wading bird reproduction throughout Water Conservation Areas (WCAs) 2 and 3 and Arthur R. Marshall (A.R.M.) Loxahatchee National Wildlife Refuge (also called WCA-1) in 2020. 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 2020 to locate and characterize nesting colonies. Due to the COVID-19 pandemic, systematic aerial flights were halted in March for the remainder of the season. Standardized aerial surveys occurred on or around the 15th of each month from January through March 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 in the photos were counted. Without the usual standardized and comprehensive aerial surveys for the remainder of the season, the reported numbers of nest starts for 2020 should be interpreted as minimums rather than maximums. Individual colony 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 (SFWMD) helicopter surveys staggered by 2 weeks from the University of Florida survey, ground visits, unmanned aerial vehicle (UAV) flights, and inference from observations across the season.

In 2020, a UAV was used to supplement the aerial survey sampling method in WCA-3A during the pandemic. Surveys were conducted over as many well-known active colony locations as possible to obtain maximum nest starts. However, conditions throughout the Everglades were abnormally dry and not all active colonies could be reached. Additionally, UAV flights were conducted over seven colonies in WCA-3A (6th Bridge, Cypress City, Jetport South, Joule, Jerrod, Vacation, and Start Mel) to determine nest turnover and success. A DJI Inspire II quadcopter, fitted with a Zenmuse X7 35-mm equivalent camera lens was used to conduct aerial surveys. Images captured via UAV were from an altitude of 350 feet above ground level, were shot at an angle of 15° from nadir, and included more than 75% overlap in all four directions. The images were stitched together using AgiSoft Metashape software on a 10-core computer and were annotated manually by a single observer using Photoshop or Zooniverse software. Imagery collected by the UAV most likely increased overall detection of wading bird species compared to imagery collected via Cessna due to several factors, including higher-resolution photos, lower flight heights (250 feet above ground level versus 500 feet above ground level), and angle of imagery. In particular, visibility of subcanopy and understory nesting species such as WHIB, *Egretta* herons, and Roseate Spoonbills (ROSP) was much higher in UAV imagery.

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, comprising 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 Herons (LBHE), Tricolored Herons (TRHE), and Great Blue Herons (GBHE).

Table 3. Minimum number of nesting pairs found in A.R.M. Loxahatchee National Wildlife Refuge (WCA-1) during aerial and ground surveys, January through June 2020.

Colony	Latitude	Longitude	GREG	WHIB	WOST	ROSP	SNEG	LBHE	TRHE	SMDH	SMWH	Colony Total
Cook NC4	26.53280	-80.27617	90	3,250	47							**3,387**
Lox 99	26.43822	-80.39053	287	1,200				80	64		240	**1,871**
NO NAME	26.61059	-80.29449									500	**500**
Canal Junction (new)	26.54121	-80.23359					280	5	65			**350**
NO NAME (south of STA-1E)	26.61839	-80.30578									300	**300**
Lox West	26.55014	-80.44268	80	12		13	12	18	14		80	**229**
Lox Ramp/011	26.49511	-80.22533	61	7		4	37	16	9		60	**194**
NO NAME	26.5729	-80.2745	180									**180**
Yamir	26.57228	-80.27217	170									**170**
6	26.61526	-80.30763						27	3		130	**160**
Yew	26.55737	-80.25987					45	40	20		40	**145**
Canal N	26.55993	-80.24871					7	11	3	18	40	**79**
Lox 73/Tyr	26.37187	-80.26597	57									**57**
Colonies >50 nests			925	4,469	47	17	381	197	178	18	1,390	**7,622**
Colonies <50 nests*			6	0	0	0	0	0	0	0	0	**6**
Total by Species			**931**	**4,469**	**47**	**17**	**381**	**197**	**178**	**18**	**1,390**	**7,628**

Note: GBHE, GLIB, BCNH, CAEG, YCNH, and ANHI were not observed (count = 0).
* Includes count of wading bird nesting pairs from ground surveys.

Table 4. Minimum number of nesting pairs found in WCA-2 and WCA-3 during aerial and ground surveys, January through June 2020.

Colony	WCA	Latitude	Longitude	GREG	WHIB	WOST	ROSP	SNEG	GBHE	LBHE	TRHE	BCNH	SMDH	SMWH	ANHI	Colony Total*
Rhea	2	26.23782	-80.31280	325	500		3	20		20				50		**918**
6th Bridge	3	26.12428	-80.54148	728	9,500		627	201	31	+	+	+		1,301	+	**12,388**
Nanse	3	26.10715	-80.49802	428	44		20	67	22	+	+	+	20	25	+	**626**
Horus	3	25.96052	-80.57207	485					113						+	**598**
Jetport South	3	25.80510	-80.84902	154		275	7		1							**4337**
Cypress City	3	26.12410	-80.50440	237		36	72		23						+	**368**
Joule	3	26.01230	-80.63233	285		14			2						+	**301**
Vulture	3	26.02765	-80.54106	211	65		6	5						10	+	**297**
Enki	3	25.86842	-80.80663					189		60						**249**
Jerrod	3	26.00012	-80.59513	167			1	11	24			+			+	**203**
Alley North	3	26.20132	-80.52873	89			65									**154**
485	3	25.92521	-80.77935		17			50		45	35					**147**
Jupiter	3	26.01557	-80.56272	95					15							**110**
487	3	25.93638	-80.78196					55		45	10					**110**
436	3	25.92014	-80.79869					25		75	3					**103**
Forseti	3	25.88681	-80.70217	75					1							**76**
Start Mel	3	25.94812	-80.63816	72					2						+	**74**
Enlil	3	25.87414	-80.65365	64					7						+	**71**
Henry	3	25.81913	-80.83983	40			25									**65**
Hidden	3	25.77353	-80.83722	62			1									**63**
800	3	25.88699	-80.70177	55	2							1			5	**58**
434	3	25.921854	-80.79305					8		45	6	1				**60**
Vacation	3	25.91565	-80.63022	50					9						+	**59**
422	3	25.90926	-80.80518					15		35	4					**54**
423	3	25.91284	-80.80738					12		30	10					**52**
Colonies >50 nests				3,622	10,128	325	827	658	250	355	68	2	20	1,386	5	**17,641**
Colonies <50 nests**				190	50	8	0	6	219	27	12	1,725	0	1	380	**2,238**
Total by Species				**3,812**	**10,178**	**333**	**827**	**664**	**469**	**382**	**80**	**1,727**	**20**	**1,387**	**385**	**19,879**

Note: GLIB was present but not counted at the 6th Bridge colony only. CAEG and YCNH were not observed (count = 0).
+ Present but not counted.
* Excludes ANHI.
** Includes count of wading bird nesting pairs from ground surveys.

RESULTS

Monitoring during the 2020 spring was strongly impacted by the COVID-19 outbreak. Because of distancing rules, the University of Florida field team was unable to accomplish systematic manned flights after March. Despite several near-collapses due to contact rules, the field team was able to monitor nesting via drone and ground surveys. Together with aerial surveys accomplished by Mark Cook of the SFWMD, monitoring of total nest starts and detection of colonies is presumed to be very close to the standards of previous years.

Nesting Effort

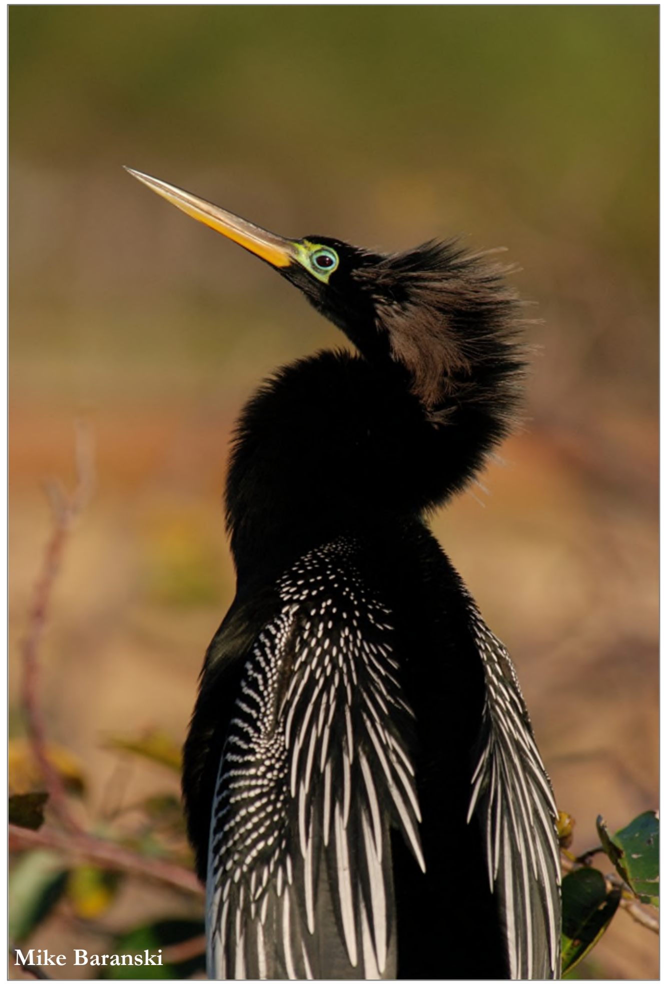
An estimated minimum of 27,507 wading bird nests were initiated at colonies within WCA-1, WCA-2, and WCA-3 in 2020 (**Tables 3** and **4**). This is considered a relatively comprehensive overview of nesting effort in the WCAs despite the lack of systematic aerial surveys due to COVID-19. However, 100% coverage was not achieved; therefore, reported nesting numbers must be considered minimums.

The total estimated number of nests was 1.10 times the 10-year average nesting effort and 0.83 times the average of the last 5 years, suggesting this was an average nesting event. While minimum nesting efforts by all species individually were just above or below the 5- and 10-year averages, nesting effort for ROSP (844 nests) were at least 5 and 6.2 times the 5- and 10-year averages, respectively, and the highest nesting effort for ROSP in the last 20 years. This follows the trend of increasing nesting effort by ROSP in the WCAs. Most nesting ROSP were located in the largest mixed colony in WCA-3 this season (6th Bridge, 627 nests) and accounted for much of this difference. However, much higher detection rates of ROSP via high-quality UAV imagery (compared to traditional aerial surveys) may influence this. Even so, large numbers of ROSP were observed nesting in colonies from the ground.

Numbers of nesting WOST were 73% and 94% of the 5- and 10-year averages. In addition to historical locations (Jetport South), WOST initiated nesting in the northern portion of WCA-3A in Joule and Cypress City. WOST were also observed nesting for the first time in WCA-1 (Cook NC4). WHIB nesting effort was at least 86% of the 10-year average. On the heels of the banner nesting season of 2018, WHIB 5-year average nesting effort was slightly lower at 64%. GREG nesting effort was at least 1.05 and 1.04 times the 5- and 10-year average, respectively.

This season showed a continued long-term trend of decreased *Egretta* heron nesting effort, with 44 TRHE and 262 LBHE nests observed during systematic ground surveys. Compared to average nesting between 1996 and 2007, the average number of nests between 2007 and 2020 was reduced by 78% for LBHE and 84% for TRHE. However, there was an uptick in LBHE nesting effort in 2020, with 1.8 times the 5- and 10-year averages, but still far below the overall average. While few TRHE nests were observed during systematic ground surveys, nesting TRHE were observed in large mixed colonies, including 6th Bridge and Tamiami West. These patterns 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. However, large numbers of nesting LBHE were observed in WCA-1, where SNEG also nested in higher numbers. Competing predictions about the declines are being addressed, such as a decline or shift in prey base composition, displacement by Black-crowned Night Herons (BCNH), or movement to coastal colonies. BCNH are likely to be a predator on nestlings of *Egretta* herons and have been increasing as nesters, roosters, and foragers over the past 10 years. BCNH were observed in the highest numbers to date, with 1,730 individuals observed (2.4 and 2.7 times the 5- and 10-year averages, respectively) during systematic ground surveys in 2020.

Reproductive Success



Nest success was monitored at six colonies, including one in ENP (Tamiami West) and five in WCA-3 (6th Bridge, Joule, Jerrod, Henry, Start Mel, and Vacation). Individual nests of GREG (n = 205 at six colonies), WHIB (n = 183 at Tamiami West and 6th Bridge), WOST (n = 41 at Tamiami West), ROSP (n = 33 at 6th bridge and Henry), BCNH (n = 28 at 6th Bridge and Tamiami West) and *Egretta* herons (n = 116 at Tamiami West and 6th Bridge) were monitored during ground-based nest checks every 5 to 7 days throughout the season.

Systemwide nest success (P; probability of fledging at least one young, Mayfield method) showed considerable variation by species; GREG (P = 0.667; SD = 0.034), *Egretta* herons (P = 0.788; SD = 0.040), WHIB (P = 0.504; SD = 0.038), WOST (P = 0.468; SD = 0.0742), BCNH (P = 0.344; SD = 0.010), and ROSP (P = 0.799; SD = 0.093). Nestling success (53% to 89%) was slightly higher than incubation success (47% to 88%) across species and colonies, suggesting conditions remained constant throughout the nesting period. Initial low water levels followed by a relatively dry season resulted in late initiation of nesting for some species, including GREG and WOST. GREG and WOST began nesting in mid-March, at least a month later than normal for GREG and one of the latest initiations on record for WOST. While conditions remained favorable throughout much of the nestling stage for most species, the onset of the rainy season in mid-May resulted in a large water level reversal. WOST nestlings were at the cusp of fledging at that point, and post-fledgling survival was probably poor. ROSP and *Egretta* heron overall success was high, and most young of these species fledged before rains began. ROSP nesting effort was asynchronous compared to other species, and some fledglings were observed during initial ground visits to colonies in early March.

Peter Frederick, Morgan Earnest, and Lindsey Garner
Department of Wildlife Ecology and Conservation
University of Florida
P.O. Box 110430
Gainesville, FL 32611
(352) 846-0565
pfred@ufl.edu
skmorgane@ufl.edu
lagarner@ufl.edu

EVERGLADES NATIONAL PARK

MAINLAND

This summary report addresses wading bird colony monitoring within the slough and estuarine areas of Everglades National Park (ENP) using data collected during the 2020 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 for wading bird nesting colonies in ENP are as follows:

- Collect data on locations of wading bird colonies, numbers of nests, timing of nesting, and nesting success.
- 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

Airplane and helicopter surveys of known colony locations were conducted by park staff from January to February 2020. Flight dates were January 17 and February 3 and 25. Park-operated flights were suspended in mid-March due to the COVID-19 pandemic.

The South Florida Water Management District (SFWMD) conducted helicopter surveys of the major colonies in ENP from January to June 2020. SFWMD flight dates were January 8; February 5; March 27; April 3; May 8; and June 5, 19, and 26. Flight altitude was maintained at 600 to 800 feet above ground level during all surveys. During each flight, visual estimates of nest numbers by species were made and photos were taken using a digital SLR camera with a 100-400mm lens. Photos were compared to visual estimates to determine nest numbers, nesting stage, and species composition.

Systematic reconnaissance colony surveys were conducted on March 5, 6, and 11 across slough and estuarine habitat within ENP to locate new colonies. Usually, this flight is conducted in April because the White Ibis (WHIB) colonies become active at this time; however, it was conducted early this year due to the uncertainty of future operations during the COVID-19 pandemic. Two observers, one sitting on each side of a Cessna 206 high-wing float aircraft, searched for colonies along 20 established transects oriented east to west and spaced 1.6 nautical miles apart. Flight altitude was maintained at 800 feet above ground level throughout the survey. Coordinates of colony locations were recorded, and photos were taken of colony sites. Species monitored included Great Egret (GREG), Wood Stork (WOST), WHIB, Snowy Egret (SNEG), Roseate Spoonbill (ROSP), Tricolored Heron (TCHE), and Little Blue Heron (LBHE).

RESULTS

An estimated 10,138 wading bird nests were initiated in ENP (**Table 5**). This effort did not approach the considerable nesting event observed during the 2018 nesting season (44,688 nests), but it continues the pattern of increasing nesting effort in ENP relative to recent decades, and it is only the sixth year in the last 20 when total nests for ENP have exceeded 10,000 nests. The bulk of nesting birds were WHIB, which were located at five colony sites. A total of 16 wading bird colonies were active this season compared to 37 in 2018 (**Figure 5**). Of the 16 colonies, 7 were transient smaller GREG colonies located in Shark River Slough. An additional four colonies were inactive in 2020.

WOST and GREG started nesting in late January or early February, which is slightly later than the December and early January nesting starts of recent years. A rainfall event and subsequent water level reversal in early February caused abandonment of many of the first cohort of WOST nests; however, many WOST nested shortly thereafter (perhaps some re-nested), for a peak count of 912 nests. Many nests produced two to three healthy nestlings, but the vast majority (approximately 95%) failed just prior to fledging after a heavy rainfall and water level reversal event in mid-May. By contrast, many of the GREG nests fledged their young prior to the May rain event and were largely successful.

As is typical, WHIB made up the bulk of nesting birds in ENP this season (6,350 nests). They were first seen roosting at Cabbage Bay on February 25, but no nests were observed there until late March. Nesting effort remained limited (fewer than 500 nests) until early May when nesting started at the Alligator Bay and Rookery Bay colonies and increased considerably at Cabbage Bay. By early June, large numbers were nesting at Alligator Bay and had started at Otter Creek. Nesting success appeared to be mixed, depending on the timing of nesting in relation to the May water level reversal event, with birds nesting early and late being relatively successful, while those that nested in early May largely failed.

FLORIDA BAY

ENP staff conduct aerial surveys of most islands in Florida Bay. Audubon Florida conducts ground checks of most islands. Please see the *Nesting Activity of Water Birds on Spoonbill Colony Keys in Florida Bay and Baywide Aerial Survey Results, 2020 Season* section for combined Florida Bay survey data.

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

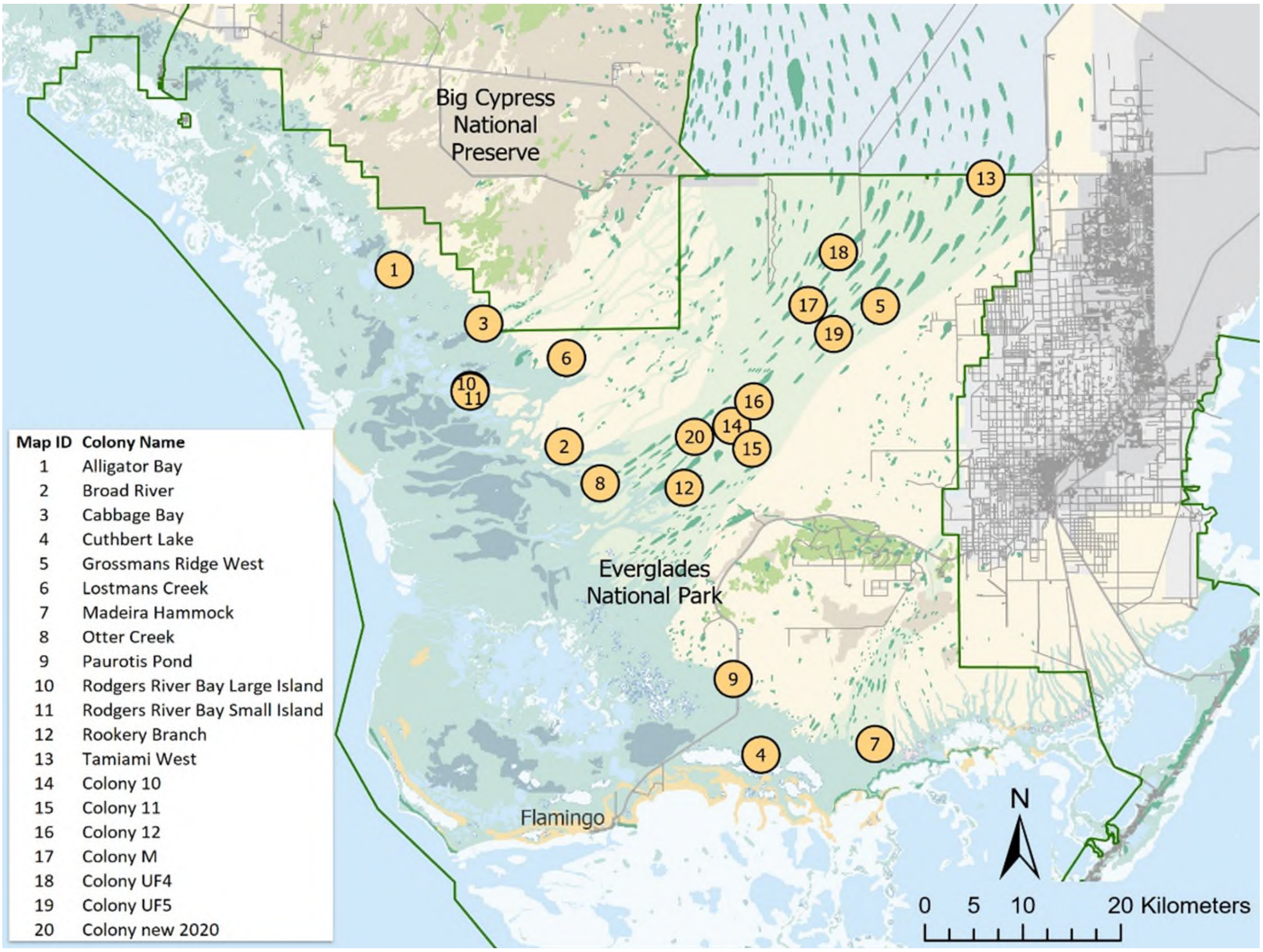


Figure 5. Wading bird nesting colonies in ENP, 2020. **Table 5** contains colony details.

Table 5. Peak numbers of wading bird nests found in ENP colonies from January 8, 2020 through June 26, 2020.

Map ID	Site Name	Latitude	Longitude	GREG	WHIB	WOST	ROSP	SNEG	LBHE	TRHE	SMDH	SMWH	Total
1	Alligator Bay	25.67099	-81.14714	180	1,850			40	1	80	30	620	**2,801**
2	Broad River	25.50292	-80.97440	80		370	40					100	**590**
3	Cabbage Bay	25.62000	-81.05612	250	3,200	240	80	42				400	**4,212**
4	Cuthbert Lake	25.20933	-80.77500	58		22							**80**
5	Grossmans Ridge West	25.63627	-80.65275	20									**20**
6	Lostmans Creek	25.58723	-80.97204										**0**
7	Madeira Hammock	25.21932	-80.65945										**0**
8	Otter Creek	25.46780	-80.93772	220	820							75	**1,115**
9	Paurotis Pond	25.28150	-80.80300	63		70	10						**143**
10	Rodgers River Bay Large Island	25.55667	-81.06984										**0**
11	Rodgers River Bay Small Island	25.55522	-81.06998										**0**
12	Rookery Branch	25.46356	-80.85256	110	60								**170**
13	Tamiami West	25.75745	-80.54502	270	420	210	12					30	**942**
14	GREG Colony 10	25.52249	-80.80403	2									**2**
15	GREG Colony 11	25.50063	-80.78364	3									**3**
16	GREG Colony 12	25.54569	-80.78167	2									**2**
17	GREG Colony M	25.63739	-80.72625	5									**5**
18	GREG Colony UF4	25.68746	-80.69531	43									**43**
19	GREG Colony UF5	25.60978	-80.70030	4									**4**
20	GREG Colony New 2020	25.51209	-80.84182	6									**6**
	Total			**1,316**	**6,350**	**912**	**142**	**82**	**1**	**80**	**30**	**1,225**	**10,138**

Note: GBHE and GLIB were not observed (count = 0).

ROSEATE SPOONBILL NESTING IN FLORIDA BAY

METHODS

Historically, Roseate Spoonbills (ROSP) have used 61 keys in Florida Bay and three mainland colony sites adjacent to Florida Bay for nesting (**Figure 6**). These colonies are divided into five distinct nesting regions based on the primary foraging locations used by the birds (**Figure 6**; **Table 6**; Lorenz et al. 2002). During the 2019-2020 nesting season (November 2019 through June 2020), complete nest counts were performed on 56 offshore mangrove islands within Florida Bay and three adjacent colony sites. Each colony was entered on foot or by kayak, and all nests were counted.

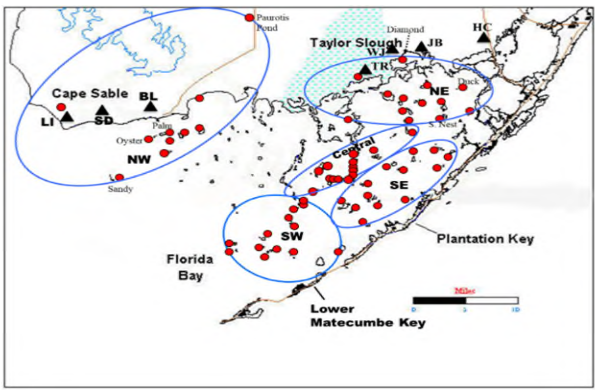


Figure 6. Map of Florida Bay, indicating all current and past ROSP colony locations (red dots), hydrostations (black triangles), and nesting regions (blue circles). Names of active colonies in northeastern and northwestern Florida Bay in 2020 are indicated.

Nest production was estimated using mark-and-revisit surveys. These 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 one chick to 21 days per nesting attempt (c/n). If revisits placed chicks (ROSP or other species) in danger or could not be performed because of logistical reasons (e.g., water levels were too low to access the colony), flighted young of the year (they conspicuously roost in the colony tree tops) prior to fledging from the island were counted, and the maximum observed number was used. Estimates of lay and hatch dates were calculated using the standard 21-day incubation period for ROSPs and age approximations gathered from each revisit survey.

ROSP are an indicator of the overall health of the Florida Bay ecosystem (Lorenz et al. 2009). Results from each region are compared using 1984 as a baseline; 1984 was the year the South Dade Conveyance System was completed, which has direct water management implications on Florida Bay and has impacted ROSP nesting activity within the bay (Lorenz et al. 2002, Lorenz 2014).

RESULTS

Northeast Region

There were three active colonies in the Northeast region this year (Diamond, Duck, and South Nest Keys), producing an estimated 57 nests. This nest total is double last year's effort but below the 5-year mean of 76.8 nests and only 8% of the restoration target of 688 nests (**Table 6**). The 43 nests with known fates yielded an average of 0.81 chicks per nest, with 44% successful at rearing at least one chick to 21 days old. The estimated mean lay date was February 2, and the estimated mean hatch date was March 3, the latest nesting period of all five regions. Unfortunately, data are missing from the Northeast region because COVID-19 regulations interfered with the ability to survey the Madeira Hammock colony. This colony is very difficult to access and requires aerial surveys performed by ENP staff to know when to access the colony. These flights were not performed in 2020, resulting in two ill-timed attempts to access the colony. ROSP were observed at the colony, but it is not known if nesting occurred there this year.

Northwest Region

A total of 66 nests from four colonies (Sandy, Palm, the Oyster Keys, and Paurotis Pond) were observed throughout the Northwest region (**Table 6**). Nesting at these colonies was considerably lower than last year's 202 nests and the restoration target 210 nests. A total of four nests at Sandy Key is the new minimum record for that colony since 1984. Of the 49 nests with known fate, only 35% were successful, the lowest percentage of any region. The estimated production for this region was 0.82 chicks per nest. The mean lay date was December 25, and the mean hatch date was January 15, the earliest nesting effort of all regions. The low nesting performance in the Northwest region was exacerbated by poor nesting success at Paurotis Pond. Fourteen nests were discovered at Paurotis Pond, and their locations were recorded on January 23. The nest survey on February 17 revealed complete abandonment. Only one of the originally marked nests successfully hatched young, but it failed to rear them to 21 days old.

Central Region

The Central region produced a total of 40 nests at five colonies (Central Jimmie, North Jimmie, First Mate, Little Calusa, and South Park Keys), which is comparable to the long-term average of 42.6 total nests and almost double the average from the last 10 years (**Table 7**). An estimated 1.3 chicks hatched per nest (n = 30 nests), the highest hatch rate of all regions this year, and 77% of nests were successful at rearing at least one chick to 21 days old (**Table 6**). In late February, a survey at Little Calusa Key discovered nine recently vacated nests with 18 flighted young perched in nearby mangroves and foraging along the adjoining mud bank. The nests were not successfully monitored, but the total count is significant enough to be included here. These birds were attributed to each nest evenly, and production values were calculated accordingly. The mean lay and hatch dates were closer to the historical nesting period, with both falling in January.

Table 6. Colony locations, production values, and nest timing.

Region	Colony	Latitude	Longitude	# of Nests Observed	# of Nests with Known Fate[1]	# of Chicks to 21 Days	Estimated Production of Chicks to 21 Days per Nest	Estimated Number of Chicks[2]	# of Nests with at Least One Branchling	% Success	Estimated Mean Lay Date	Estimated Mean Hatch Date
Northeast	Diamond	25.23208	-80.56449	34	21	15	0.71	24.3	7	33%	3/10/20	3/30/20
	Duck	25.18011	-80.48931	7	7	8	1.14	8.0	5	71%	12/25/19	1/15/20
	South Nest	25.13783	-80.50871	16	15	12	0.80	12.8	7	47%	1/3/20	1/24/20
	Region Subtotal			**57**	**43**	**35**	**0.81**	**46.4**	**19**	**44%**	**2/12/20**	**3/3/20**
Northwest	Sandy	25.03451	-81.01448	4	4	4	1.00	4.0	2	50%	1/1/20	1/22/20
	Palm	25.11226	-80.87861	45	28	33	1.18	53.0	14	50%	12/22/19	1/13/20
	Paurotis Pond	25.28142	-80.80114	14	14	0	0.00	0.0	0	0%	2/3/20	2/24/20
	Oyster	25.10392	-80.95156	3	3	3	1.00	3.0	1	33%	12/19/19	1/9/20
	Region Subtotal			**66**	**49**	**40**	**0.82**	**53.9**	**17**	**35%**	**12/25/19**	**1/15/20**
Central	Central Jimmie	25.04978	-80.64493	7	7	3	0.43	3.0	2	29%	12/25/19	1/15/20
	North Jimmie	25.06596	-80.64272	5	5	6	1.20	6.0	4	80%	1/2/20	1/21/20
	First Mate	25.02591	-80.64831	10	10	3	0.30	3.0	2	20%	1/9/20	1/30/21
	Calusa (Little)	25.04801	-80.69211	9	0	18	2.00	18.0	9	100%	12/21/19	1/11/20
	South Park	25.10854	-80.56482	9	8	9	1.13	10.1	6	75%	1/15/20	2/5/20
	Region Subtotal			**40**	**30**	**39**	**1.30**	**52.0**	**23**	**77%**	**1/2/20**	**1/22/20**
Southeast	Stake	25.05936	-80.58583	16	16	5	0.31	5.0	5	31%	1/19/20	2/9/20
	Pigeon	25.05600	-80.51150	14	14	10	0.71	10.0	5	36%	1/10/20	1/27/20
	West	24.98439	-80.64946	4	3	3	1.00	4.0	2	67%	3/2/20	3/23/20
	Middle Butternut	25.08322	-80.51419	2	2	4	2.00	4.0	2	100%	12/25/19	1/15/20
	Bottle	25.06602	-80.55628	3	3	4	1.33	4.0	3	100%	12/28/19	1/18/20
	Region Subtotal			**39**	**38**	**26**	**0.68**	**26.7**	**17**	**45%**	**1/17/20**	**2/5/20**
Southwest	South Twin	24.96699	-80.74358	1	1	0	0.00	0.0	0	0%	U/K	U/K
	Region Subtotal			**1**	**1**	**0**	**0.00**	**0.0**	**0**	**0%**	**U/K**	**U/K**
	Total			**203**	**161**	**140**	**0.87**	**176.5**	**76**	**47%**	**1/18/20**	**2/8/20**

U/K = unknown.

[1] Nests with known fates are a subsample of nests chosen within a colony to be marked and revisited to determine if any chicks survived to 21 days post-hatch, when they leave the nest and become branchlings.

[2] Estimated number of chicks fledged per colony is the nest production value multiplied by the total number of nests observed within the colony.

Table 7. Long-term trends in nest counts per region, including minimum, mean, and maximum values since 1984.

Season	Northwest	Northeast	Central	Southeast	Southwest	Florida Bay Total
2009-10	177	41	9	5	1	**233**
2010-11	91	3	3	13	2	**112**
2011-12	178	183	44	29	2	**436**
2012-13	127	188	30	22	0	**367**
2013-14	85	76	19	10	1	**191**
2014-15	173	158	24	4	6	**365**
2015-16	141	189	29	6	2	**367**
2016-17	103	56	13	34	3	**209**
2017-18	140	58	55	23	2	**278**
2018-19	202	24	27	28	0	**281**
2019-20	66	57	40	39	1	**203**
Mean Last 10 Years	134.8	93.9	26.6	19.4	1.8	**276.5**
Mean Last 5 Years	130.4	76.8	32.8	26.0	1.6	**267.6**
Minimum Since 1984	65	3	3	4	0	**112**
Mean Since 1984	**191.9**	**143.3**	**42.6**	**53.5**	**6.5**	**437.1**
Maximum Since 1984	325	333	96	117	35	**880**

Southeast Region

The Southeast region contributed 39 nests this season, with almost all having known fates. While the nest total is only 73% of the average since 1984, the 5-year mean suggests this region's population is stable, with a small increase from last season (**Table 7**). Production was an estimated 0.68 chicks per nest due to unsuccessful nesting efforts at Stake and Pigeon Keys, the region's two largest contributors. The mean lay and hatch dates were January 17 and February 5, respectively.

Southwest Region

The Southwest continues to attract low numbers of nesting ROSP and does not produce many chicks (**Table 6**). This season, a single nest was discovered with one egg laid at South Twin Key on January 9. This solitary nest failed to produce any chicks.

BAYWIDE SYNTHESIS

The 2019-2020 nesting season produced a total of 203 ROSP nests in Florida Bay from 18 colonies. This is a relatively modest nesting effort compared to recent years; it is 73% of the 10-year average (276.5 nests) and only 16% of the target (1,258 nests). Moreover, nesting effort was poor, with the bay-wide estimated 0.87 chicks produced per nest falling well below the target 1.38 chicks per nest.

ROSP nesting success in Florida Bay depends on high prey fish concentrations that result from water levels at or below approximately 13 centimeters in dwarf mangrove habitats (Lorenz 2014). This is referred to as the prey concentration threshold (PCT). The nesting responses from this year reflect that ROSP continued to be adversely influenced by the loss of optimal foraging conditions due to sea level rise, with higher water levels resulting in fewer and shorter prey concentration events. This makes the timing of nesting a critical factor for success. **Figure 7** presents daily mean water levels at four locations north of Florida Bay in what were, historically, the primary foraging grounds for the Northeast region's ROSP (**Figure 6**; Bjork and Powell 1994, Lorenz et al. 2002). **Figure 7** also shows the mean lay dates, hatch dates, and dates chick reach 21 days old at three colonies in the Northeast region (South Nest Key, Duck Key, and Diamond Key). Nesting at South Nest Key was 7 days later than at Duck Key, and the mean hatch date at South Nest Key coincided with a reversal in the drying pattern. Following the first 7 days post-hatch, water levels remained well above the PCT, creating poor foraging conditions, hence the low nesting success at South Nest Key. In contrast, water levels during the first 7 days after hatching at Duck Key were near or below the PCT, and these chicks hatched during more favorable foraging conditions and exhibited higher survival. At Diamond Key, laying occurred much later in the season when water levels were low; however, a reversal in the drying pattern caused water levels to rise well above the PCT for almost the entire 21-day nestling period resulting in low nesting success (**Table 6**). Such differences between keys within the same region demonstrates that PCT levels are being met, but the occurrence is relatively capricious, highly localized, and short lived. Prior to sea level rise and changes to water management practices, drying patterns at foraging grounds were more predictable (Lorenz et al. 2002).

ROSP nesting in northwestern Florida Bay historically foraged in the wetlands of Cape Sable (Bjork and Powell 1994, Lorenz et al. 2002), and three hydrostations located at traditional foraging sites provide insight into the nesting patterns in this region (**Figure 8**). Paurotis Pond was excluded because the colony is too distant from Cape Sable (**Figure 6**). Oyster and Palm keys are located near one other and began nesting just a few days apart (**Figure 8**). Both colonies had a mean hatch date when the two hydrostations close to these colonies indicated favorable foraging conditions. Conditions remained favorable at the closest hydrostation for almost the entire 21-day nestling period. Both colonies had relatively high nest production compared to the other nesting colonies (**Table 6**). Palm Key had higher nesting success than Oyster Key, but this may have been due to the small sample size of nests at Oyster Key. Nesting at Sandy Key, located farther west, began more than a week after Palm Key and Oyster Key (**Table 6**, **Figure 8**). At that time, foraging conditions were favorable but the closest hydrostation to that colony indicated a much more variable hydrologic pattern (**Figures 6** and **8**). Despite having longer foraging flights to find favorable conditions, Sandy Key had similar production to Oyster Key but lower than Palm Key.

During the 2019-2020 nesting season, hydropatterns in local foraging areas provided valuable insight into the productivity and success of ROSP nesting and accounted for why nesting success was higher at the northwestern colonies than in the northeast. In both regions, sea level rise, and possibly water management, appeared to factor into prey availability.

Keven Welsh, Beau Daigneault, and Jerome J. Lorenz
Audubon Florida, Everglades Science Center
115 Indian Mound Trail
Tavernier, FL 33070
(305) 852-5318
jlorenz@audubon.org

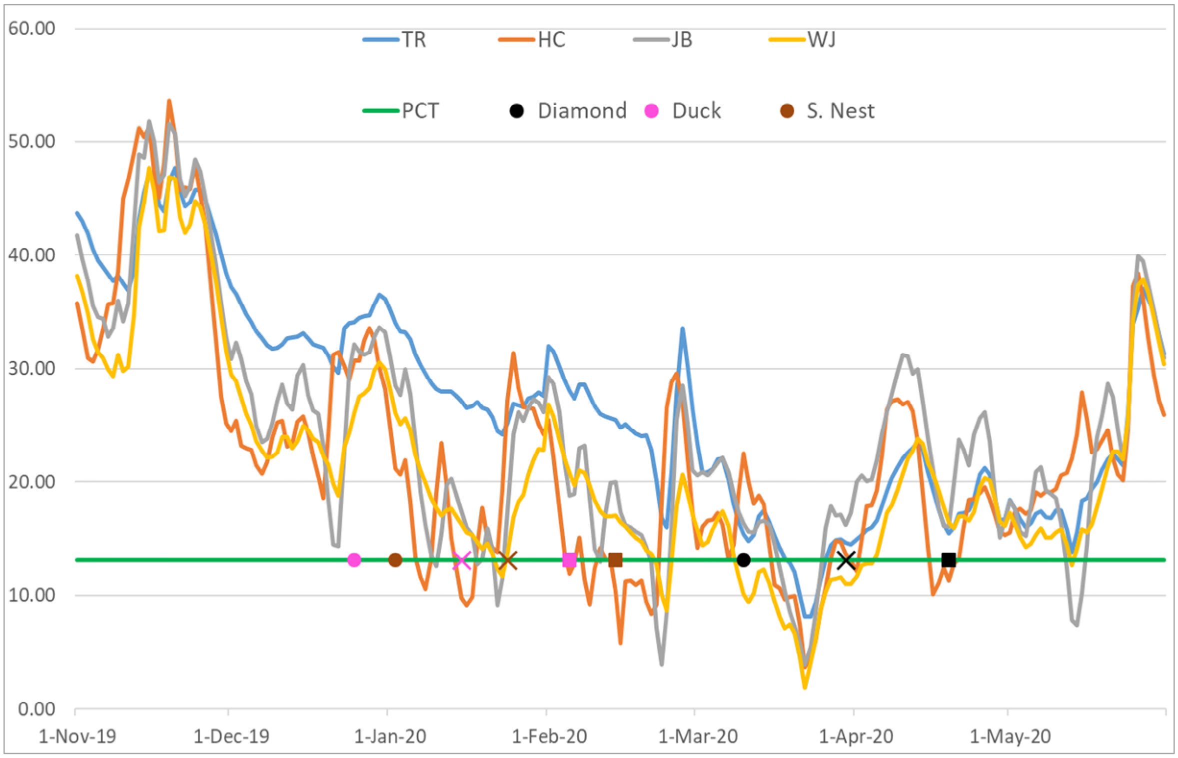


Figure 7. Mean daily water levels at four known foraging sites for ROSP nesting in the Northeast region of Florida Bay. Also depicted is the prey concentration threshold (PCT) and the timing of nesting of the three active colonies in the Northeast region of Florida Bay. Circles represent the mean egg-laying date at each colony, X represents the mean hatch date, and squares represent the mean date that chicks reached 21 days post-hatch.

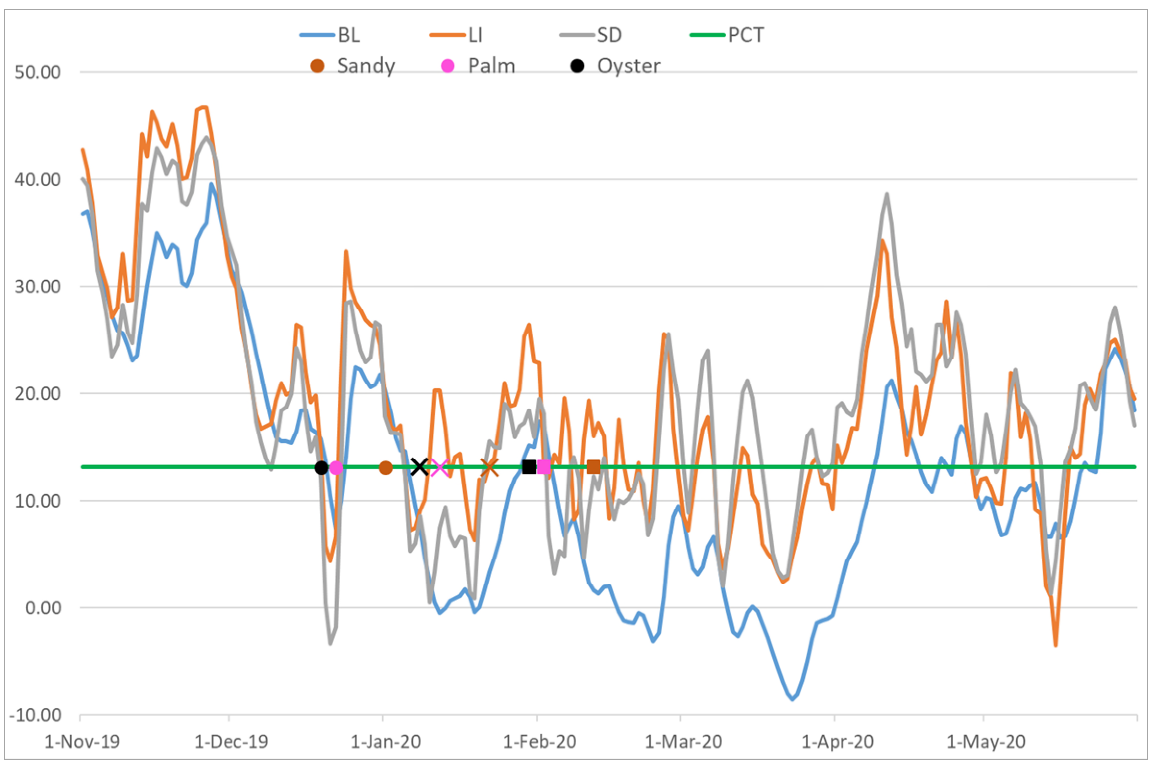


Figure 8. Mean daily water levels at three known foraging sites for ROSP nesting in the Northwest region of Florida Bay. Also depicted is the prey concentration threshold (PCT) and the timing of nesting of the three active colonies in the Northwest region of Florida Bay. Circles represent the mean egg-laying date at each colony, X represents the mean hatch date, and squares represent the mean date that chicks reached 21 days post-hatch.

NESTING ACTIVITY OF WATER BIRDS ON SPOONBILL COLONY KEYS IN FLORIDA BAY AND BAYWIDE AERIAL SURVEY RESULTS, 2020 SEASON

Audubon Florida and Everglades National Park (ENP) staff surveyed nesting water birds in Florida Bay and adjacent habitats. The results of those surveys were combined by selecting the largest nest count for each species for each nesting site regardless of who performed the survey, the survey method, or the time of the survey. Results are presented in **Table 8**.

METHODS

Audubon Florida

While surveying known Roseate Spoonbill (ROSP) colonies throughout Florida Bay, 12 other species of water birds were observed nesting on the islands (**Figure 9**). Attempts were made to count the nests, but 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 ROSP nesting sites on a given key were not searched.

That stated, every effort was made to find all ROSP and Reddish Egret (REEG) nests. Total counts were used when possible, rather than the maximum count on a given survey because REEG timing of nesting is highly asynchronous in Florida Bay (Cox et al. 2017). REEG recently became a species of interest at the state and local level and are now surveyed the same as ROSP (i.e., attempts are made to find all nests and document productivity). The REEG estimates are likely an accurate representation of effort for this species in Florida Bay.

Everglades National Park

Aerial surveys were conducted in Florida Bay on December 16-17, January 13-14, and February 20 and 24 using a National Park Service Cessna 206 high-wing float aircraft. Surveys were not conducted in March and April after the COVID-19 pandemic halted ENP aviation operations through the remainder of the summer. Peak nest counts for wading birds and Brown Pelicans (BRPE) were recorded by island or island group. Nesting Double-crested Cormorants (DCCO) were noted, but nest numbers were not estimated. The survey area included most islands and island groups within Florida Bay.

RESULTS

Table 8 presents the peak nest estimates per species from the combined Audubon Florida's and ENP's surveys. In recent decades, nesting surveys throughout southern Florida have indicated a marked decline in Tricolored Herons (TRHE) (Cook and Baranski 2020); however, Audubon Florida surveys indicate that TRHE are using nesting sites in Florida Bay at relatively high levels in relation to the rest of southern Florida. Furthermore, the number of TRHE foraging in the interior lakes of Florida Bay keys appears to have increased in recent years, compared to what was observed in the early 2000s (J. Lorenz, personal observation). **Table 8** provides the nest estimates for TRHE since surveys began in 2014-2015. The high variability in these data (especially the low count in 2016-2017) reflects the highly variable effort to count nests due to changes in, or lack of, personnel and because of the difference in nest timing between ROSP and TRHE. The ROSP nesting period in Florida Bay prior to 2010 was from November to March or April. Since 2010, ROSP have nested from January to as late as June. The TRHE nesting period in Florida was and continues to be April to July (Powell and Bjork 1990). That being the case, counts tend to be higher when ROSP nested later in the year. In 2019-2020, because of the low numbers elsewhere, a concerted effort was made to survey islands more thoroughly for TRHE and later in the year (though June with one last colony check at Diamond Key on July 9). In 2020, 1,317 nests were observed, which is double the average for the previous 5 years (669.2 nests) and vastly outnumbers the TRHE nests observed throughout the mainland Everglades system in the last several years (Cook and Baranski 2020). These numbers are comparable to those reported by Powell and Bjork (1990) from 1987 to 1990 from the four largest colonies in Florida Bay, which they surveyed through the end of the TRHE nesting cycle in July. These data suggest that the number of nesting TRHE in Florida Bay has not declined as has been observed throughout the rest of southern Florida. A concerted effort to survey the entirety of Florida Bay for the duration of the TRHE nesting season might provide insight into the unexplained declines in this species throughout the rest of the system.

Jerome J. Lorenz, Beau Daigneault, and Kevin Welsh
Audubon Florida Everglades Science Center
115 Indian Mound Trail
Tavernier, FL 33070
(305) 852-5092
jlorenz@audubon.org

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

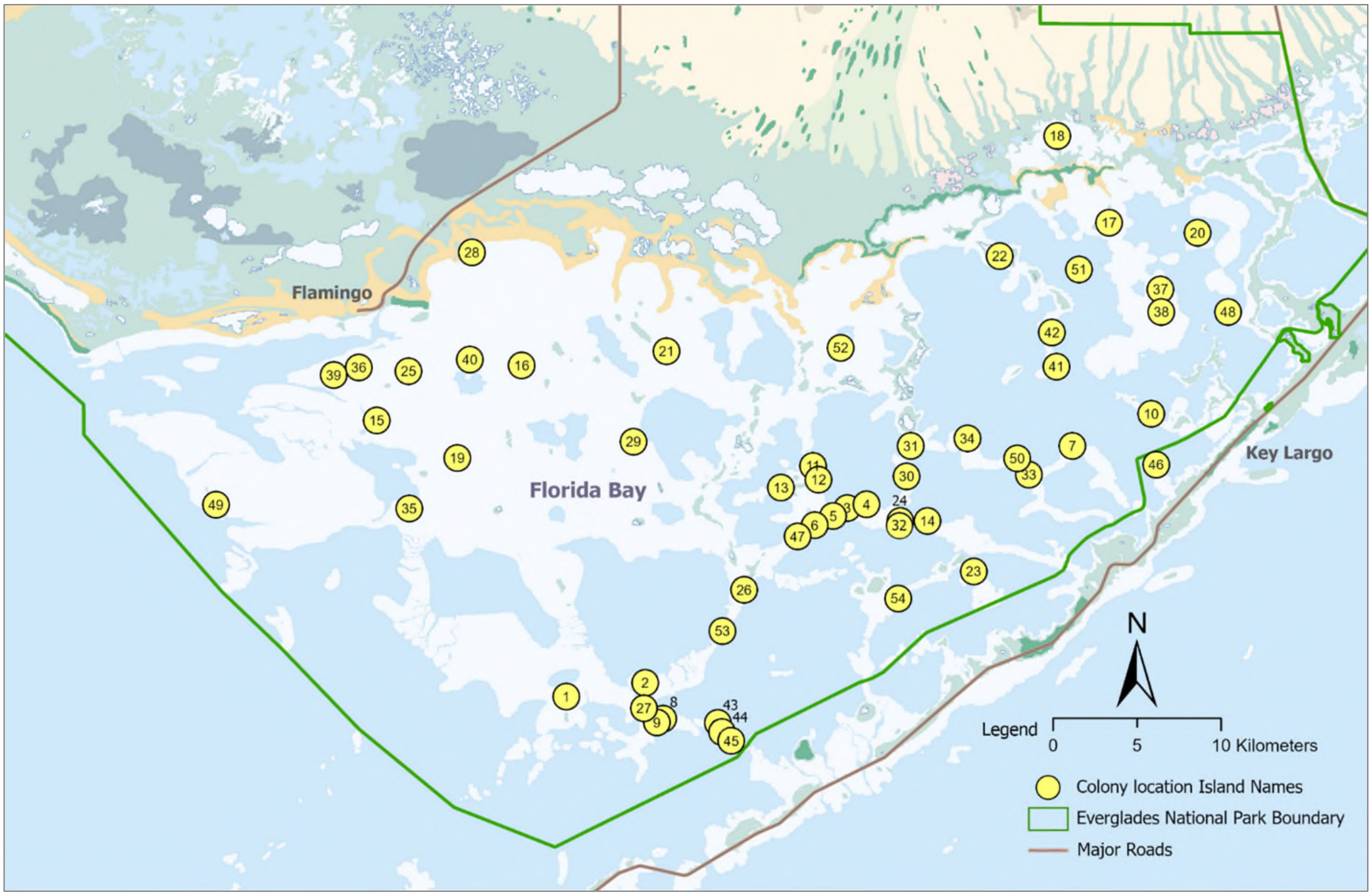


Figure 9. Active nesting colony sites in Florida Bay, 2020. **Table 8** contains the colony names and details.

Table 8. Peak nest numbers found in Florida Bay wading and water bird colonies through April 2020. Underlined numbers are estimates collected by Audubon Florida using ground surveys, while plain text numbers are estimates collected by Everglades National Park from aerial surveys.

Map ID	Colony	Latitude	Longitude	GBHE	GWHE	GREG	REEG	LBHE	SNEG	TRHE	ROSP	WHIB	BRPE	DCCO	ANHI	Total
1	Arsenicker Keys, upper and lower	24.93180	-80.82707													**0**
2	Barnes Key	24.93923	-80.78494		1											**1**
3	Bob Allen Keys, central	25.03279	-80.67685													**0**
4	Bob Allen Keys, east	25.03469	-80.66637													**0**
5	Bob Allen Keys, west	25.02845	-80.68426													**0**
6	Bob Allen Keys, west, small	25.02353	-80.69413													**0**
7	Bottle Key	25.06602	-80.55628								3					**3**
8	Buchanan Keys, east	24.91996	-80.77522										3	4		**7**
9	Buchanan Keys, west	24.91791	-80.77857		2											**2**
10	Butternut Keys, middle	25.08322	-80.51419				2			138	2	52				**194**
11	Calusa Keys, big	25.05542	-80.69512		1		1									**2**
12	Calusa Keys, small island SE of Big Calusa	25.04801	-80.69211								9		13	8		**30**
13	Calusa Keys, west (Bruce Key)	25.04371	-80.71225				7									**7**
14	Captain Key	25.02583	-80.63380		3											**3**
15	Clive Key	25.07971	-80.92849	20	15	25		5	120	250		200	13	150		**798**
16	Cormorant Key	25.10915	-80.85087		13											**13**
17	Deer Key	25.18557	-80.53665													**0**
18	Diamond Key	25.23208	-80.56449			106		1	30	80	34				2	**253**
19	Dildo Key	25.05960	-80.88542	22	42											**64**
20	Duck Key	25.18011	-80.48931				10				7			13		**30**
21	Dump Keys, north and south	25.11678	-80.77342													**0**
22	Eagle Key	25.16779	-80.59527		11		1									**12**
23	East Key	24.99888	-80.60918		5									5		**10**
24	First Mate Key	25.02591	-80.64831		1		1				10			9		**21**
25	Frank Key	25.10609	-80.91138													**0**
26	Gopher Keys, north and south	24.98893	-80.73192													**0**
27	Green Mangrove Key	24.92559	-80.78548											30		**30**
28	HanVan, Gibby Point	25.16966	-80.87754													**0**
29	Jim Foot Key	25.06834	-80.79112													**0**
30	Jimmie Keys, central	25.04978	-80.64493				2			405	8					**415**
31	Jimmie Keys, north	25.06596	-80.64272		1		5				5					**11**
32	Jimmie Keys, south including First Mate	25.02575	-80.64832													**0**
33	Low Key	25.05064	-80.57963		2											**2**
34	Manatee Keys	25.06999	-80.61251													**0**
35	Man of War Key	25.03250	-80.91111													**0**
36	Murray Key	25.10806	-80.93806		15											**15**
37	Nest Keys, north	25.14988	-80.50914													**0**
38	Nest Keys, south	25.13783	-80.50871		1		1				16					**18**
39	Oyster Keys	25.10392	-80.95156		6						3		98			**107**
40	Palm Key	25.11226	-80.87861		1		6		38	103	45					**193**
41	Park Keys, south	25.10854	-80.56482				2				9					**11**
42	Park Keys, north	25.12677	-80.56724													**0**
43	Peterson Keys, north	24.91773	-80.74591													**0**
44	Peterson Keys, central	24.91285	-80.74366		1											**1**
45	Peterson Keys, south	24.90806	-80.73873		2											**2**
46	Pigeon Key	25.05600	-80.51150		4					6	14			59		**83**
47	Pollock Keys	25.01750	-80.70333		2									17		**19**
48	Porjoe Key	25.13777	-80.47305													**0**
49	Sandy Key	25.03451	-81.01448	1	30	6	22		5	121	4	92		70		**351**
50	Stake Key	25.05936	-80.58583		2		3			4	16					**25**
51	Tern Keys	25.16056	-80.55278							210		9				**219**
52	Triplet Key	25.11862	-80.68025		2											**2**
53	Twin Keys, south	24.96700	-80.74357				2				1					**3**
54	West Key	24.98439	-80.64946	1	4						4					**9**
	Total			**44**	**167**	**137**	**65**	**6**	**193**	**1,317**	**190**	**353**	**127**	**365**	**2**	**2,966**

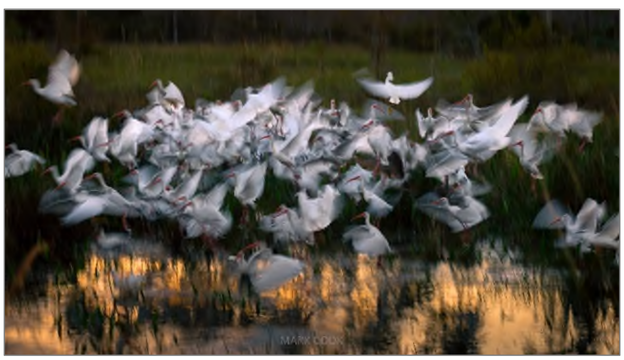
Note: Black-crowned Night Heron and Neotropic Cormorant were not observed (count = 0).

COLONIAL NESTING BIRDS IN BISCAYNE NATIONAL PARK

Nesting colonies of wading birds and seabirds are important indicators of ecosystem health as they respond 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 will suffer and may indicate a problem in the ecosystem. The South Florida/Caribbean Inventory and Monitoring Network of the National Park Service is monitoring colonial nesting birds in Biscayne National Park, and this report summarizes the results for the nesting year July 2019 through June 2020.

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 Cormorants (DCCO), Great Egrets (GREG), Great White Herons (GWHE), Great Blue Herons (GBHE), White Ibises (WHIB), and Roseate Spoonbills (ROSP) (referred to as focal species).
- The annual peak active nest counts of colonial nesting birds in Biscayne National Park for the focal species.
- An annual nesting index (sum of monthly nest counts) for the focal species.
- The timing of peak nest counts for the focal species.



METHODS

The 2019-2020 monitoring process consisted of an annual park-wide survey via helicopter to locate new nesting colonies of wading birds and seabirds within Biscayne National Park coupled with monthly surveys of located colonies that were detected during the annual survey. Two staff members (a photographer and an observer) participated in each survey. As the helicopter circled each island colony, the colony was photographed, and the observer recorded the number of visible nesting and non-nesting birds. Approximately 400 photographs were taken during each survey. The photographs were downloaded to a computer to be analyzed and processed for identification of active nests by species. The identified nests were circled on the processed photographs and then counted.

Peak nest counts were identified for each colony and summed across colonies to calculate the peak nesting year total across the park for each species. "Year" refers to nesting year defined as July through June in the subsequent year. In addition, an annual nesting index was calculated as the sum of 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. The South Florida/Caribbean Inventory and Monitoring Network uses the annual nesting index as well as peak nest counts because some species (e.g., DCCO) nest in all months and peak nest counts alone were considered insufficient to describe the nesting effort. Estimating the true number of nest starts currently is not feasible. This year's peak nest counts and nesting index are compared to the previous nesting years' mean, maximum, and minimum (**Table 9**). Complete methods are described by Muxo et al. (2015).

Colony surveys were conducted each month from July through September 2019 and December 2019 through March 2020. Because of the COVID-19 pandemic, surveys scheduled for April through June were cancelled. The October and November surveys did not occur because of logistical issues. The nine colonies surveyed during the routine monthly flights were: Kings Road Island (25.49250, -80.33861), Mangrove Key (25.39444), -80.31583), West Arsenicker (25.40528, -80.31722), Arsenicker Key (25.39667, -80.28611), Jones Lagoon (25.37194, -80.24111), Ragged Key 5 (25.52722, -80.18972), Ragged Key 4 (25.53040, -80.17234), Soldier Key (25.59027, -80.16139), and Kings Bay (25.6286, -80.30667) (**Figure 10**). Although the Kings Bay colony is located north of the park boundary, it is being monitored because of its proximity to the park. The birds nesting at Kings Bay most likely use the park for resources; therefore, monitoring the colony provides a more complete picture of the colonial nesting birds using Biscayne Bay.

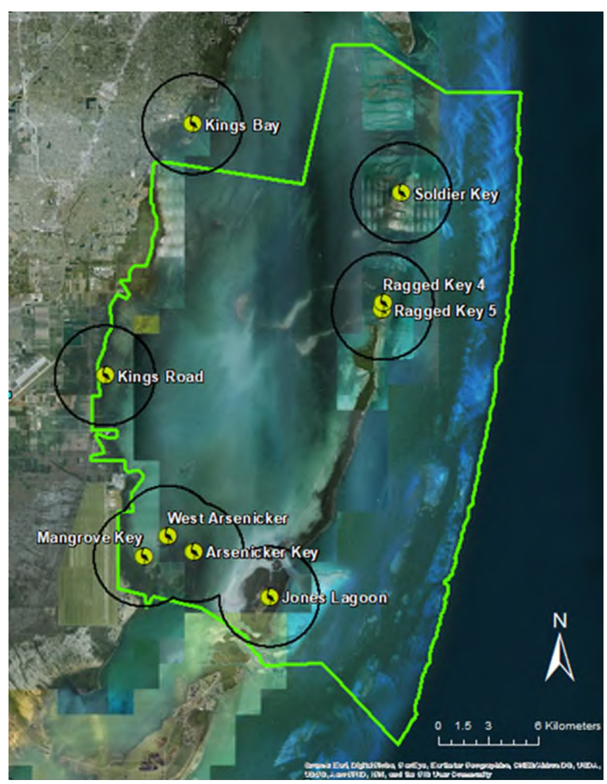


Figure 10. Nine island colonies monitored within Biscayne National Park and the estimated foraging areas.

RESULTS AND DISCUSSION

With the 2019-2020 nesting year, the South Florida/Caribbean Inventory and Monitoring Network completed the tenth full nesting year of monitoring colonial nesting birds in Biscayne National Park. This monitoring season was unusual due to COVID-19 restrictions.

The monitoring results yielded valuable nesting data for documenting species-specific nesting patterns and trends. Survey results are organized by grouping bird species according to their feeding method: diver, stalk and strike, and tactile. Species-specific information is presented with a focus on DCCO, GREG, GWHE, GBHE, ROSP, and WHIB. **Figure 11** shows the species detected on the colonies over the last eight nesting seasons.

The missing surveys make it difficult to compare annual trends in the monitoring data. However, the 2019-2020 nesting data showed a drastic reduction in DCCO nesting over the winter months, December through March (**Figure 12**). This reduction in nesting was greater than that from September through December 2017, following Hurricane Irma. It is difficult to know if this reduction was the total extent of the reductions in nest counts or the nesting index due to the missed surveys.

GREG, GBHE, ROSP, and WHIB also showed reductions in peak nests and nesting indices (**Figure 13**). The reduction of ROSP and WHIB nests may be because the timing of their nesting corresponds with the months not surveyed. The reduction of species nesting on six of nine colonies may also be a result of the missed surveys. The reduction in nesting for these species is not of concern compared to the dramatic reduction in DCCO nesting.

GBHE were detected nesting on three colonies (Jones Lagoon, Mangrove Key, and Soldier Key) this year, compared to six colonies last year (**Figure 11**). Both the peak nest and nesting index measures fell within the range of previous monitoring years for GBHE (**Table 9**). GREG were detected nesting at two colonies (Arsenicker and West Arsenicker), while last year they were detected at Jones Lagoon and West Arsenicker colonies (**Table 9**, **Figure 11**). The minimum nest count (three nests) was one lower than any previous year. This year, GWHE nested on seven of the nine colonies (**Figure 11**). The GWHE peak nest count (38 nests) was below the previous high of 46 nests and above the average of 30.1 nests (**Table 9**).

ROSP were detected nesting on the Arsenicker Key and Jones Lagoon colonies (**Figure 11**). The peak nest number (two nests) is higher than the previous minimum of zero nests but below the mean of five nests. WHIB nesting was detected on only one colony, West Arsenicker (**Figure 11**, **Table 9**). WHIB have consistently nested at West Arsenicker (**Figure 14**) for the past 5 years. The WHIB peak nest count of nine nests (**Table 9**) is a new low, and the nesting index of zero is the lowest nesting index.

Six of the nine colonies showed a reduction in the number of species nesting from the previous season (**Figure 11**). West Arsenicker had eight species last nesting season compared to three species this season, and Jones Lagoon went from six to five species. Mangrove Key and Kings Bay lost two species each, while Ragged Key 5 and Kings Road colonies each lost one. Whether the reduction in the number of species on existing colonies is a result of missing surveys is unknown. Arsenicker Key and Ragged Key 4 maintained the same levels of species, four and two, respectively. Soldier Key was the only colony with an increase in species, going from three to four species. Jones Lagoon and Mangrove Key had the highest number of species, with five each.

Robert Muxo and Dr. Kevin R.T. Whelan
South Florida/Caribbean Inventory and Monitoring Network
National Park Service
18001 Old Cutler Road, Suite 419
Palmetto Bay, FL 33157
(305) 252-0347
Rob_Muxo@nps.gov
Kevin_R_Whelan@nps.gov

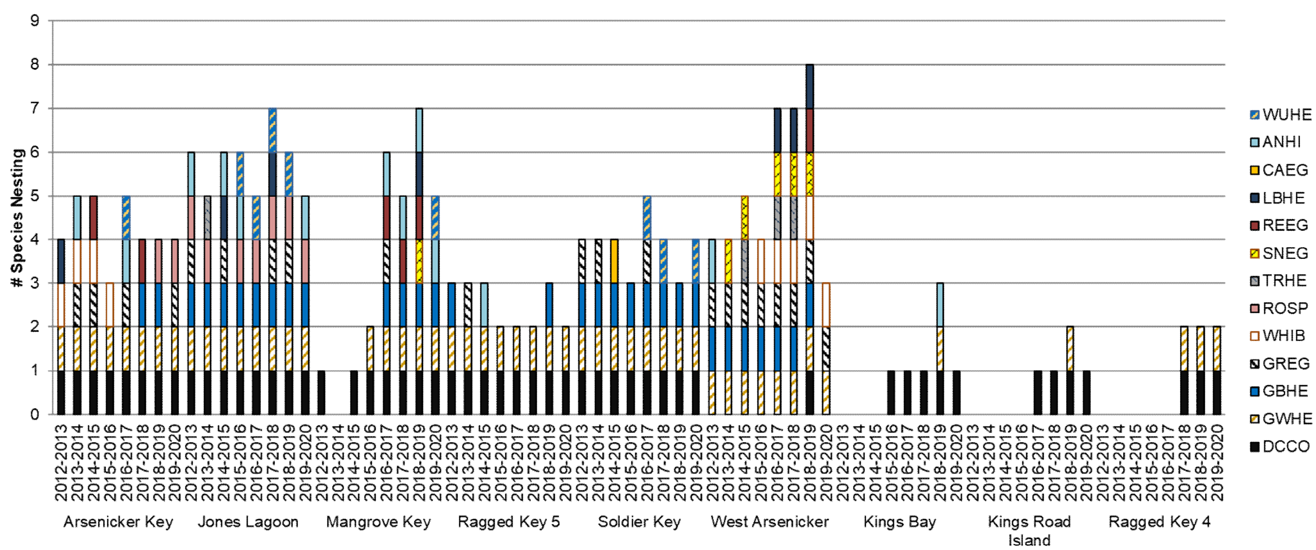


Figure 11. Number of species detected nesting, by colony and year. (Includes all egrets, ibises, spoonbills, and herons.)

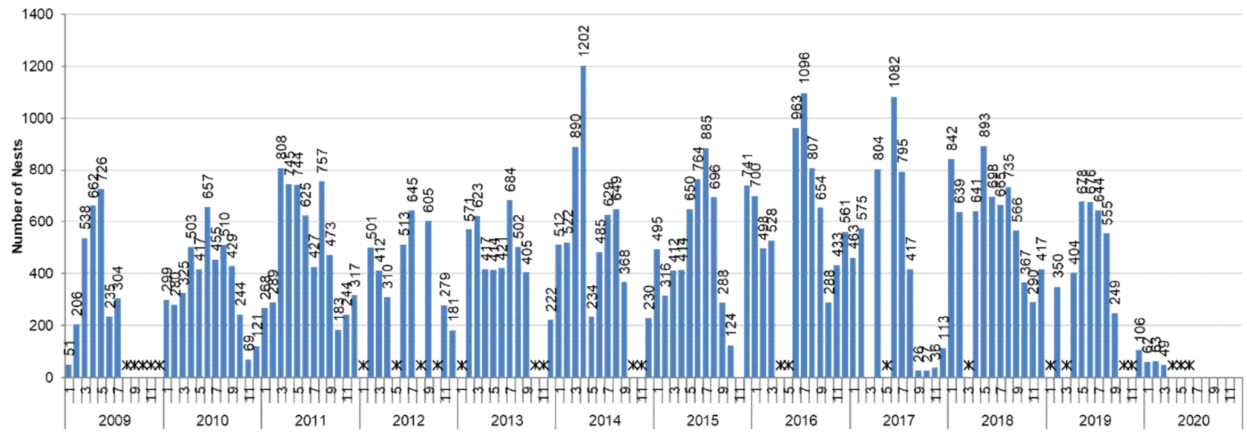


Figure 12. Number of DCCO nests per month. (*Months not sampled.)

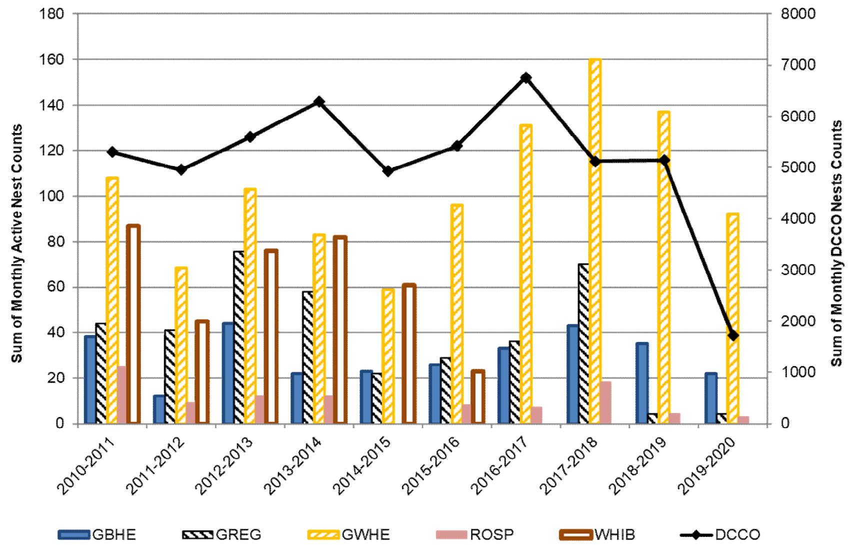


Figure 13. Annual nesting index across colonies, by focal species. The number of nests counted at each colony during each month was summed to create an annual nesting index across all colonies for the six focal species. This number exceeds the actual number of nest starts because a single nest could be counted during two or more monthly visits.

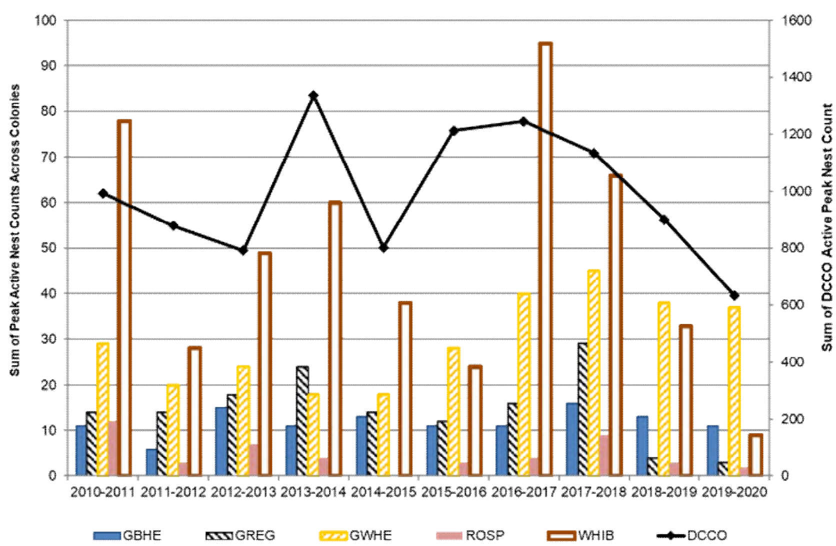


Figure 14. Total of peak active nest counts from all colonies.

Table 9. Peak nest and nesting index for Biscayne National Park, by species and colony, for the 2019-2020 nesting year, plus the mean, maximum, and minimum of the previous nesting years (July through June). An asterisk indicates a newer colony with fewer sampling events.

Species	Peak Nest				Peak Index			
	2019-2020	Mean	Max.	Min.	2019-2020	Mean	Max.	Min.
Biscayne National Park								
DCCO	657	108.7	1,336	792	1,728	5,504.1	6,763	4,927
GBHE	11	11.9	16	6	22	30.7	44	12
GREG	3	16.1	29	4	4	42.2	75.5	4
GWHE	38	29.2	46	18	92	105.1	160	59
ROSP	2	5	12	0	3	10.6	25	0
WHIB	9	52.3	95	24	0	41.6	87	0
Arsenicker Key								
DCCO	49	146.7	257	56	108	627.4	983.5	254
GBHE	0	0.4	2	0	0	0.8	5	0
GREG	1	0.6	2	0	1	1.3	5	0
GWHE	5	5.4	13	2	15	20.2	46	11
ROSP	1	0.5	1	0	1	0.5	1	0
WHIB	0	31.5	60	0	0	41.6	87	0
Jones Lagoon								
DCCO	29	103	135	55	172	516.1	905	287
GBHE	3	6.2	10	2	16	18.9	30	6.5
GREG	0	1	2	0	0	1	2	0
GWHE	3	9.2	14	6	33	34.7	48	18
ROSP	1	4.9	12	0	2	10.4	25	0
WHIB	0	0	0	0	0	0	0	0
Mangrove Key								
DCCO	198	31.3	115	0	70	96.4	309	0
GBHE	0	1.8	4	0	4	3.3	9	0
GREG	0	0.3	1	0	0	0.4	2	0
GWHE	4	1.9	8	0	6	5.9	29	0
ROSP	0	0	0	0	0	0	0	0
WHIB	0	0	0	0	0	0	0	0
Ragged Key 5								
DCCO	198	410.8	706	294	490	2,513.7	3,568	1,774
GBHE	0	0.4	1	0	0	0.4	2	0
GREG	0	0.2	1	0	0	0.2	1	0
GWHE	4	4.7	8	2	10	16.9	29	9
ROSP	0	0	0	0	0	0	0	0
WHIB	0	0	0	0	0	0	0	0
Soldier Key								
DCCO	160	206.7	342	140	415	1,177.8	1,531	752
GBHE	2	1.1	2	1	2	2.8	9	1
GREG	0	0.5	1	0	0	0.4	1	0
GWHE	10	4.2	9	2	24	14.6	33	5
ROSP	0	0	0	0	0	0	0	0
WHIB	0	0	0	0	0	0	0	0
West Arsenicker								
DCCO	0	1.4	10	0	0	1.8	13	0
GBHE	0	2.8	5	1	0	5.2	15	1
GREG	2	14.1	27	3	3	39.2	73	3
GWHE	1	3.2	6	1	1	11.9	29.5	4
ROSP	0	0	0	0	0	0	0	0
WHIB	9	24.3	95	0	0	0	0	0

Species	Peak Nest				Peak Index			
	2019-2020	Mean	Max.	Min.	2019-2020	Mean	Max.	Min.
Kings Bay*								
DCCO	106	275	357	250	290	1,122	1,578	212
GBHE	0	0	0	0	0	0	0	0
GREG	0	0	0	0	0	0	0	0
GWHE	0	0	1	0	0	0.3	1	0
ROSP	0	0	0	0	0	0	0	0
WHIB	0	0	0	0	0	0	0	0
Kings Road Island*								
DCCO	39	54	66	33	99	124.3	209	0
GBHE	0	0	0	0	0	0	0	0
GREG	0	0	0	0	0	0	0	0
GWHE	0	0	1	0	0	0.5	1	0
ROSP	0	0	0	0	0	0	0	0
WHIB	0	0	0	0	0	0	0	0
Ragged Key 4*								
DCCO	23	25	38	12	84	79	137	16
GBHE	0	0	0	0	0	0	0	0
GREG	0	0	0	0	0	0	0	0
GWHE	1	1.5	2	1	3	2.7	3	2
ROSP	0	0	0	0	0	0	0	0
WHIB	0	0	0	0	0	0	0	0

SOUTHWEST FLORIDA

The 2020 nesting season represented the 63rd consecutive year monitoring the historical Corkscrew Wood Stork (WOST) colony. In 2020, Audubon Florida monitored five wading bird colonies in Lee and Collier counties. In addition to the colony at Audubon's Corkscrew Swamp Sanctuary (CSS), each site has been had a WOST colony at some point in the past decade.

The decline in WOST nesting in this region has been concurrent with development and loss of foraging habitat, particularly short hydroperiod wetlands used early in the nesting season. Since 2007, a pattern has emerged in the Corkscrew colony where WOST fail to nest more frequently than they successfully nest. Clem and Duever (2019) suggested this change may be associated with a significant hydrologic change (marked reduction of hydroperiod) that they described at CSS during the same time period. A recently completed hydrologic modeling study concluded that reducing downstream drainage from flood control operations can reduce CSS's dry season water loss. The study recommended developing a mitigation plan to reverse hydrologic change and restore ecologic function for WOST at this historic colony (Clem and Cornell 2021). This restoration would complement ongoing wetland restoration projects like those in Picayune Strand and the Southern Corkscrew Regional Ecosystem Watershed, with the goal of improving foraging and nesting habitat for wading birds.

METHODS

Monthly aerial surveys were conducted from a fixed-wing aircraft between December 2019 and March 2020. Monitoring flights were suspended in March 2020 due to safety concerns associated with the onset of COVID-19. At each colony location, a series of overlapping photographs were taken of the colony from an altitude of 500 to 1,000 feet. While WOST were the primary target for these surveys, all light-colored wading birds were counted. The progression of the nesting season and the ultimate success of nests after the March monitoring flight are unknown.

HYDROLOGY

Long-term rainfall data from CSS indicate Water Year (WY) 2020 (June 1, 2019 to May 31, 2020) rainfall was below average, as CSS received a total of 43.9 inches (average is 60.8 inches). Monthly rainfall totals were at or below average most months of the year, except December 2019, which received 5.4 inches and was the third rainiest December in CSS's 62-year data set. WY2020 surface water levels reflected this rainfall pattern. Peak annual water level in CSS was observed in late August 2019 (peak typically is in early October), with water levels reaching near-record seasonal lows by early October (**Figure 15**). Mid-December rainfall raised dry season water levels 6 inches, and a smaller reversal event in late January raised water levels more than 3 inches. Water levels receded smoothly and quickly through the remainder of the nesting season, with surface water levels falling below ground in most of the cypress forest by mid-April.

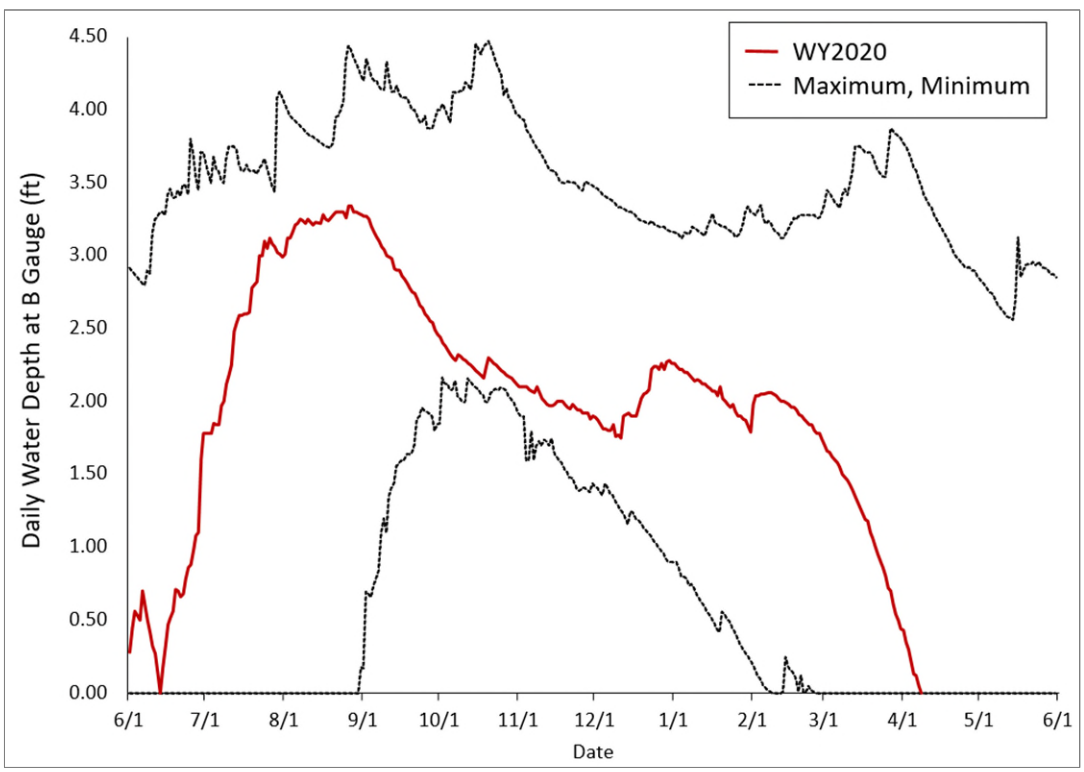


Figure 15. Daily surface water depth (in feet) at Audubon's Corkscrew Swamp Sanctuary in Water Year 2020 (June 1, 2019 through May 31, 2020). Zero represents ground level at the B staff gauge. Dashed lines represent daily maximum and minimum 1959 to present.

Nest Surveys

While WOST were first seen at some colony sites in February 2020, the first nesting in Southwest Florida was observed in early March, a late nest initiation date for this region. This late nest initiation likely was due to reversal events observed in December and January. Flights were conducted December 12, January 9, February 4, and March 10. No comparison to prior nesting efforts is made in this report, as this year's data likely do not reflect peak nesting numbers because monitoring was suspended due to COVID-19 soon after nest initiation.

Corkscrew Swamp Sanctuary (26.377196°, -81.615280°)

No wading bird nesting was observed at CSS in 2020.

Barron Collier 29 (26.273025°, -81.344057°)

Wading bird nesting was first observed at Baron Collier 29 in March. While 147 WOST were observed in the colony in March, nesting was in the very early stages, with only 13 active nests. Great Egrets (GREG), Cattle Egrets (CAEG), and Roseate Spoonbills (ROSP) were present but not observed nesting.

Collier-Hendry Line (26.370383°, -81.272717°)

No wading bird nesting activity was observed at the Collier-Hendry Line colony in 2020.

Caloosahatchee East (26.696583°, -81.794950°)

Great Blue Herons (GBHE) were first observed in Caloosahatchee East in January, although nesting activity was not confirmed until March (four nests). No other nesting activity was observed in this colony.

Lenore Island (26.688867°, -81.830150°)

WOST were first observed at Lenore Island in February, although nesting activity was not confirmed until March. In March, WOST were in the early stages of nesting, with 191 WOST present and 22 active nests. Also present in this colony were 10 GREG (no confirmed nests), 48 GBHE (20 nests), 4 ROSP (no confirmed nests), and 40 Brown Pelicans (BRPE; 5 nests).

Shawn E. Clem
Audubon Florida's Western Everglades Research Center
Corkscrew Swamp Sanctuary
375 Sanctuary Road
Naples, FL 34120
(239) 354-4469
Shawn.clem@audubon.org

HOLEY LAND AND ROTENBERGER WILDLIFE MANAGEMENT AREAS

For the third consecutive year, Holey Land Wildlife Management Area supported two small nesting colonies on the eastern boundary of the area (26.392170, -80.687975; 26.364350, -80.685050). The nest numbers decreased from last year; approximately 2 Tricolored Heron (TRHE) and 10 Little Blue Heron (LBHE) nests in each colony. The colony of Anhinga (ANHI) also returned to its previous nesting location in the northeastern corner of Holey Land (26.42878, -80.69782) and contained three nests.

No nesting colonies were observed in Rotenberger Wildlife Management Area this year.

Ashley Taylor, Fisheries and Wildlife Biological Scientist III
Holey Land and Rotenberger Wildlife Management Area
Florida Fish and Wildlife Conservation Commission
10088 NW 53rd Street
Sunrise, FL 33351
(954) 746-1789
Ashley.Taylor@myfwc.com

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

INTRODUCTION

For 13 consecutive years, the Florida Department of Environmental Protection (FDEP) and United States Fish and Wildlife Service have collaborated to collect wading and diving bird nesting data. Staff at Charlotte Harbor Aquatic Preserves (CHAP), a field site of the FDEP's Office of Resilience and Coastal Protection, and J.N. "Ding" Darling National Wildlife Refuge (NWR) have conducted colonial nesting bird surveys within the Ding Darling NWR Complex, and the Matlacha Pass, Pine Island Sound, Gasparilla Sound-Charlotte Harbor, Cape Haze, and Lemon Bay Aquatic Preserves (**Figure 16**). Colonial wading and diving bird nest monitoring began in 2008 with nine islands and expanded to 34 islands in 2011. This year, 37 islands were monitored and 26 were identified as active wading and diving bird nesting sites. Goals of this continuous study include establishing a long-term data set to assess nesting effort and seasonality, and to monitor activity status of known rookeries and establishment of new rookeries in the greater Charlotte Harbor area. In 2017, two islands in Pine Island Sound (Hemp Key and Broken Islands) were designated by the Florida Fish and Wildlife Conservation Commission as Critical Wildlife Areas. The islands were posted as Critical Wildlife Areas in 2018.

METHODS

The study area was divided between the two agencies based on location. J.N. "Ding" Darling staff monitored islands in South Matlacha Pass, San Carlos Bay and South Pine Island Sound. FDEP/CHAP staff monitored islands in North Matlacha Pass, North Pine Island Sound, Gasparilla Sound, Lemon Bay and Cape Haze. Both agencies employed the same direct count method with a boat captain, data recorder, and two observers. Islands were circled by boat, and nests were recorded by nesting stage (incubating, chicks, or unknown) for each species. Due to COVID-19 safety measure implementation, from April through July, only one observer was used to report nesting stage. The incubating stage was used when an adult was sitting on and shading the nest. The chicks stage was used when juvenile birds were visible in or near the nest. This category was counted as a nesting stage (chicks in the nest) and not used as a measure of productivity. The unknown stage was used when the nesting stage could not be determined. Data were collected from February through July 2020. Peak numbers reflect the highest number of nests per species throughout the survey period. The total number of peak nests was also calculated for each island.

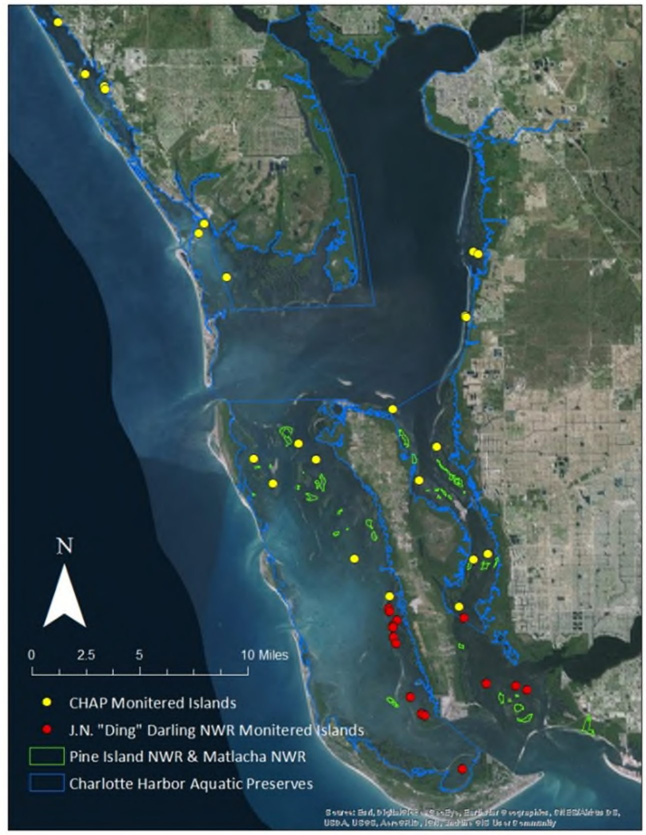


Figure 16. Locations of monitored bird colonies in CHAP and the J.N. "Ding" Darling NWR Complex.

RESULTS

The peak estimate for all colonial nesting birds in the study area was 1,677 nests (**Table 10**). This was less than a 1% decrease from the 2019 total peak nesting effort of 1,693 nests. Diving birds constituted approximately 67% of the documented nests, while the remaining 33% were wading bird nests. Wading bird nests increased 29% in 2020 compared to 2019. The largest nesting efforts in 2020 occurred on Broken Islands (338 nests), Hemp Key (265 nests) and N of York Island (128 nests). In 2020, Broken Islands also supported the greatest species diversity, with 11 species nesting.

Table 10. Colonial nesting bird peak counts for CHAP and the J.N. "Ding" Darling NWR Complex, February through July 2020.

Colony (Island)	Latitude	Longitude	GBHE	TRHE	LBHE	SNEG	GREG	REEG	CAEG	YCNH	BCNH	GRHE	WHIB	BRPE	DCCO	ANHI	ROSP	Total
Bodifer Key	26.4977	-82.1125	2	3	1													**6**
Broken Islands	26.6777	-82.1940	2	21	4	8	1	2	9				71	116	101	3		**338**
Burnt Store Marina N	26.7625	-82.0669	5	1	5	11	7							9				**38**
Burnt Store Marina S	26.7611	-82.0660	2							7	2	5						**16**
Clam Key	26.5063	-82.1128	2		1			1						11	27	1		**43**
E of Chadwick Cove	26.9289	-82.3511	13			13	13								5			**44**
Fish Hut Island	26.5467	-82.1245	2	4	6	5	3	1	3						7	1		**32**
Gasparilla Marina S	26.8269	-82.2625	3	1		11	8			1	2	1		24	44	6		**101**
Hemp Key	26.5999	-82.1532	11			1	15	1			2			86	149			**265**
N of Mason Island	26.5581	-82.1219												2				**2**
N of York Island	26.4945	-82.1043	2	2	2	2	9	1		1				49	54	6		**128**
N of Big Smokehouse	26.0000	-82.1225	3											1	15			**19**
NE of York Island	26.4940	-82.1021		1										15		3		**19**
NW of Mason Island	26.5543	-82.1250		1											4	1		**6**
NW of Pumpkin Key	26.5660	-82.1279	2												12			**14**
Oyster Creek W	26.8181	-82.3359	6			2	5							13	17		4	**47**
Pirate Harbor N	26.8052	-82.0597	9	1		3	11		2					41	33	1		**101**
Pirate Harbor SE	26.8037	-82.0565		24	1	2	2		39					17	31	1		**117**
Royal Palm Marina W	26.9640	-82.3708	11															**11**
Skimmer Island	26.5104	-82.0250	2	5	3	3	3	4					2	28	20			**70**
SW of Mason Island	26.5534	-82.1250		2	1			1			1				11	2		**18**
SW of Pumpkin Key	26.5640	-82.1275	1		1						1				17			**20**
Tarpon Bay Keys	26.4577	-82.0744	4	8	4	2	5	1	1					20	16			**61**
Upper Bird Island	26.5592	-82.0714	2															**2**
Useppa Oyster Bar	26.6513	-82.2134	1							1				46	54			**102**
White Pelican Island	26.7905	-82.2463	5		1	32	5	3							11			**57**
Total			**90**	**74**	**30**	**95**	**87**	**15**	**54**	**10**	**8**	**6**	**73**	**478**	**628**	**25**	**4**	**1,677**

Note: Nesting birds were not observed at the following colonies (islands): Bird Keys, Bird Rookery Keys, Cork Island, Crescent Island, Darling Keys, Givney Key, Little Oyster Creek, Lumpkin Island, Lower Bird Island, Masters Landing, and N Regla.

Species Summaries – Diving Birds

Double-crested Cormorant (DCCO)

DCCO nesting peaked at 628 nests, which is approximately 37% of the total nests in the 2020 season. This was an 11% increase from 567 peak nests documented in 2019. Nesting was documented on 19 islands, with the highest nest count (149 nests) occurring on Hemp Key in May.

Brown Pelican (BRPE)

BRPE nesting peaked at 478 nests on 15 islands, accounting for approximately 29% of the nesting effort documented this season. This was a 30% decrease from the record count of 680 nests in 2019. The highest peak nest count occurred in May at Broken Islands with 116 nests.

Anhinga (ANHI)

ANHI nesting peaked at 25 nests, which was down 19% from the 2019 peak count of 31 nests. The highest nest count (6 nests) occurred on Gasparilla Marina South and N of York islands.

Species Summaries – Wading Birds

Great Blue Heron (GBHE)

GBHE nesting efforts were documented on 21 of the 26 active islands. The peak nest count for GBHE was 90 nests. This was a 13% increase from last year's peak nesting effort of 80 nests. E of Chadwick Cove (13 nests) had the largest number of peak nests.

Tricolored Heron (TRHE)

TRHE nests were documented on 13 islands, with a peak nest count of 74 nests. This was a 25% increase from last year's peak nest count of 59 nests. The highest peak nesting effort (24 nests) occurred at Pirate Harbor SE.

Little Blue Heron (LBHE)

LBHE nesting peaked at 30 nests in 2020. This was a 100% increase from the peak nest count of 15 nests in 2019. Nests were documented on 12 islands, with the highest nest count (6 nests) on Fish Hut Island.

Snowy Egret (SNEG)

SNEG nesting occurred on 13 islands, with a peak nest count of 95 nests. This was an 86% increase from the 2019 nesting effort of 51 nests. The highest nest count (32 nests) was recorded at White Pelican Island in May.

Great Egret (GREG)

GREG nesting peaked at 87 nests. This was a 5% increase from the peak nest count of 83 nests in 2019. The greatest GREG nesting effort was documented on Hemp Key, with 15 nests.

Reddish Egret (REEG)

REEG were documented nesting on 9 islands with a peak nest count of 15 nests. This was an increase of 1 nest from 2019 peak nesting effort. The highest peak nest count (4 nests) occurred on Skimmer Island.

Yellow-crowned Night Heron (YCNH)

YCNH had a peak nest count of 10 nests in the 2020 nesting season. This was a 67% increase from the 2019 peak. Burnt Store Marina South had the highest peak nest count (7 nests) in May.

Black-crowned Night Heron (BCNH)

BCNH nesting was documented on 5 islands and peaked at 8 nests. This was a decrease of 33% from the peak nest count (12 nests) in 2019.

Green Heron (GRHE)

GRHE nesting peaked at 6 nests, and nesting activity occurred on 2 islands. This was an increase of 1 nest from 2019 peak nesting effort.

White Ibis (WHIB)

WHIB nesting occurred on 2 islands, with a peak count of 73 nests. This was a 55% increase from last year's peak nest count of 47 nests. Broken Islands accounted for most nests (71 nests).

Cattle Egret (CAEG)

CAEG nesting peaked at 54 nests in 2020. This was a 42% increase from the peak nest count of 38 nests in 2019. The highest peak nest count (39 nests) was recorded at Pirate Harbor SE in May.

Roseate Spoonbill (ROSP)

ROSP were first documented in the study area in 2018 and continued to be observed during the 2019 and 2020 seasons. The peak nesting effort (4 nests) occurred at Oyster Creek W.

CONCLUSIONS

The total peak nesting effort in 2020 was 1,677 nests (**Figure 17**). This is less than a 1% decrease from the 2019 nesting season, but there was a shift between wading and diving birds. Ten wading bird species experienced nests increases, and overall wading bird nests increased by 29% compared to 2019. Diving birds, like BRPE and ANHI, experienced decreases compared to 2019, but the 2020 numbers are still higher than the average peak nests over the last 13 years. The top peak nest counts on Broken Islands, Hemp Key, and N of York Island accounted for 44% of the total nesting effort in 2020.

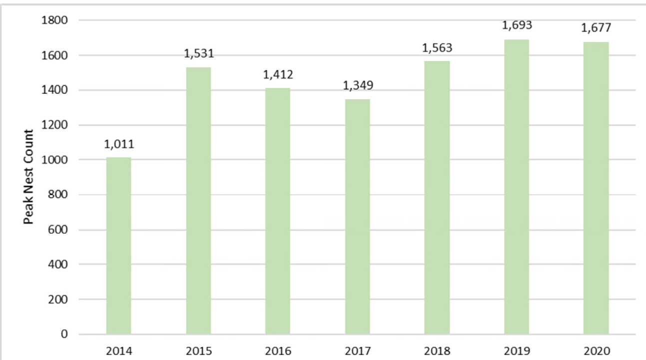


Figure 17. Annual peak nest counts in study area from 2014 to 2020.

Jeremy Conrad, Wildlife Biologist
J.N. "Ding" Darling National Wildlife Refuge
1 Wildlife Drive
Sanibel, FL 33957
(239) 472-1100 ext. 230
Jeremy_Conrad@fws.gov

Mary McMurray, Environmental Specialist
Charlotte Harbor Aquatic Preserves
12301 Burnt Store Road
Punta Gorda, FL 33955
(941) 575-5861 ext. 113
Mary.McMurray@dep.state.fl.us

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

Estero Bay Aquatic Preserve (EBAP) was designated in 1966, becoming Florida's first aquatic preserve. EBAP is a field site of the Florida Department of Environmental Protection and managed by the Florida Coastal Office. The colonial nesting, wading, and diving bird monitoring and protection program began in 2008 at 15 islands and has expanded to 34 islands, 20 of which are active nesting sites. Two islands (Emily's Keys and Taylor Island) were added when they were discovered during the 2019 breeding season.

Historically, the highest concentration of wading and diving bird nesting activity has been observed on three islands: Matanzas Pass, Coconut Point East, and Big Carlos Pass West of 52. These islands are now designated as Critical Wildlife Areas and were marked in February 2018.

The objectives of this monitoring program are as follows:

- Provide peak estimates of nesting effort for each species of colonial nesting bird;
- Monitor population trends;
- Record movement of colonies, human disturbance, and bird fatalities due to fishing line entanglement;
- Reduce the number of entanglements and fatalities due to fishing line and trash within Estero Bay; and
- Provide recommendations for the management of nesting wading and diving bird colonies in the EBAP.

METHODS

Between 2008 and 2020, surveys were conducted monthly throughout the nesting season. Since 2012, surveys have been conducted year-round due to the extended period of nesting. Employing a direct count method, two observers surveyed each island by boat from a distance of 30 to 45 meters, with a third person recording the data for each nest's species and stage (Audubon Florida 2004). EBAP staff served as primary observers. Trained volunteers or staff conducted secondary observer counts until April 2020, when staff from EBAP, Charlotte Harbor Aquatic Preserves (CHAP), and the Florida Fish and Wildlife Conservation Commission (FWC) began doing both observations. The averages of the two observers' counts were calculated and reported. Peak nest counts observed from 2020 were compared with mean peak nest counts from 2008 through 2019, which represent the 12-year average for observed nesting effort in EBAP.

RESULTS

The observed peak nesting effort for wading and diving birds was 463 nests (**Table 11**). April marked the height of the EBAP nesting season, with 280 active nests. The Matanzas Pass colony, with an annual peak of 154 nests, supported the greatest number of nests in the bay. Overall, nesting effort increased 4% compared to the 12-year average (**Table 12**). All species-specific increases or decreases in observed nesting effort are relative to the 12-year average.

Double-crested Cormorant (DCCO) nests were documented on 7 islands. Nesting activity peaked in April (44 nests). The annual peak nest count (75 nests) was 10% higher than the 12-year average.

Anhinga (ANHI) nests were documented on 1 island. Nesting activity peaked in September (2 nests). ANHI nesting has only been documented since 2018. The annual peak (2 nests) increased 700% relative to the 12-year average or 33% relative to the preceding 2-year average.

Brown Pelican (BRPE) nests were documented on 3 islands. Nesting activity peaked in April and June (88 nests). The annual peak nest count (104 nests) decreased 17%.

Great Blue Heron (GBHE) nests were documented on 14 islands. Nesting activity peaked in April (50 nests). The annual peak nest count (58 nests) decreased 14%.

Table 11. Peak nest counts documented in Estero Bay Aquatic Preserve colonies, January through September 2020.

Colony	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	BCNH	YCNH	GRHE	ROSP	WHIB	Total
Big Bird Island	26.38286	-81.84995	5			1												**6**
Big Carlos Pass between M-50 and M-52	26.42774	-81.90218				4								4				**8**
Big Carlos Pass W of M-52	26.42469	-81.89359	3		27	3	31	3		7	2		1					**77**
Big Hickory E of M-85	26.35315	-81.84164	22			9	1				2							**34**
Chain of Islands	26.38411	-81.84905													9			**9**
Coconut Point East	26.38111	-81.84976	12	2	40	4	13	4	1	3				1		2		**82**
Coconut Point West	26.43803	-81.86937				2												**2**
Denegre Key	26.43772	-81.86728	11			7	1	2		8	1		7					**37**
Emily's Keys	26.43029	-81.86113													1			**1**
Estero River M-30	26.43653	-81.86091													1			**1**
Estero River North	26.43416	-81.86211												4				**4**
Little Davis Key	26.38865	-81.85925				1												**1**
Matanzas Pass	26.40465	-81.86816	21		37	13	3	16	1	45	6	2	2	1			7	**154**
New Pass M-21	26.40498	-81.86449				1												**1**
New Pass M-9	26.40572	-81.86338				5												**5**
North Coconut E of M-3	26.41131	-81.85486	1			3	8	9		8			1					**30**
North Coconut M-4/ Monkey Joe Key	26.40783	-81.85302				2	2											**4**
North Coconut NE M-5/ Ruth's Island	26.41069	-81.85412													1			**1**
Taryn's Key	26.45286	-81.86753				3									1			**4**
Taylor Island	26.42438	-81.89769												1	1			**2**
Total			**75**	**2**	**104**	**58**	**59**	**34**	**2**	**71**	**11**	**2**	**11**	**11**	**14**	**2**	**7**	**463**

Note: Nests were not observed (count = 0) in the following colonies: 619038c, Big Carlos Pass S of M-48, Big Carlos Pass M-43, Big Carlos Pass between M-46 and M-48, Big Carlos Pass M-48, Big Carlos Pass W of M-46, Big Hickory M-83 Seagrass Island, Big Hickory Pass M-49 2NW, Big Hickory Pass M-49 3NW, Estero River South, Hogue Channel M-78, Hurricane Pass/Rebecca's Island, Kelsey's Island, and North Coconut M-2.

Table 12. Mean peak nest count (2008 to 2019), standard error, current (2020) peak nest count, and percent mean difference by species.

Species	Mean (2008-2019)	Standard Error	Peak Count (2020)	Percent Change	Percent Change 2019-2020
DCCO	68.3	5.3	75	10	63
ANHI	0.3	0.2	2	700[a]	100
BRPE	125.9	14.5	104	-17	-54
GBHE	67.1	4.9	58	-14	32
GREG	55.3	7.5	59	7	31
SNEG	29.1	3.1	34	17	3
LBHE	14.0	1.7	2	-86	-78
TRHE	35.8	4.9	71	99	25
REEG	7.8	0.8	11	40	-21
CAEG	1.3	0.5	2	60	--[b]
BCNH	16.2	2.9	11	-32	-48
YCNH	18.8	2.2	11	-42	-35
GRHE	6.5	1.3	14	115	-7
ROSP	0.3	0.2	2	500[c]	0
WHIB	0.2	0.2	7	4,100[d]	--[b]
Total	**446.8**	**27.5**	**463**	**4**	**-13**

[a] ANHI only observed in recent years. If compared to the last 2 years, the percent change would be 33.3%.
[b] 2019 count was 0 nests.
[c] ROSP only observed in recent years. If compared to the last 3 years, the percent change would be 50%.
[d] WHIB only observed in recent years. If compared to the last 2 years, the percent change would be 600%.

Great Egret (GREG) nests were documented on 7 islands. Nesting activity peaked in April (57 nests). The annual peak nest count increased 7% to 59 nests.

Snowy Egret (SNEG) nests were documented on 5 islands. Nesting activity peaked in June (31 nests). The annual peak nest count increased 17% to 34 nests.

Little Blue Heron (LBHE) nests were documented on 2 islands, with peak nest counts from April through August (1 nest). The annual peak nest count (2 nests) decreased 86%.

Tricolored Heron (TRHE) nests were documented on 5 islands. Nesting activity peaked in June (61 nests). The annual peak nest count (71 nests) increased 99%.

Reddish Egret (REEG) nests were documented on 4 islands. Nesting activity peaked in May (10 nests). The annual peak nest count increased 40% to 11 nests.

Cattle Egret (CAEG) nests were documented on 1 island. Nesting activity peaked in June (2 nests). The annual peak count (2 nests) increased 60%.

Black-crowned Night Heron (BCNH) nests were documented on 4 islands. Nesting activity peaked in September (8 nests). The annual peak nest count (11 nests) decreased 32%.

Yellow-crowned Night Heron (YCNH) nests were documented on 5 islands. Nesting activity peaked in May (8 nests). The annual peak nest count (11 nests) decreased 42%.

Green Heron (GRHE) nests were documented on 6 islands. Nesting activity peaked in May (9 nests). The annual peak nest count (14 nests) increased 115%.

ROSP nests were documented on 1 island. This is the fourth consecutive annual observation of ROSP nesting in Estero Bay. Nesting activity peaked in April and May (2 nests). The annual peak nest count (2 nests) represents a 500% increase relative to the 12-year average or a 50% increase relative to the preceding 3-year average.

WHIB nests were documented on 1 island. These are the second recorded WHIB nests in EBAP (the first were in 2018). Nesting activity peaked in September (7 nests). The annual peak nest count (7 nests) increased 4,100% increase relative to the 12-year average or 600% relative to the preceding 2-year average.

Between January and March 2020, volunteers contributed 76.5 hours of service to monitoring and protecting wading and diving bird colonies in EBAP. Unfortunately, the COVID-19 pandemic brought about a temporary halt in the volunteer program.

During this nesting season, staff and volunteers documented 26 bird fatalities (1 REEG, 1 TRHE, 1 WHIB, 19 BRPE, and 4 unknown species) due to fishing line entanglement. They removed 309 feet of fishing line and 14 hooks from nesting islands this season. Large-scale cleanups of the islands are conducted after nesting season to minimize disturbance to colonies. During cleanups from September through December 2019, staff and volunteers removed 1,424 feet of fishing line, 28 hooks, and 63 pounds of trash.

DISCUSSION

Estero Bay nesting activity continues to exhibit annual variation. The 2020 annual peak nest count (463 nests) was near the 12-year average (447 nests) and more similar to nest counts prior to Hurricane Irma in September 2017 (**Figure 18**).

The higher nest counts in 2018 and 2019 may have been an artifact of mangrove damage, which removed observational obstructions. Other factors may have contributed, including temporary displacement of nesting birds from more heavily damaged rookeries farther south close to where Hurricane Irma made landfall and/or behavioral responses to environmental stress (e.g., increased reproductive effort).

Ten species (DCCO, ANHI, GREG, SNEG, TRHE, REEG, CAEG, GRHE, ROSP, and WHIB) increased nesting effort in 2020 compared to the 12-year average. While five species (BRPE, GBHE, LBHE, BCNH, and YCNH) decreased nesting activity. Two other species were documented nesting this year: one black vulture nested on a Critical Wildlife Area island, and one osprey nested in another rookery.

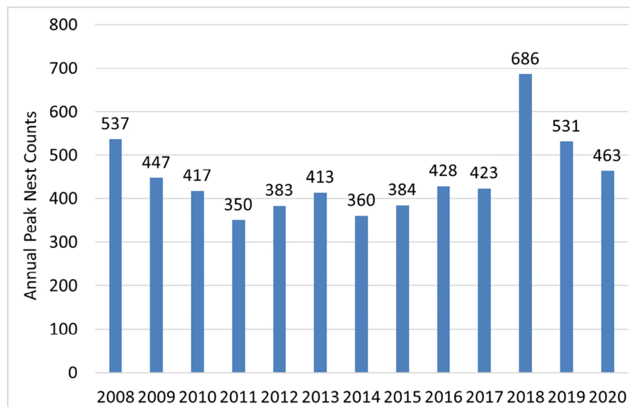


Figure 18. Annual peak nest counts in Estero Bay Aquatic Preserve from 2008 to 2020.

ACKNOWLEDGMENTS

This report is an annual update to reports prepared by Cheryl Clark, Kelsey Lang, and Charles "Mike" Cooper of EBAP. Sincerest thanks to the volunteers, who are vital to the program's success, and the staff from CHAP and FWC for their invaluable assistance with field monitoring this season.

Neilson Ayers
Estero Bay Aquatic Preserve
Florida Department of Environmental Protection
700-1 Fisherman's Wharf
Fort Myers Beach, Florida 33931
(239) 530-1003
Neilson.Ayers@floridadep.gov

CORKSCREW REGIONAL ECOSYSTEM WATERSHED MANAGEMENT AREA

Due to the COVID-19 pandemic, the Florida Fish and Wildlife Conservation Commission (FWC) only conducted aerial wading bird surveys from January to March 2020. During those months, FWC did not locate or monitor any nesting colonies in or around the Corkscrew Regional Ecosystem Watershed (CREW) Management Area or Audubon's Corkscrew Swamp Sanctuary in Lee and Collier counties. Limited foraging and roosting aggregations were identified with the goal of monitoring long-term trends in activity.

METHODS

Monthly aerial surveys were conducted in a Cessna 172 with two observers (one of each side of the aircraft). Flights were conducted on January 7, February 11, and March 4, 2020. Flights were canceled from April through June due to health concerns surrounding the COVID-19 pandemic. January's survey data were lost because of a hard drive failure; therefore, foraging and roosting data presented here only reflect February and March surveys.

Surveyed areas totaled 200 km² (49,389 acres) and included CREW, Corkscrew Swamp Sanctuary, a portion of the Larry Kiker Preserve, and the Hidden Cypress Preserve. Transects were flown at an altitude of 244 meters (800 feet), spaced 1.48 kilometers (0.8 nautical miles) apart, and oriented northeast to southwest (**Figure 19**). When a colony was located, flight altitude was reduced to 152 meters (500 feet), GPS coordinates were recorded, and digital photographs were taken using a Canon EOS 7D with a 70-300 mm lens with image stabilization. Photographs were used to count and identify wading bird species. Each photo was digitally marked using Adobe® Photoshop Elements 15 to avoid double-counting. Foraging birds were defined as an aggregation of five or more birds on or near the ground who were actively foraging or subjectively appeared to have been foraging. Roosting birds were defined as five or more birds perched in trees or above ground who did not appear to be foraging.

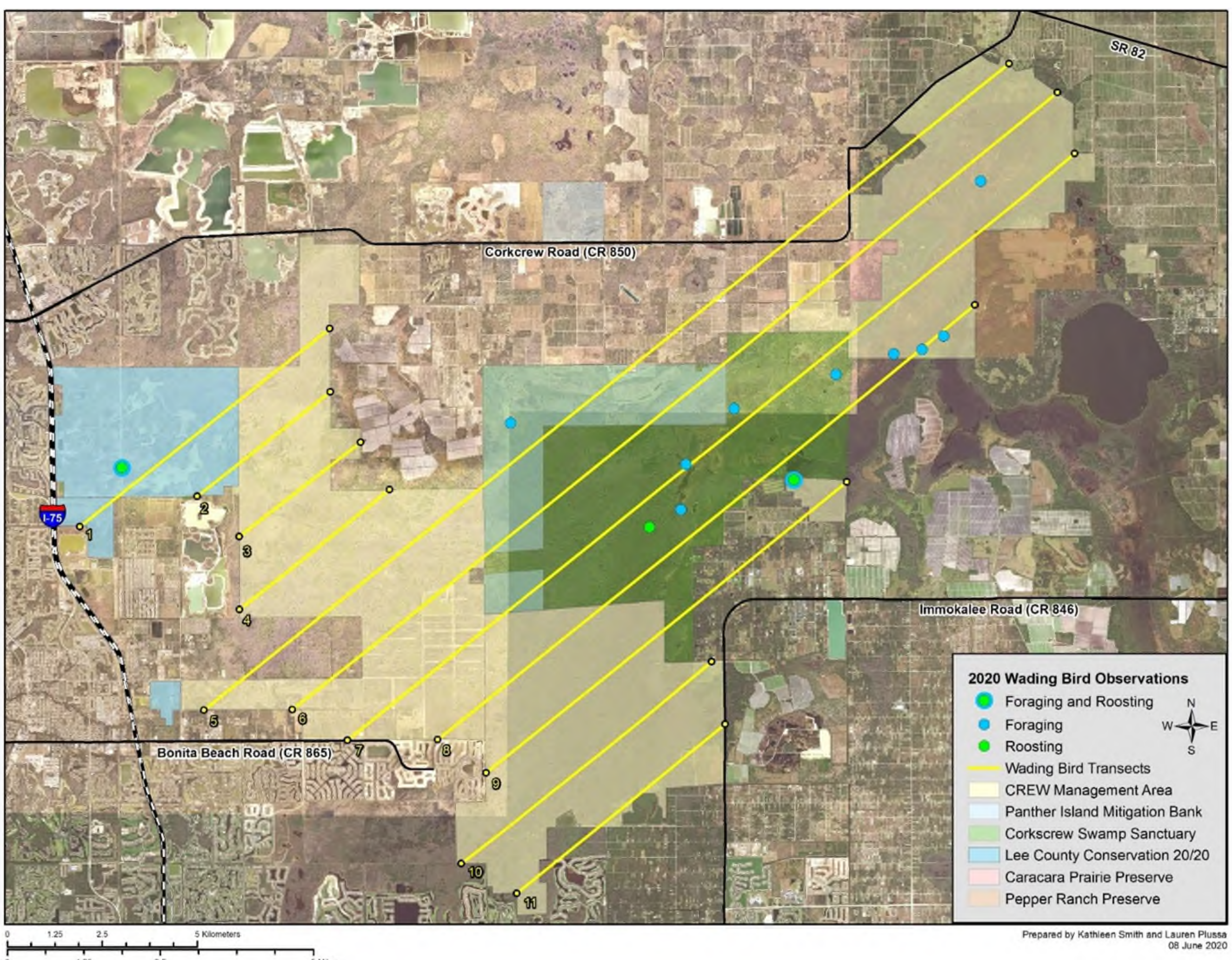


Figure 19. Locations of foraging and roosting wading birds in and around the CREW Management Area and Corkscrew Swamp Sanctuary, February through March 2020.

HYDROLOGY

Please refer to the *Southwest Florida* section for information on the region's hydrology.

RESULTS AND DISCUSSION

No nesting was observed during the abbreviated survey season. However, it is fairly certain that no Wood Storks (WOST) nested at the Corkscrew Swamp Sanctuary colony in 2020.

Foraging and Roosting

Eleven foraging aggregations and three roosting colonies were located (**Figure 19**). White Ibis (WHIB), Great Egret (GREG), Snowy Egret (SNEG), Roseate Spoonbill (ROSP), WOST, and Tricolored Heron (TRHE) were the most abundant species observed in foraging aggregations. WHIB and GREG were present in 100% and 73% of the foraging aggregations, respectively.

WHIB (observed in 100% of colonies) and GREG (observed in 33% of colonies) were the most common species present in roosting colonies. Other species of interest, either foraging or roosting in the CREW Management Area, included WOST, ROSP, SNEG, Little Blue Heron (LBHE), TRHE, and Green Heron (GRHE).

Kathleen Smith
Corkscrew Regional Ecosystem Watershed Wildlife and Environmental Area
Florida Fish and Wildlife Conservation Commission
23998 Corkscrew Road
Estero, FL 33928
(561) 686-8800 ext. 7385
Kathleen.Smith@myfwc.com

WADING BIRD NESTING AT LAKE OKEECHOBEE

In May 2005, Florida Atlantic University began monitoring the timing, size, and location of wading bird colonies at Lake Okeechobee as a part of the Comprehensive Everglades Restoration Plan (CERP) Monitoring and Assessment Plan. In 2020, three focal species, Great Egret (GREG), Snowy Egret (SNEG), and White Ibis (WHIB), initiated an estimated 1,529 nests, which is 54% lower than the average since 2008, when the current lake schedule was implemented. Nest abundances were 44%, 48%, and 66% below average for GREG, SNEG, and WHIB, respectively, and were the second lowest since 2008 (20 nests) as nesting was limited almost entirely to small spoil island and off-lake colonies due to dry conditions in the littoral zone. Clewiston Spit (470 nests) and Gator Farm (529 nests), a spoil island and off-lake colony respectively, supported the largest number of GREG, SNEG, and WHIB nests this year.

METHODS

Florida Atlantic University personnel monitored the location, timing, and number of clutch initiations of wading bird nesting colonies on the lake from February to June 2020. Systematic aerial surveys were conducted monthly along transects covering the lake's littoral zone, with two dedicated observers surveying for SNEG, GREG, WHIB, Wood Stork (WOST), and Roseate Spoonbill (ROSP) nests. Counts and species composition of large colonies were subsequently verified by airboat. Estimates of nest initiation date were based on nest monitoring by boat at three spoil island colonies. More detailed methods are described in previous editions of the *South Florida Wading Bird Report*.

Rainfall and lake stage data were obtained from the South Florida Water Management District (SFWMD) DBHYDRO database. The lake stage is calculated as the mean of four gauges in the pelagic zone of Lake Okeechobee (L001, L005, L006, and LZ40). All elevation data are presented in National Geodetic Vertical Datum 1929 (NGVD29) and locations are in North American Datum 1983 (NAD83). Stage data from 2008 represents the lake levels under the current Lake Okeechobee Regulation Schedule.

RESULTS

Hydrology

During the 2020 nesting season, Lake Okeechobee were characterized by low lake stage, a moderate recession rate, and two minor reversals (0.06-inch rise in stage per day from January 28 to February 12; 0.31-inch rise per day from April 26 to 29) preceding the seasonal rise in water levels in May (**Figure 20**). Water levels were similar to those during the 2019 nesting season (mean lake stage from January 1 to May 31 was 12.1 feet and 12.2 feet in 2019 and 2020, respectively). On January 1, the lake stage was at a seasonal high of 13.16 feet. The lake receded at a mean rate of 1.11 inches per week from January 1 to 28 before unseasonal rainfall caused the lake stage to increase from 12.8 feet on January 28 to 12.9 feet on February 12. The lake receded at a mean rate of 1.60 inches/week from mid-February to mid-May, except for one reversal in late April. During that reversal, lake stage increased 1.56 inches before receding to the lowest depth of the season, 11.0 feet, on May 17. The reversal may have impacted small heron (SMHE) nest success by lowering prey availability (pre-reversal SMHE nest survival was 0.67 [n = 147] and post-reversal SMHE nest survival was 0.51 [n = 34]). The low lake stage during the 2020 nesting season also may have limited nest numbers because low water levels decrease the availability of natural nesting habitat in the short-hydroperiod marsh.

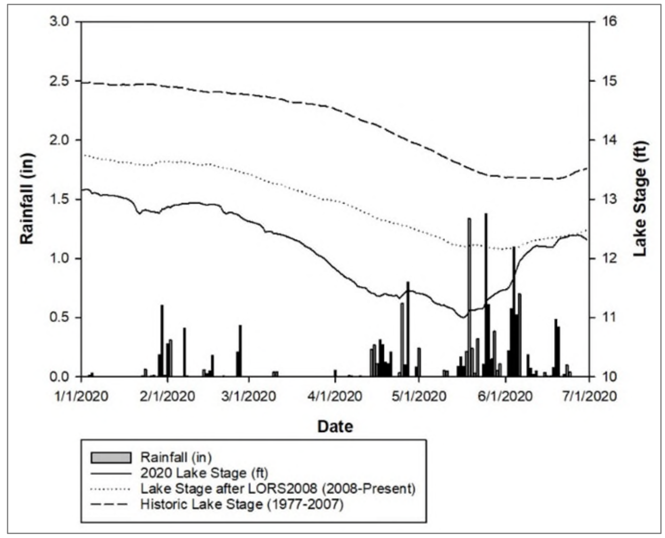


Figure 20. Hydrologic patterns in Lake Okeechobee from January to July 2020, and mean lake stages from 1977 to 2007 and from 2008 to present (i.e., since the 2008 Lake Okeechobee Regulation Schedule was implemented).

Colony Location and Size

Seven colonies (**Figure 21**) supported 1,529 GREG, SNEG, and WHIB nests, 54% lower than the average from 2008 to 2020 (3,261 ± 2,020; all averages use standard deviation [SD]) but 58% higher than 2019, a year with similar lake levels. Colonies were detected at four created spoil islands (Little Bear Beach, Clewiston Spit, Bird Island, and Pahokee Airport), one natural willow colony in the marsh (Eagle Bay Island), and two off-lake, created islands (Lakeport Marina and Gator Farm). Clewiston Spit was the largest colony, supporting 470 GREG, SNEG, and WHIB nests (**Table 13**). Peak nest abundance was 393 GREG, 747 SNEG, and 389 WHIB nests (**Table 14**). GREG, SNEG, and WHIB nest abundance was 44%, 48%, and 66% lower than the average from 2008 to 2020, respectively (708 ± 476 GREG nests; 1,444 ± 1,054 SNEG nests; 1,148 ± 867 WHIB nests). Even with the low nesting in 2019 and 2020, the average nest abundance of GREG, SNEG, and WHIB on the lake has remained higher under the current regulation schedule (2008 to present; 3,261 ± 2,020) compared to the 1977 to 2007 lake schedule (2,601 ± 2,364 nests).

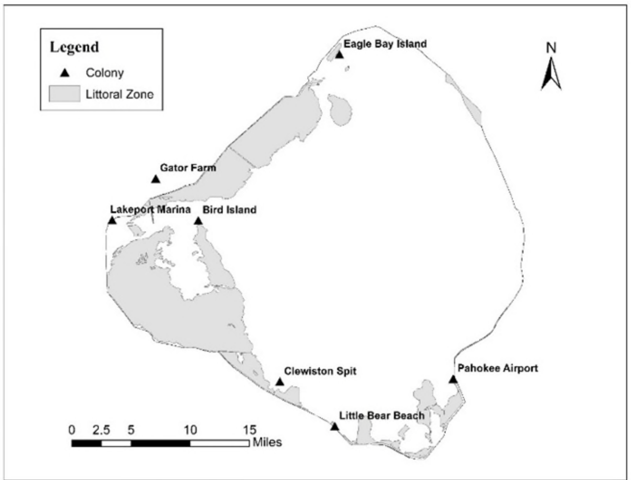


Figure 21. Map of wading bird colonies detected on Lake Okeechobee from February to June 2020.

Timing and Success

The median clutch initiation date was March 24 for GREG and April 4 for SNEG. This was 11 days later for GREG than the average since 2009 (the period for which nest initiation data are available) and the same as the average since 2009 for SNEG. Apparent nest survival was 59% for GREG and 65% for SMHE, which is 9% lower for GREG and 7% lower for SMHE than the average apparent nest survival from 2011 to 2020 (the period for which nest survival data are available). Apparent survival in 2019, a hydrologically similar year, was almost identical for SMHE (63%) and 15% lower for GREG (50%).

Wood Storks and Roseate Spoonbills

Fifty-two WOST nests and 51 ROSP nests were detected at Gator Farm, an off-lake colony located north of the Moonshine Bay area. Most ROSP and WOST nests appeared to fail as only 21 WOST fledglings and 13 ROSP fledglings were detected in photos taken on May 20. WOST have nested at the Gator Farm in 9 of the last 14 years (2007 to 2010 and 2016 to 2020) and have successfully fledged chicks every year nesting has occurred. ROSP have nested at the Gator Farm in low numbers (4 to 20 nests) for the past 4 years (2016 to 2020), successfully fledging chicks in the last 3 years.

Table 13. Geographic coordinates (NAD83) and species-specific peak nest abundances in detected colonies during the 2020 breeding season at Lake Okeechobee.

Colony	Peak Month[1,2]	Latitude	Longitude	GREG	WHIB	SNEG	WOST	ROSP	GBHE	LBHE	TRHE	GLIB	CAEG	ANHI	Total[1]
Bird Island	April	26.97196	-81.00858			12			3		21				**36**
Clewiston Spit	April	26.77573	-80.90938	98	2	370			4		105				**579**
Eagle Bay Island	April	27.17427	-80.83663		387	142					5	10	263	1	**544**
Gator Farm	April	27.02300	-81.06110	179		30	52	51	1	26	1	8	132	12	**348**
Lakeport Marina	May	26.9726	-81.1144	22		35				3	19		539	3	**79**
Little Bear Beach	April	26.72139	-80.84222	82		127			2		45				**256**
Pahokee Airport	May	26.77908	-80.69760		4	94					10	1	14		**109**
	Total			**381**	**393**	**810**	**52**	**51**	**10**	**29**	**206**	**19**	**948**	**16**	**1,951**

[1] Does not include CAEG or ANHI.
[2] Peak month refers to the month during which combined nest effort peaked and does not refer to species-specific peak nest efforts.

Table 14. Timing and nest numbers for species breeding in wading bird colonies at Lake Okeechobee in 2020.

Month	GREG	WHIB	SNEG	WOST	ROSP	GBHE	LBHE	TRHE	GLIB	CAEG	ANHI
February	25			10	10	1					
March	165	5	8	22	43	2	1				12
April	**393**	**389**	**747**	**52**	**51**	**10**	26	**182**	**18**	472	15
May	114	50	563	17	7	4	**34**	86	11	**1,764**	**18**
June	--[a]	60	62[a]	--[a]	4			20[a]		1,265	8

[a] Large number of roosting birds present, but not on nests.
Note: Bold values denote peak nest effort for species.

ACKNOWLEDGMENTS

Funding for the nest monitoring was provided by the United States Army Engineer Research and Development Center and Florida Atlantic University with the support of RECOVER. We appreciate the support from our technicians for their dedication to difficult field work. We also benefited from discussions with Mike Baranski at the South Florida Water Management District.

Rachel C. Larson, Rostam Mirzadi, and Dale E. Gawlik
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431
(561) 297-3333
dgawlik@fau.edu

SAVANNAS PRESERVE STATE PARK

The Savannas Preserve State Park is a 5,000-acre property in northern Martin County and southern St. Lucie County, situated just west of the Indian River Lagoon. The property is bisected by an oligotrophic, linear basin marsh system that stretches from Jensen Beach to southern Fort Pierce. It is the longest contiguous freshwater marsh system of its kind remaining in southeast Florida, spanning approximately 10 miles north to south. The western preserve is dominated by a pine flatwood community with numerous depression marshes and wet prairies. The eastern preserve is along the Atlantic Coastal Ridge and typically dominated by sand pine scrub and scrubby flatwood communities. The marsh and associated wetlands provide a stopover for migrating birds and support nesting activities in small tree islands and dense sawgrass patches.

Beginning in February 2020, Florida State Parks staff surveyed a wading bird rookery at Savannas Preserve State Park. This rookery and two others to the south were originally surveyed between 1995 and 2003 by the South Florida Water Management District. Surveys were continued in 2016, 2018, and 2019; however, drought in 2017 prevented the survey of the site due to lack of access.

The Savannas Preserve State Park basin marsh hydrological conditions are driven primarily by annual rainfall patterns, but also are influenced by local runoff. Rainfall accumulation for 2020 peaked mid-May through mid-June with accumulations around 23.5 inches. Drought followed a typical pattern and peaked from early March through late April. Compared to the 2019 breeding season, basin marsh levels were higher for a longer period; however, the spring drawdown along the basin marsh ecotone and associated depressional marshes allowed for prime foraging habitat for nesting birds.

METHODS

The North Marsh Rookery is a shrub island within the basin marsh located approximately 1 mile north of Walton Road and 0.5 mile west of Indian River Drive. This island primarily consists of pond apple and wax myrtle with sawgrass edges. Surveys were completed by canoe along the island's western and southern edge.

RESULTS

Overall nest numbers in 2020 appear to be approximately three times greater than numbers collected from 2016, 2018, and 2019. Species with the greatest increase in nests include Glossy Ibis (GLIB), White Ibis (WHIB), Great Egret (GREG), and Snowy Egret (SNEG), respectively. This site was surveyed February through June, with peak nesting activity documented in May and June. The 2020 nest counts for the North Marsh Rookery are provided in **Table 15**.

FUTURE PLANS

The Savannas Preserve State Park strives to continue surveys to develop long-term data that can be matched with statewide numbers. This, coupled with rainfall and water level data, will help determine long-term water management strategies within the basin marsh system. Plans are to continue surveys at the North Marsh Rookery and observe any notable nest numbers at the South Marsh Rookery (27.2769, -80.2474) between January and June 2021.

Scott Tedford and Doug Rogers
District 5 Florida State Parks
13798 SE Federal Highway
Hobe Sound, FL 33455
(772) 546-0900
Scott.Tedford@dep.state.fl.us
Doug.T.Rogers@dep.state.fl.us

Table 15. Peak nest counts for each wading bird species in Savannas Preserve State Park, 2018 to 2020.

Year	Colony	Latitude	Longitude	GREG	CAEG	SNEG	GBHE	LBHE	BCNH	WHIB	GLIB	ANHI	Total
2018	North Marsh Rookery	27.3117	-80.2713	7		3	10	5	1	1	5	17	**49**
2019	North Marsh Rookery	27.3117	-80.2713	6	8		12	3				14	**43**
2020	North Marsh Rookery	27.3117	-80.2713	24	13	10	9	6	2	26	37	29	**156**

SOUTH FLORIDA (VARIOUS LOCATIONS)

METHODS

The Florida Fish and Wildlife Conservation Commission (FWC) staff and volunteers conducted nest counts at seven wading bird colonies throughout FWC's south region in 2020. Nest numbers for Wood Stork (WOST) were higher this year than in 2019 and productivity was high at the coastal colonies.

Bird Island Critical Wildlife Area (27.190821, -80.187908) is a spoil island in the Indian River Lagoon. The island is closed to public access year-round to protect nesting and roosting birds. It is cooperatively managed with Martin County and monitored monthly throughout the year. Nest counts were conducted from a boat circling the island, and it is certain that some interior nests were not counted.

BallenIsles (26.830148, -80.109158) is a small island located on a lake within the BallenIsles Country Club golf course. Nest counts were conducted on foot from vantage points on the north and south sides of the golf course. Kate Schlepr with Florida Atlantic University conducted most of the surveys this season while conducting WOST research.

The Solid Waste Authority of Palm Beach County (26.770188, -80.125313) has multiple spoil islands in abandoned shell pits that were mined in the early 1960s. Counts were done by boat, and it is certain that some interior nests were not counted. Only limited data were obtained this season due to the COVID-19 pandemic. Access to the Solid Waste Authority was not possible after February, so some species (e.g., White Ibis [WHIB]) had not started nesting and the peak numbers for WOST nests appear lower than previous years.

Wakodahatchee Wetlands (26.479889, -80.142326) is a manmade wetland where many wading bird species nest. WOST and other species were counted from the boardwalk, but not all species present were recorded. Only limited data were obtained this season due to the COVID-19 pandemic. Access to Wakodahatchee Wetlands was not possible after February, so some species had not started nesting and the peak numbers for WOST nests appear lower than previous years.

Sawgrass Ford (26.149837, -80.337621) is a spoil island behind the Sawgrass Ford dealership in Sunrise. Nest counts were conducted by circling the island in a kayak.

Griffin (26.063633, -80.366492) is in Emerald Estates Park. Surveys were done from the road on the south side of the colony or by kayak and foot from the north side. Kate Schlepr with Florida Atlantic University conducted most of the surveys this season while conducting WOST research.

ABC Islands Critical Wildlife Area (25.063633, -80.366492) encompasses three spoil islands on the eastern side of Marco Island. The islands are closed to public access year-round to protect nesting, migrating, and wintering birds. This site is cooperatively managed and monitored with Rookery Bay National Estuarine Research Reserve. Counts were conducted by boat, and it is certain that some interior nests were not counted.

RESULTS

Nest count data from each region are presented in **Table 16**.

Table 16. Peak numbers of nests at various locations from January to June 2020.

Colony	ANHI	BCNH	CAEG	DCCO	GBHE	GLIB	GREG	GWHE	LBHE	REEG	ROSP	SNEG	TRHE	WHIB	WOST
Bird Island CWA	+	+	2	6	+		43	+	+	+	6	+	1	+	78
BallenIsles				15			9					1	3		20
Solid Waste Authority		1			+		17		+		10	+	5		100
Wakodahatchee Wetlands				8	10	7	11	7	3		+	+	3		55
Sawgrass Ford				1			58					+	14		102
Griffin	+			+					1				6		71
ABC Islands CWA	+	+	+	5	6		6			2		3	2		
Total	**0**	**1**	**2**	**35**	**16**	**7**	**144**	**7**	**4**	**2**	**16**	**4**	**34**	**0**	**426**

+ Present but not counted.

Ricardo Zambrano and Andrea Pereyra (FWC) and Kate Schlepr (FAU)
Florida Fish and Wildlife Conservation Commission
8535 Northlake Boulevard
West Palm Beach, FL 33412
(561) 625-5122
Ricardo.Zambrano@myfwc.com

PALM BEACH COUNTY NATURAL AREAS

Staff at Palm Beach County's Department of Environmental Resources Management surveyed wading bird colonies in natural areas between January and May 2020 to assess nesting efforts. Only the Northeast Loxahatchee Slough colony was active during that period. A late season (July) colony was observed at Central Loxahatchee Slough.

METHODS

The Northeast Loxahatchee Slough colony was visited by staff on April 29. This colony is located within a matrix of pine flatwoods, marsh, and cypress swamp habitats. The 1.4-acre colony consists of two deepwater pond apple and willow heads within a larger cypress dome. From the ground, staff recorded the numbers of nests. Counts were recorded from multiple vantage points to ensure full coverage.

County staff opportunistically observed nesting at the Central Loxahatchee Slough colony in late July. Staff returned to survey the colony on July 28. At that time, all birds had fledged and staff counted nests in the 0.5-acre pond apple stand.

RESULTS

Small heron nesting was recorded at the Northeast Loxahatchee Slough Colony during four of the past five years (excluding 2017). This year's nesting efforts were the largest recorded, and nearly doubled the number of nests observed last year. Small heron nesting was only recorded at the Central Loxahatchee Slough colony in 2017 when drought conditions precluded nesting at the Northeast Loxahatchee Slough colony. This year's nesting effort at the Central Loxahatchee Slough colony was similar to 2017.

The Northeast Loxahatchee Slough colony had several nests with chicks too young to identify and were recorded as *Egretta* herons (SMHE). All the birds at the Central Loxahatchee Slough colony had fledged by the time of the survey. Staff could not determine what species occupied each nest; therefore, all the small heron nests were recorded as SMHE. Surveys of birds roosting at the Central Loxahatchee Slough colony indicated the composition was primarily Little Blue Herons (LBHE), with a few Tricolored Herons (TRHE), Cattle Egrets (CAEG), and Great Egrets (GREG) (**Table 17**).

Department of Environmental Resources Management Staff
Palm Beach County
2300 North Jog Road, Fourth Floor
West Palm Beach, FL 33411
(561) 233-2400
dwitmer@pbcgov.org

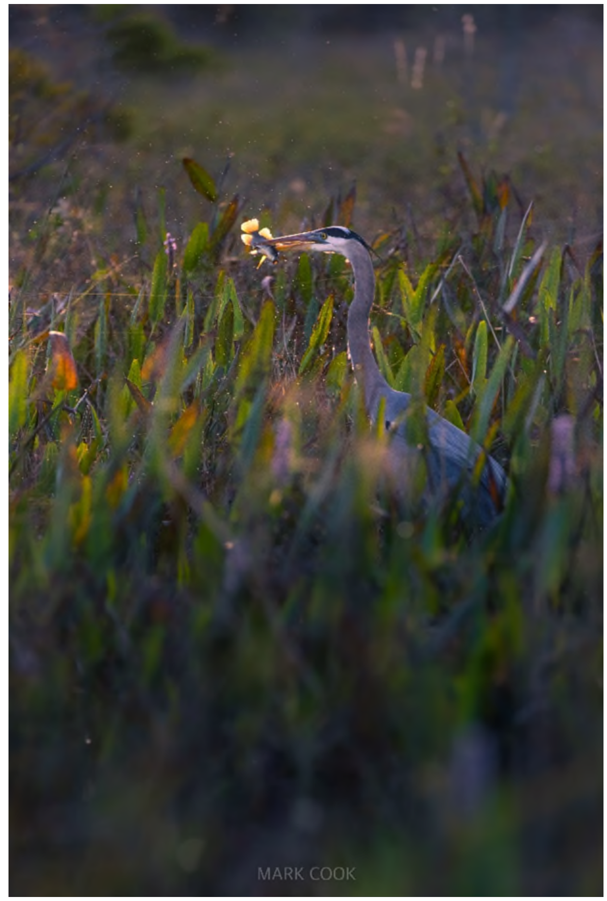
Table 17. Peak number of wading bird nests by species observed in the Loxahatchee Slough Natural Area.

Colony	Latitude	Longitude	CAEG	LBHE	TRHE	YCNH	SNEG	SMHE	Total
Northeast Loxahatchee Slough	26.89205	-80.17307	8	104	30	1	1	14	**158**
Central Loxahatchee Slough	26.86861	-80.1778						48	**48**

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. The Restoration Coordination & Verification (RECOVER) program established performance measures (http://www.evergladesplan.org/pm/recover) that include a 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 three measures, 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 to further capture key ecological relationships found in the historical ecosystem (Frederick et al. 2009). This section reports on the long-term trends and the current status of all the restoration performance measures. When considering the progress towards the restoration measures, it should be remembered that the hydrological system is not yet restored to provide anything like the ecological functions expected in a completed CERP. While the 2018 nesting season moved the needle considerably for most measures, the 2020 season was comparatively disappointing. Based on the recent status of the hydrological system, restored or even partially restored wading bird population indicators would not have been predicted.

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), this species has proven extremely difficult to consistently monitor due to the inability to see their dark plumage in colonies during aerial surveys. Ogden et al. (1997) lumped TRHE and SNEG population targets (e.g., 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).



RESTORATION METRICS

Numbers of Nesting Pairs

The 3-year running average for nesting pairs in the mainland Everglades (2018 to 2020) are 7,806 GREG pairs, 2,191 SNEG pairs, 46,347 WHIB pairs, and 1,911 WOST pairs (**Table 18**; **Figure 22**). Trends for GREG over time for this measure increased markedly from 1988 to 2004, and have been roughly stable since, with the 3-year running average meeting or exceeding restoration criteria for 24 consecutive sampling periods since 1996. Trends for SNEG also increased markedly from 1986 to 2004, dropped dramatically between 2005 and 2017, then rebounded considerably during the 2018 to 2020 nesting seasons. Generally, big nesting years for flock-foraging species show an increase in SNEG nesting. Nonetheless, 3-year running averages of breeding SNEG have been consistently well below the target restoration goal since 1986 when systematic monitoring began. The 3-year running average has increased markedly (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 2020) showed substantial fluctuation in WHIB nesting, with a 50% reduction in three of the years, and three of the five years in that period being well below the average of the previous decade. The huge nesting effort during the 2018 nesting season pulled the running average up markedly, and the running average may remain high for the next 3 years because of the 2018 contribution. WHIB nesting populations have met or exceeded the breeding population criterion for the past 20 years. WOST showed a marked increase from averages in the 2- to 300-pair range (1986 to 1992) to averages above 1,000 pairs in many years after 1999. WOST have equaled or exceeded the restoration population criterion during 11 of the last 20 years, including 2020.

Table 18. Three-year running averages of the number of nesting pairs for four indicator species in the mainland Everglades (water conservation areas and Everglades National Park, not including Florida Bay). Bolded years are those that meet minimum criteria.

Period	GREG	SNEG	WHIB	WOST
1986-1988	1,946	1,089	2,974	175
1987-1989	1,980	810	2,676	255
1988-1990	1,640	679	3,433	276
1989-1991	1,163	521	3,066	276
1990-1992	2,112	1,124	8,020	294
1991-1993	2,924	1,391	6,162	250
1992-1994	3,667	1,233	6,511	277
1993-1995	3,843	658	2,107	130
1994-1996	**4,043**	570	2,172	343
1995-1997	**4,302**	544	2,850	283
1996-1998	**4,017**	435	2,270	228
1997-1999	**5,084**	616	5,100	279
1998-2000	**5,544**	1,354	**11,270**	863
1999-2001	**5,996**	2,483	**1,655**	**1,538**
2000-2002	**7,276**	6,455	**23,983**	**1,868**
2001-2003	**8,460**	6,131	**20,758**	**1,596**
2002-2004	**9,656**	6,118	**24,947**	1,191
2003-2005	**7,829**	2,618	**20,993**	742
2004-2006	**8,296**	5,423	**24,926**	800
2005-2007	**6,600**	4,344	**21,133**	633
2006-2008	**5,869**	3,767	**17,541**	552
2007-2009	**6,956**	1,330	**23,953**	1,468
2008-2010	**6,715**	1,723	**21,415**	**1,736**
2009-2011	**8,270**	1,947	**22,020**	**2,263**
2010-2012	**6,296**	1,599	**11,889**	1,182
2011-2013	**7,490**	1,299	**16,282**	**1,686**
2012-2014	**7,041**	1,017	**17,194**	**1,696**
2013-2015	**6,300**	710	**21,272**	**1,639**
2014-2016	**5,328**	837	**17,379**	995
2015-2017	**5,655**	639	**17,974**	1,195
2016-2018	**8,803**	1,224	**41,465**	**2,152**
2017-2019	**7,966***	1,840*	**44,967**	**2,282**
2018-2020	**7,806**	2,191	**46,347**	**1,911**
Target Minima	4,000	10 – 20k	10 – 25k	1.5 - 2.5k

* Average has been corrected as erroneous data were reported for the 2019 report (Volume 25).

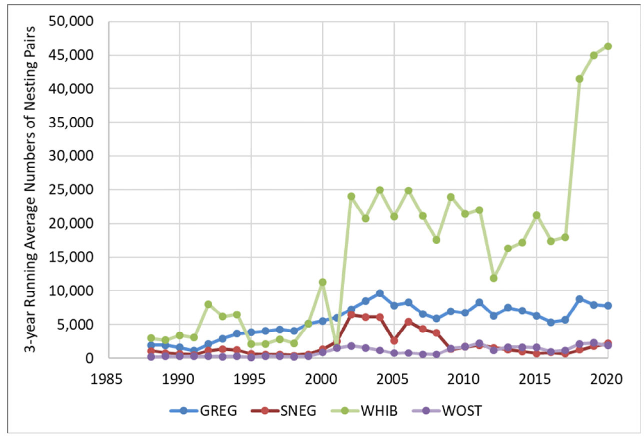


Figure 22. Trends in nesting pairs of four target species since 1986.

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 these species have met restoration targets in many or most years. While SNEG appear to be rebounding in the last 2 years, this species has never met restoration targets. In addition, there is evidence from systematic ground surveys in WCA-3 (see *Water Conservation Areas 2 and 3, and A.R.M. Loxahatchee National Wildlife Refuge* section) that breeding populations of the other two small herons in the genus *Egretta* (TRHE and Little Blue Heron [LBHE]) are also declining sharply in the Everglades.

Coastal Nesting

More than 90% of indicator species nesting is estimated to have occurred in the southern ecotone region during the 1930s and early 1940s, likely because it was the most productive area. A major restoration hypothesis holds that the reduction of freshwater flows to the coastal region 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 23**), and during the last several years has ranged between 15% and 41%. In 2020, 25% of all nests were in ENP, which is high compared with the average since 1986 but a considerable reduction from 2018 (41%). This metric is not yet meeting the target of 50%, but the trend has been improving in recent years.

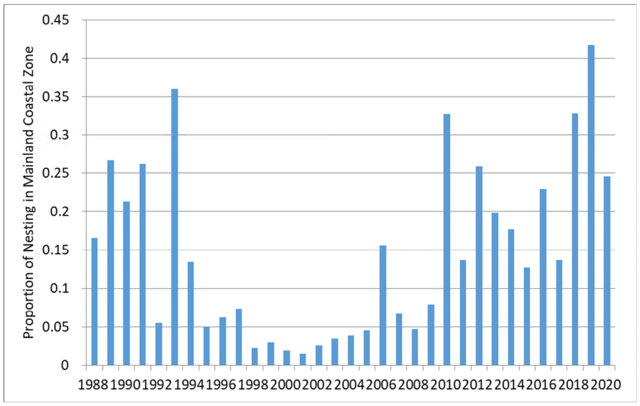


Figure 23. Proportion of all mainland Everglades nests located in the coastal estuarine zone, 1986 to 2020.

Ratio of Visual to Tactile Foragers

This measure recognizes that the breeding wading bird community has shifted from being numerically dominated by tactile foragers (WOST and WHIB) 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 both 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 can forage both in groups and 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 7.9 in 2018), the metric is still an order of magnitude less than the restoration target. In 2020, the ratio was 3.8 (**Figure 24**), and the 5-year running average was 4.76. The running average is still strongly influenced by the high proportions in 2018 and 2019.

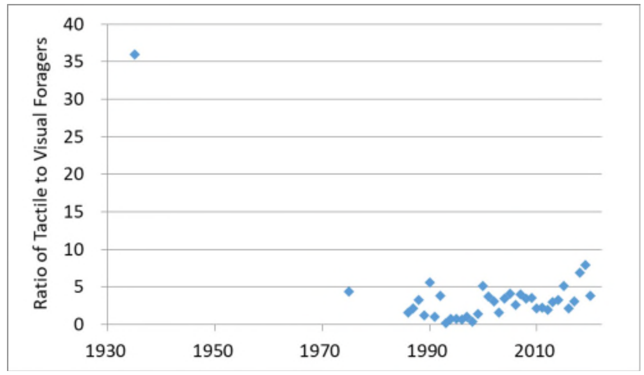


Figure 24. Ratio of tactile feeding species (WHIB and WOST) nests to sight foraging (GREG) nests in the Everglades, 1930 to 2020.

Timing of Nesting

This parameter applies only to the initiation of nesting for WOST, which has shifted from November through December (1930s through 1960s) to January through 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, with variation around a February mean initiation date since the 1980s (**Figure 25**). Although some years in the mid-2000s showed earlier nesting, there has been no lasting improvement. The 2018 season start (late December) was quite early compared with recent years and was only one of three years in the last 30 years in which WOST have initiated nesting by the end of December. The 2020 date was mid-January, which was similar to recent years. The 4-year running average for 2020 was 3.2, which corresponds to an averaged nest initiation date of early January. This metric has seen steady improvement since 2016, though much of the consistency may be traced to the lagged nature of the metric being a running average.

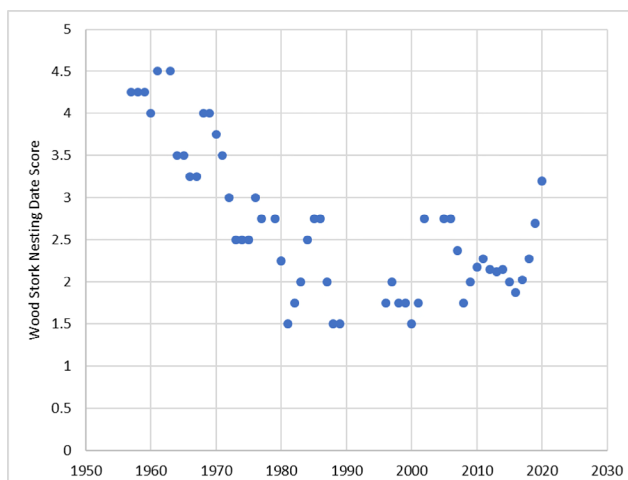


Figure 25. Four-year running average of WOST nest initiation date in the Everglades. Initiation in March is a 1, initiation in November is a 5.

Exceptionally Large Ibis Aggregations

Episodic, exceptionally large breeding aggregations of WHIB were characteristic of the pre-drainage system and are thought to be indicators of the wetland system's ability to produce very large pulses of prey, resulting in part from typical cycles of drought and flood. Large breeding aggregations during the recent period are defined as more than 16,977 nests each year, 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 notably improved since the 1970s, with the target achieved in 12 of the last 13 years. The 2020 WHIB nesting reached the restoration criterion, and the interval averaged over the last 5 years is 1.4 years, slightly more frequently than in the 1930s.

DISCUSSION

While there have been real improvements in several of the measures during the past one or two decades, several key measures are stalled and not showing further improvement. Two measures are genuinely hopeful: numbers of nesting pairs of 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. There has been real progress in the location of nesting, with dramatic increase in 2018 and 2019, and an apparent positive trend. Nonetheless, there is much room for improvement, especially in the multi-year mean. While the numbers of SNEG have improved in the last 2 years, they remain far from restoration targets. There is little evidence that the timing of WOST nesting is improving on average, despite early nesting from 2017 to 2019. The ratio of tactile to visual foragers has improved since the mid-2000s but remains an order of magnitude below the restoration target.

Over the last two decades, wading birds likely have responded to a combination of altered water management regimes, favorable rainfall patterns, and changing hydropatterns by nesting more consistently in the coastal zone and by increasing populations of WHIB and WOST. While these population increases might be attributable, at least partly, to forces outside the Everglades system, the fact that these species have been attracted to nest in the Everglades in larger numbers, and that nesting has often been successful, suggests that nesting remains a solid indicator of ecological conditions. The lack of movement of the other measures suggests that the current hydrological management regimes are not powerful enough to nudge 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.

Peter Frederick
Department of Wildlife Ecology and Conservation
University of Florida
P.O. Box 110430
Gainesville, FL 32611
(352) 846-0565
pfred@ufl.edu

SPECIAL TOPICS

BIOLOGY AND CONSERVATION OF THE AMERICAN FLAMINGO IN FLORIDA: UPDATE FOR 2020

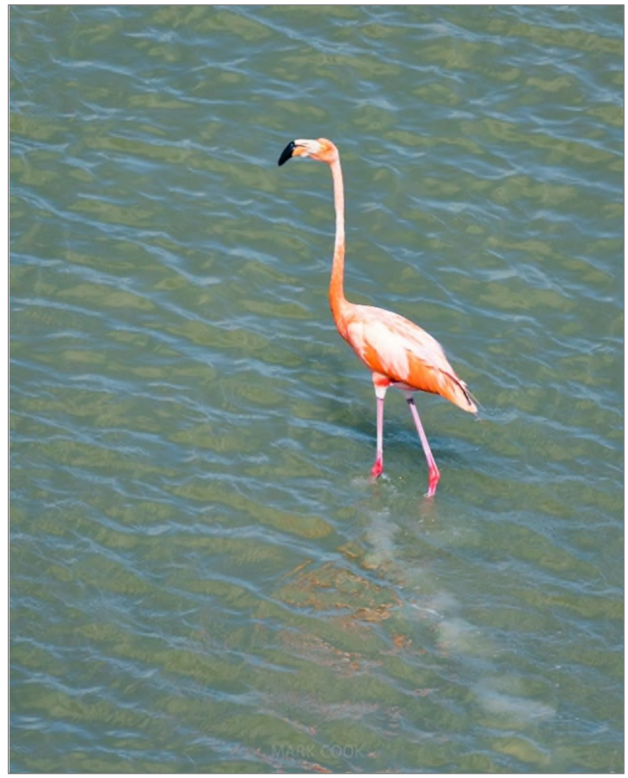
Recent years have seen a broad rise in interest in the biology and conservation of the American Flamingo (AMFL) in South Florida. Since the 1920s, AMFL in South Florida wildlands typically had been viewed by ornithologists as escaped birds from one of Florida's many animal attractions (Bailey 1928, 1932; Allen 1954). Yet heightened scrutiny over the birds' origins was triggered by the appearance of banded AMFL in Florida Bay from nesting colonies in Yucatan, Mexico (Galvez et al. 2016), and with the regular yearly arrival of foraging flocks in Stormwater Treatment Area (STA) 2, numbering up to 147 AMFL in 2014. To clarify a population history for the species, Whitfield et al. (2018a) reconstructed historical baselines from 19th century and population trends from 1950 to 2015 using community science databases. The data showed definitive evidence for a historical population driven extinct by hunting and a recent increase in AMFL observations, likely an indication of nascent recovery in Florida as nesting areas around the Caribbean have grown considerably. Subsequently, Whitfield et al. (2018b), on behalf of several conservation organizations in South Florida, petitioned the Florida Fish and Wildlife Conservation Commission (FWC) to evaluate whether AMFL warrant inclusion under Florida's threatened species laws.

FWC BIOLOGICAL STATUS REVIEW

In fall 2018, the FWC began internal processing of the petition to list AMFL, and by the end of 2018 moved forward to convene a Biological Review Group – a panel of species experts from outside the FWC to review biological information on AMFL and apply the FWC's standard listing criteria. The Biological Review Group concluded its work in early 2020, and the listing process has returned to the FWC's Division of Habitat and Species Conservation for further review. The FWC presented its decision on the petition at the May 2021 commission meeting. A listing recommendation from the FWC commissioners could lead to increased protections for AMFL and efforts to help the population recover in Florida.

OCCASIONAL LONG-TERM RESIDENCY OF AMFL IN FLORIDA

Sightings of AMFL generally are viewed as short-term stopovers or storm-displaced birds that quickly depart Florida for other areas, rather than long-term residents (McNair and Gore 1998, Pranty and Basili 2007). However, new observations suggest that at least some AMFL may be staying in Florida for longer than brief stopovers. In late 2015, a team of biologists captured an AMFL from the Naval Air Station in Key West, given the informal name of "Conchy." After a short rehabilitation period, Conchy was equipped with bands and a satellite transmitter, and was released in Florida Bay. While the team expected Conchy to quickly depart Florida, Conchy's transmitter returned coordinates from within Florida Bay for 22 months before ultimate failure in 2017 (Whitfield et al. in press). Since 2017, Conchy's record as the longest-residing AMFL in recent history appears to have been upended. On October 31, 2018, a lone AMFL was sighted in St. Marks National Wildlife Refuge (Wakulla County) and reports through eBird continued through January 2021 (Mauro et al. 2020). This AMFL is currently spending its third winter in northern Florida, raising questions about the environmental tolerances of the species and length of residency.



DETERMINING THE ORIGINS OF FLORIDA'S FLAMINGOS

While three banded AMFL sighted in Florida Bay and the Florida Keys provide definitive links to the nesting area in Yucatan, Mexico, it is far from clear what proportion of AMFL in Florida are of Mexican origin. Mexico's banding operations in recent years have outpaced banding efforts in other nesting areas, including nearby areas such as Cuba and The Bahamas (Clum 2006, Galvez et al. 2016). Two ongoing studies should help clarify the origins of AMFL. First, Zoo Miami is nearing completion of a study that aims distinguish wild and captive AMFL based on stable isotope analysis of feathers, which may also shed light on geographic origins of AMFL in Florida. Second, in collaboration with Dr. Eric Hoffmann at the University of Central Florida, Zoo Miami is conducting a population genomic study of AMFL in Florida and nearby breeding colonies – from modern living flamingos in captive populations and the wild, and from flamingos collected by naturalists more than a century ago. Understanding current and historical population structure and connectivity will be an important step in developing evidence-based conservation and management strategies.

FLORIDA FLAMINGOS WORKING GROUP

In late 2020, a group of conservation biologists and wildlife managers from a broad network of local, state, federal, and private organizations met to discuss a research and conservation agenda for Florida's flamingos. Through a series of meetings in November and December 2020, the team collectively decided to hold quarterly meetings to discuss conservation, research, management, and advocacy on behalf of AMFL in Florida and throughout the Caribbean. Those interested in joining the Florida Flamingos Working Group should contact Steven Whitfield at steven.whitfield@miamidade.gov.

Steven M. Whitfield
Conservation and Research Department
Zoo Miami
12500 SW 152nd Street
Miami, FL 33177
(305) 251-0400
Steven.Whitfield@miamidade.gov

LITERATURE CITED

Allen, R.P. 1954. Comments on the status of the flamingo in Florida. Everglades Natural History 2:115-118.

Audubon Florida. 2004. Project Colony Watch: A Colonial Waterbird Protection Project. http://www.tbep.org/pdfs/FinalColonyWatchHandbook.pdf.

Bailey, H. 1928. Regarding a late Florida record of the flamingo. The Wilson Bulletin 40:197-198.

Bailey, H.H. 1932. Nature faking in Florida. Oologist 49:69.

Beerens, J.M., D.E. Gawlik, G. Herring, and M.I. Cook. 2011. Dynamic habitat selection by two wading bird species with divergent foraging strategies in a seasonally fluctuating wetland. Auk 128:651-662.

Beerens, J.M., E.G. Noonburg, and D.E. Gawlik. 2015. Linking dynamic habitat selection with wading bird foraging distributions across resource gradients. PLoS ONE 10(6):e0128182.

Bjork, R.D. and G.V.N. Powell. 1994 Relationship between hydrologic conditions and quality and quantity of foraging habitat for Roseate Spoonbills and other wading birds in the C-111 basin. Final report to the South Florida Research Center, Everglades National Park, Homestead, FL.

Boyle, R.A., N.J. Dorn, and M.I. Cook. 2014. Importance of crayfish prey to nesting White Ibis (*Eudocimus albus*). Wetlands 37:19-29.

Clem, S.E. and B. Cornell. 2021. Investigation of observed drier conditions in long-term data at Lettuce Lake by National Audubon Society's Corkscrew Swamp Sanctuary. Final report to South Florida Water Management District, Big Cypress Basin, Naples, FL.

Clem, S.E. and M.J. Duever. 2019. Hydrologic changes over 60 years (1959-2019) in an old-growth bald cypress swamp on a rapidly developing landscape. Wetland Science & Practice 36(4):362-372.

Clum, N. 2006. Bahamas Flamingo (*P. ruber*). Bulleting of the IUCN-SSC/Wetlands International Flamingo Specialist Group 14:6.

Cook, M.I. and M. Baranski. 2020. Systemwide Summary, pp. 1-5. In. M.I. Cook and M. Baranski (eds.), South Florida Wading Bird Report, Volume 25. South Florida Water Management District, West Palm Beach, FL.

Cook, M.I., E.M. Call, R.M. Kobza, S.D. Hill, and C.J. Saunders. 2014. Seasonal movements of crayfish in a fluctuating wetland: Implications for restoring wading bird populations. Freshwater Biology 59:1,608-1,621.

Cox, W.A., A. Schwarzer, R. Kiltie, A. Paul, M. Rachal, G.M. Kent, K.D. Meyer, J.J. Lorenz, P.E. Frezza, H. Rafferty, and S. Roebling. 2017. Development of a survey protocol for monitoring Reddish Egrets (*Egretta rufescens*) in Florida, USA. Waterbirds 40(4):334-343.

Dorn, N.J. and M.I. Cook. 2015. Hydrological disturbance diminishes predator control in wetlands. Ecology 96:2,984-2,993.

Frederick, P.C. and J.C. Ogden. 2001. Pulsed breeding of long-legged wading birds and the importance of infrequent severe drought conditions in the Florida Everglades. Wetlands 21:484-491.

Frederick, P.C., D.E. Gawlik, J.C. Ogden, M.I. Cook, and M. Lusk. 2009. The White Ibis and Wood Stork as indicators for restoration of the Everglades ecosystem. Ecological Indicators 9:S83-S95.

Galvez, X. L. Guerrero, and R. Migoya. 2016. Evidencias fisicas de la estructura metapoblacional en el Flamenco Caribeño (*Phoenicopterus ruber ruber*) a partir de avistamientos de individuos anillados. Revista Cubana de Ciencias Biologicas 4:93-98.

Gawlik, D.E. 2002. The effects of prey availability on the numerical response of wading birds. Ecological Monographs 72:329-346.

Herring, G., M.I. Cook, D.E. Gawlik, and E.M. Call. 2011. Physiological stress responses of nestling white ibis to variable food availability. Functional Ecology 25:682-690.

Lorenz, J.J. 2014. The relationship between water level, prey availability and reproductive success in Roseate Spoonbills foraging in a seasonally flooded wetland while nesting in Florida Bay. Wetlands 34:201-211.

Lorenz, J.J., J.C. Ogden, R.D. Bjork, and G.V.N. Powell. 2002. Nesting patterns of Roseate Spoonbills in Florida Bay 1935-1999: Implications of landscape scale anthropogenic impacts, pp. 555-598. In: J.W. Porter and K.G. Porter (eds.), The Everglades, Florida Bay and the Coral Reefs of the Florida Keys: An Ecosystem Sourcebook. CRC Press, Boca Raton, FL.

Lorenz, J.J., B. Langan-Mulrooney, P.E. Frezza, R.G. Harvey, and F.J. Mazzotti. 2009. Roseate Spoonbill reproduction as an indicator for restoration of the Everglades and the Everglades estuaries. Ecological Indicators 9S:S96-S107.

Mauro, A., S.M. Whitfield, F.N. Ridgley, and J.J. Lorenz. 2020. American flamingos in Florida: Updates on sightings, distributions, and conservation efforts. Flamingo, Bulleting of the IUCN-SSC/Wetlands Internal Flamingo Specialist Group 5:11.

McNair, D.B. and J.A. Gore. 1998. Assessment of occurrences of flamingos in northwest Florida, including a recent record of the greater flamingo (*Phoenicopterus ruber*). Florida Field Naturalist 26:40-43.

Muxo, R., K.R.T. Whelan, R. Urgelles, J. Alonso, J.M. Patterson, and A.J. Atkinson. 2015. Biscayne National Park Colonial Nesting Birds Monitoring Protocol, v. 1.00. Natural Resource Report NPS/SFCN/NRR—2015/994. National Park Service, Fort Collins, CO.

Ogden, J.C. 1994. A comparison of wading bird nesting dynamics, 1931-1946 and 1974-1989 as an indication of changes in ecosystem conditions in the southern Everglades, pp. 533-570. In: S. Davis and J.C. Ogden (eds.), Everglades: The Ecosystem and its Restoration. St. Lucie Press, Delray Beach, FL. 848 pp.

Ogden, J.C., G.T. Bancroft, and P.C. Frederick. 1997. Ecological success indicators: Reestablishment of healthy wading bird populations. In: Ecologic and Precursor Success Criteria for South Florida Ecosystem Restoration. A Science Subgroup report to the South Florida Ecosystem Restoration Working Group.

Powell, G.V.N. and R.D. Bjork. 1990. Studies of wading birds in Florida Bay: A biological assessment of the ecosystem. Comprehensive report 1987-1990 to Elizabeth Ordway Dunn Foundation. National Audubon Society Field Research Department, Tavernier, FL.

Pranty, B. and G.D. Basili. 2007. First record of the Greater Flamingo for northeastern Florida. Florida Field Naturalist 35:114-118.

Trexler, J.C., W.F. Loftus, and S. Perry. 2005. Disturbance frequency and community structure in a twenty-five year intervention study. Oecologia 145(1):140-152.

Whitfield, S.M., P. Frezza, F.N. Ridgley, A. Mauro, J.M. Patterson, A. Pernas, and J.J. Lorenz. 2018a. Status and trends of American Flamingos (*Phoenicopterus ruber*) in Florida, USA. The Condor 120:291-304.

Whitfield, S.M., F.N. Ridgley, M. Davis, A. Pernas, P. Frezza, and J. Dunster. 2018b. Petition to evaluate species status of American Flamingo (*Phoenicopterus ruber*) in Florida.

Whitfield, S.M., J.M. Patterson, A. Pernas, M. Davis, J.J. Lorenz, and F.N. Ridgley. In press. Satellite telemetry reveals habitat use and movement patterns of an American Flamingo in Florida Bay. Florida Field Naturalist.