

FINAL REPORT
South Carolina State Wildlife Grant SC-T-F16AF00707
South Carolina Department of Natural Resources
October 1, 2016 – September 30, 2018

Project Title: Conservation of seabirds, shorebirds, wading birds, and marsh birds in South Carolina

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Objective 1:

Seabird and Shorebird Components

- a) Reduce disturbance of beach nesting seabirds and shorebirds on public and private islands.
- b) Annually assess population trends for colonial nesting seabirds: black skimmer, brown pelican, gull-billed tern, least tern, sandwich tern, royal tern, Forster's tern, and common tern. This information is essential for oil spill, wind energy, and climate change planning.
- c) Increase nesting productivity, especially for least terns.
- d) Assess migratory shorebird trends in South Carolina, especially for listed species (red knot and piping plover).

Accomplishments:

- a) Reduce disturbance of beach nesting seabirds and shorebirds on public and private islands.

We coordinated with private, federal, state, and county owned beach managers to close part of the beach for nesting seabirds and shorebirds. This involved 2-10 site visits at each property depending on the partnership with the land manager. Site visits included meeting with managers to discuss importance of nest protection and monitoring; visits to place, maintain, and remove signs; and nest monitoring. Educational signs were placed at boat ramps and on some beach entrances. We placed closure signs at nesting sites on 20 beaches and at 2 beaches during the winter to protect roosting migratory shorebirds (Figure 1).

- b) Annually assess population trends for colonial nesting seabirds: black skimmer, brown pelican, gull-billed tern, least tern, sandwich tern, royal tern, Forster's tern, and common tern. This information is essential for oil spill, wind energy, and climate change planning.

To determine the abundance and distribution of nesting populations of seabirds in South Carolina, all active seabird colonies including black skimmer, brown pelican, common tern, Forster's tern, gull-billed tern, least tern, sandwich tern and royal tern were surveyed over the study period. Some nest estimates were a result of an actual count of nests. Counts occurred during the peak incubation period for each species. Ground counts consisted of staff and volunteers slowly walking transects through the colonies and tallying nests of each species. To minimize disturbance to nesting birds or if ground counts were not possible, staff used binoculars

or spotting scopes to count the number of adults sitting in incubation postures as a proxy for nest counts.

Nest counts that are conducted while walking through colonies can be disruptive, especially to larger seabirds such as brown pelicans, which have the potential to dislodge eggs from their nests or to become entangled in dense vegetation when flushing from the nest. To reduce the amount of disturbance to brown pelicans and crested terns, these species were counted using aerial photographic surveys of colonies. Flights were conducted by SCDNR Law Enforcement pilots in a twin engine fixed-wing Partenavia aircraft. Two SCDNR biologists accompanied the pilot: one to help direct the pilot over pelican colonies and the other to take photographs of the colonies through Bombay doors in the aircraft. Survey altitude was primarily 1000 ft. – 700 ft. and the aircraft often made several passes over the colonies to ensure complete photographic coverage. Photographs were taken using a Canon EOS 7D Mark II digital SLR camera.

In 2018, Unmanned Aerial Vehicles (UAVs or Drones) were also used for surveying colonial seabirds. UAVs have the potential to capture superior aerial imagery compared to photographs taken from fixed-wing manned aircraft and may be able to collect data with less disturbance to the birds than ground counts.

Counts from digital images were made using Image J, an image processing program which allows the user to tag items (nests) for automatic count tallying. The locations of the largest colonies are displayed in Figure 2 and number of nests counted or estimated by year are reported in Tables 1 and 2.

c) Increase nesting productivity, especially for least terns.

Breeding estimates for least terns are reported separately. Although they nest on beaches, they also nest on gravel rooftops and other artificial substrates and thus require unique management strategies. In 2017 the nest estimate for least terns in South Carolina was 1,464. In 2018 the nest estimate for least terns in South Carolina was 1,200. In 2017, ground or natural site nests (Table 3) totaled 491 (33.5%), and artificial site nests (Table 4) totaled 973 (66.5%). In 2018, ground site nests (Table 5) totaled 584 (48.7%), and artificial site nests (Table 6) totaled 616 (51.3%). Ground sites were defined as sites on natural beaches. Artificial sites are manmade and require management such as vegetation control or fences at the edge of the roof to prevent chicks from falling off the building. All ground sites were accessed by boat except for East Kiawah Island, Seabrook and Edisto Island. All artificial sites were accessed by vehicle over a 4 county area comprising Charleston, Berkeley, Georgetown, and Horry Counties. Bulls Island and the Savannah Spoil Site were visited by boat. The Savannah Spoil Site is managed by the Army Corps of Engineers and is not open to the public.

In 2017, the majority of least tern ground colonies (70.0%) were considered successful. 402 nests were considered successful. In 2018, at least 6 of the 13 least tern ground colonies were considered partially successful (< 50.0% of nests survived) to successful (>50.0% of nests survived). These 6 sites had 441 nests (75.5%) compared to 143 nests (24.5%) in the failed sites. Negative impacts on failed colonies included wash over from extreme high tides (up to 7.0 ft.) occurring April through July, predation, and human/dog disturbance.

In 2017, ten of the 14 artificial sites failed but the 4 successful sites had 66% (794 nests) of the total successful nests in SC. A contributing factor to failure of colonies on roofs was the large amount of rain during May through July. For example, the total rainfall in Charleston County (<https://www.weather.gov/chs/climate>) during late May through July was 18.85 inches which is 3.65 inches above the annual average. During this period, May had a rain event of 3 successive days totaling 1.8 inches, and June had 4 successive days totaling 2.4 inches. Heavy rain events on flat gravel-covered roofs often result in flooding and wash out of eggs and young (Krogh and Schweitzer 1999). Avian and mammalian predators also contribute to nest failure.

In 2018, six of the 19 artificial sites were successful with 384 nests (62.3% of the total nests). The 13 failed sites had 232 nests (37.7% of the total nests). Primarily avian and mammalian predators contributed to nest failure.

Conclusion:

The least tern nest estimate of 1,464 (2017) and 1,200 (2018) was higher than the 8 year mean of 1,139 nests per year from the State Wildlife Grant report “Conservation of Water, Shore, and Seabirds in South Carolina, October 1, 2008 to September 30, 2016.” In 2017, a total of 24 sites hosted nesting least terns. 11 (45.8%) of the colonies were considered successful. In 2018, a total of 32 sites hosted nesting least terns. Twelve (37.5%) of the colonies were considered successful.

- d) Assess migratory shorebird trends in South Carolina, especially for listed species (red knot and piping plovers).

Red Knot

We continued to capture red knots in 2017 and 2018, Table 7. The purpose of the capture was to retrieve previously placed geolocators and to place 19 nanotags on knots. The nanotags are a type of small radio transmitter. The tag’s frequency can be picked up by Motus Towers. The nanotags help us understand northern migration routes and time of departure from South Carolina. Location data from nanotagged knots suggest that two-thirds of the knots in SC may fly directly to the Arctic after leaving SC beaches in the spring. One knot captured in 2017 had a geolocator, see Figure 3 for migration route. Additionally, a Red Knot with a geolocator was recaptured in South America, see Figure 4 for one year of this knot’s migration.

Ruddy Turnstone

We captured 45 Ruddy Turnstones in spring 2018 and placed nanotags on them. They were primarily captured while eating horseshoe crab eggs at Turtle Island Heritage Preserve. Similar to Red Knots, some migrated north up the Atlantic coast in the spring and others flew directly to Arctic habitat from South Carolina.

American Oystercatcher

Shorebird nest monitoring only occurred at Botany Bay Plantation in 2017 (Figure 5). 4 pairs of oystercatchers nested at Botany Bay WMA. One pair nested on Interlude Beach and 3 pairs nested on Townsend Beach (Table 8). The first oystercatcher nests were found on April 10th (1 egg nest on Townsend Beach; 2 egg nest on Interlude Beach). Two pairs re-nested during the season after nest failure. One nest hatched and fledged 2 chicks yielding a productivity of 0.5

chicks per pair for the season. Mammalian predation was the cause of failure for most nest attempts (Figure 6).

Wilson's Plover

10 pairs of Wilson's plovers nested at Botany Bay this season with the majority of pairs located on Townsend Beach (Table 9). The first nest (1 egg) was found on April 10th on Townsend Beach. Five pairs re-nested during the season after failure and re-nest attempts continued through the end of June. Mammalian predation was the primary cause of nest failure this season. One nest hatched this season fledging 3 chicks and yielding a productivity estimate of 0.3 chicks per pair (Figure 7).

In October 2016, a foot bridge connecting beach access to the property was damaged by Hurricane Matthew and not replaced until after the shorebird nesting season in August 2017. SCDNR staff were only able to access the beach during a short window of time during low-tide (~2-3 hours) for shorebird nest checks. This season, it appeared that shorebird nests were being predated as soon as they were laid with several nests being eaten before a full clutch was laid. Predator control was conducted in late April/early May, but the trapper was not able to remove many animals due to accessibility issues from the damaged footbridge. However, of the 2 nests that hatched this season, both were able to fledge chicks suggesting that the most vulnerable time for beach nesting birds is the nest initiation and incubation stage.

International Shorebird Surveys

International shorebird surveys (ISS) are surveys of shorebird numbers at designated sites conducted monthly year-round or every 10 days during migration. ISS are conducted at important shorebird areas across North, Central and South America. The purpose of these surveys is to describe shorebirds' distribution, abundance, and habitat relationships; monitor trends in shorebird population size; monitor shorebird numbers at stopover locations; and assist local managers in meeting their shorebird conservation goals. Shorebird surveys were conducted in Cape Romain NWR, on Capers Island Heritage Preserve, and at Deveaux Bank Seabird Sanctuary. Surveys in Cape Romain NWR were only conducted in 2017 and are summarized in Table 10.

Significant deviations:

None.

Objective 2:

Wading Bird Components

- a) Assess population trends for wood storks.
- b) Annually assess wood stork nesting success.
- c) Monitor the distribution of active egret and heron colonies and maintain current records that can be considered by planners, managers, and property owners.

Accomplishments:

- a) Assess population trends for wood storks.

Aerial Wood Stork Surveys and Ground Counts of Nests

The SCDNR Wading Bird Project surveyed all wood stork colonies that were known to be active during 2017 and 2018 (Table 11, Figures 8 and 9). Aerial surveys were used to locate the nesting colonies. Stork nests were counted during ground surveys or, when ground surveys were not possible, from photographs taken during aerial surveys. Point-to-point flights were used to survey wading bird colonies of the coastal region and coastal plains where suitable stork nesting habitat was known to exist. We counted 2,480 and 1,730 wood stork nests during 2017 and 2018, respectively.

State Wildlife Grant SC-T-F16AF00707 funded the salary for a technician to assist the project biologist with surveys, nest monitoring, and management activities. Flights were funded through USFWS Grant Agreement F16AC00912. Surveys were conducted from fixed-wing aircraft (Cessna 206, Cessna 210, and Vulcan Air P68) owned and operated by the SCDNR Law Enforcement Division.

Wood Stork Nestling Banding Project

Beginning during 2013, SCDNR banded wood stork nestlings as part of a regional project. During 2017, SCDNR banded 49 stork nestlings. Dr. Kristina Ramstad, Assistant Professor at the University of South Carolina, Aiken accompanied SCDNR to the colony and collected samples for her genetics study. Only 7 stork nestlings were banded during 2018. Nesting was very asynchronous, so we were unable to access the rookery when most of the chicks were at the optimal age for banding due to concerns about causing great egret and older stork chicks to prematurely leave their nests.

- b) Annually assess wood stork nesting success.

Wood Stork Colony Fate Surveys

During mid-June, additional point-to-point flights were used to determine if storks were successful at raising chicks or if the colonies had failed during the nesting season. Colonies were considered to be successful if large stork chicks and/or recent fledglings were observed in the majority of the number of nests counted during the annual census. During 2017 and 2018, storks successfully fledged chicks at the majority (19 of 23) of the active colonies. Wood storks typically nest in trees in flooded forests or on small islands surrounded by water. If there is adequate water, alligators below the nests deter predators, such as raccoons, from swimming to the nesting trees and eating stork eggs and/or chicks.

Mammalian predation is believed to be the primary cause of reproductive failure at unsuccessful colonies where storks nest in shrubs along the edges of ponds in residential communities. Other potential causes of colony failure for wood storks include inadequate or inaccessible food during the chick rearing period and disturbance. If adult storks are disturbed and leave their nests, crows and other predators have the opportunity to depredate eggs and small chicks. Even where

predators are not a threat, disturbance can result in nest failure because eggs and small chicks are vulnerable to overheating when adults are not able to shade their nests.

Wood Stork Nest Monitoring

During 2011, SCDNR began monitoring a sub-set of the stork nests in index colonies to determine how successful the storks are at raising young in South Carolina. During 2017, SCDNR staff, USFWS staff, and a trained volunteer monitored nests at six colonies located between Savannah and Charleston. Four of these index colonies were also monitored during 2018. Two of the index colonies are on land managed by SCDNR (Donnelley Wildlife Management Area and Dungannon Plantation Heritage Preserve), and the other four colonies are on private land. One additional site where storks attempted to nest during previous years was also monitored by a volunteer during 2017; however, no nest attempts were initiated.

At each colony, individual stork nests were mapped as they were initiated and were monitored from a distance (using a spotting scope or binoculars) approximately once per week from the time that egg laying began until the chicks reached fledging age (mature enough to fly, which is about 7-8 weeks after hatching). The average number of chicks that survived to fledging age per nest was determined for each colony. A detailed protocol was used to standardize monitoring techniques (protocol is available by request).

During 2017, a total of 232 stork nests were monitored in seven colonies, and an average of 1.7 chicks fledged per nest site (Table 12). An average of 2.0 chicks fledged per successful nest site. In the 157 stork nest sites that were monitored during 2018 (Table 13), an average of 1.6 chicks fledged (2.2 per successful nest). The federal recovery goal for wood storks is an average of 1.5 fledglings per nest.

- c) Monitor the distribution of active egret and heron colonies and maintain current records that can be considered by planners, managers, and property owners.

Point-to-point aerial surveys of a subset of the known wading bird colonies in South Carolina were used to monitor the distribution and relative size of wading bird colonies during 2017. This year, only coastal colonies were surveyed. We focused our efforts on the areas that were most likely to have wood stork colonies. The flights were timed to coincide with peak nesting for wood storks and great egrets in the coastal region. Nest numbers were estimated and all species seen in each colony were recorded during the aerial surveys. Aerial photographs were taken of all active colonies. All species of wading birds were counted during the surveys.

The number of roseate spoonbills in South Carolina during the post-breeding season appears to be increasing; however, nesting has not yet been confirmed in the State. Many of the spoonbills seen in South Carolina are immature individuals. No reddish egret nests were found during the 2011-2018 surveys. Yellow-crowned night herons and green herons often nest in small inconspicuous colonies and were rarely located during surveys.

Conclusions from Wood Stork Surveys and Nest Monitoring

Wood storks appeared to have a productive nesting season during 2017. The number of nests counted was near the record high count of 2,512 nests set during 2016, and the average number

of fledglings from monitored nests exceeded the recovery goal of 1.5. During 2018, the number of nests counted dropped down to pre-2008 numbers; however the average number of fledglings per monitored nest still exceeded the recovery goal. Unusually warm weather during January and February followed by cold weather during March appeared to result in lower nest numbers due to abandonment of early nesting attempts (prior to the annual survey) and an asynchronous nesting season overall. South Carolina stork colonies continue to play an important role in the recovery of the species. The diverse and extensive wetlands in the coastal region of South Carolina provide more consistent prey throughout the nesting season compared to most of the Southeastern US. Managed tidal impoundments provide concentrated prey as water levels are lowered, and tidal creeks concentrate prey during low tides due to the high tidal amplitude along the coast.

Documenting several years of record high nest counts followed by a sudden decline highlights the importance of continued nest counts and monitoring. Wood storks appear to be sensitive to unusual temperature and rainfall conditions, and are likely to be effected by changes in climate.

Significant deviations:

None.

Objective 3:

Marsh Bird Components

- a) Investigate temporal vocalization patterns to develop effective survey techniques for black rails in the Southeastern United States.
- b) Determine if black rails are present in substantial numbers in coastal South Carolina during the nonbreeding season.

Accomplishments:

- a) Investigate temporal vocalization patterns to develop effective survey techniques for black rails in the Southeastern United States.

During April – June 2017, autonomous recording units (Wildlife Acoustics SM3 and SM4; ARUs) paired with automated playback units (built by C. Hand from FoxPro game callers equipped with timers and external batteries) were deployed at 37 locations within four wetlands where black rails were detected during previous years. ARU locations were randomly selected using Generalized Random Tessellation Stratified (GRTS) sampling design. At each location, the automated playback unit broadcast a two-minute recording of black rail vocalizations one time at each of the following times of day: 30 minutes after sunrise, 30 minutes before sunset, and midnight. Ten-minute-long recordings beginning with the two minutes of playback were manually reviewed using RavenPro software (Bioacoustics Research Program 2014). We visually reviewed spectrograms and listened to portions of recordings that appeared to include black rail vocalizations. The number of black rail vocalizations (“ki-ki-doo”, “churt”, “growl”, “ik-ik”) within each 10-minute recording were counted and compared. The same methodology and locations were also used to collect data using three ARUs in three wetlands during April –

June 2016, and summaries of data from both years are included in this report.

The ARU data suggest black rails were most responsive to call-playback during the sunset and sunrise sampling periods (Figure 10). Variability within each time period was high (Table 14). Camera trap data collected during the breeding season to meet objectives of other projects were also reviewed to determine diel activity patterns in the absence of playback (Figure 11). These data suggest that black rails exhibited diurnal/crepuscular activity patterns.

- b) Determine if black rails are present in substantial numbers in coastal South Carolina during the nonbreeding season.

Due to damage from Hurricane Matthew (October 4, 2016), it was not possible to conduct call-response surveys during the fall and winter of 2016/2017. Hurricane Irma (11 September 2017) once again caused damage to wildlife management area infrastructure and prevented nonbreeding season surveys during the fall of 2017. Surveys were conducted at Bear Island WMA on 28 August 2018 and 25, 26 and 27 September 2018. Below is a summary of detections during surveys conducted in the early months of the 2018/2019 nonbreeding season.

Fall Call-Response Surveys – number of survey points where black rails were detected:

28 August 2018 – 2 of 9 survey points (1 wetland)

25 September 2018 – 0 of 11 survey points

26 September 2018 – 0 of 2 survey points

27 September 2018 – 0 of 4 survey points

18 October 2018 – 2 of 9 survey points (2 wetlands, after grant period closed)

Camera traps were deployed during September 2017 – February 2018 and early September 2018 as an additional method to detect rails (Znidarsic 2017) during the nonbreeding season. Camera traps were also deployed in the same arrays to collect breeding season data to meet objectives of other projects. Figure 12 provides a monthly comparison of trigger events during January – December 2018. Sampling effort was low during September – October because equipment was removed in preparation for Hurricane Irma and was not redeployed until water levels returned to normal. During November and December, black rails were detected during 18 and 30 trigger events, respectively. These data provide confirmation that black rails are present in small numbers during the nonbreeding season in breeding habitat. During the nonbreeding season, black rails are thought to have more flexible habitat requirements and may use areas that are not suitable for breeding. Virginia rails, soras, and yellow rails were also detected by camera traps during the nonbreeding season.

Significant deviations:

Call-response surveys during the 2016/2017 and 2017/2018 nonbreeding seasons were not completed due to infrastructure damage from storms. Camera traps were redeployed after the storms in impounded and tidal wetlands.

Objective 4:

Components for All Species Groups

- a) Build awareness in South Carolina of shorebird, seabird, wading bird, and marsh bird conservation needs.
- b) Link regional and local conservation goals.
- c) Provide guidance about waterbird conservation needs and opportunities to public and private landowners and managers.

Accomplishments:

- a) Build awareness in South Carolina of shorebird, seabird, wading bird, and marsh bird conservation needs.
 - SCDNR maintains a webpage for the Wading Bird Program. The webpage includes information about species and statuses, an overview of SCDNR's projects, guidance about viewing wading birds, and management recommendations for nesting and foraging areas. Private land managers are encouraged to contact SCDNR for additional guidance. The majority of the owners and managers who have wood storks nesting on their properties receive letters in the fall with information about the survey results and contact information for the SCDNR biologist in case they would like management guidance. The biologist responded to various inquiries from the public about wading bird ecology throughout the year.
 - SCDNR maintains a webpage about seabirds and shorebirds. The webpage includes information about species and statuses and an overview of SCDNR's projects. The website also includes resources such as educational signs and brochures, links to partners, and ways for the public to get involved.
 - During October 2016 – September 2018, SCDNR was contacted by city, county, state, and federal employees, as well as private companies and contractors, who requested information about wading bird colony locations and statuses. This grant allowed SCDNR to collect data about wading birds and to provide it to a variety of organizations. Detailed information about colony boundaries is provided to organizations working near specific stork colonies to ensure compliance with the Endangered Species Act. Individuals who need access to wading bird colony data are encouraged to contact the wading bird biologist directly for assistance with their projects.
 - SCDNR maintains an ArcMap geodatabase of wading bird colony locations in South Carolina that is used by land managers, permit reviewers, power companies, and other organizations to plan projects. The map is updated annually. These data are available upon request to organizations or individuals involved in making land management decisions. Colony locations are not available to the general public due to concerns about the privacy of the property owners and potential disturbance to the birds.
 - SCDNR biologist gave presentations about the ecology and status of wading birds in South Carolina to Fripp Audubon audience on Fripp Island, Coastal Master Naturalists at Caw Caw Interpretive Center in Ravenel, and Coastal Discovery Museum audience on Hilton Head Island.

- SCDNR biologist participated in an ETV fundraising lunch with best-selling author Mary-Alice Monroe and naturalist Rudy Mancke. This panel of experts discussed shorebird conservation at the event in Spartanburg.
- Organized a booth about shorebird conservation at the Southeastern Wildlife Exposition (SEWE) in downtown Charleston in 2017 and 2018. This expo is attended by tens of thousands of people.
- Published a guide to Breeding Coastal Birds. This guide includes photos of common shorebirds and seabirds and a conservation message about limiting human disturbance to these avian species.
- Wrote an article about Red Knot ecology for the September issue of *Naturally Kiawah* magazine and the importance of South Carolina's beaches to this federally threatened shorebird. Participated in Kiawah Conservancy's Shorebird Symposium which featured presentations on shorebird ecology and a panel discussion of experts followed by a documentary about Kiawah Island's coastal birds from an award winning videographer. The Symposium also was a kick-off for the Kiawah Island Shorebird Stewardship Program beginning next spring. A press release was sent out about Red Knot migration research conducted in South Carolina. This summarized nanotag and geolocator location information.
- Staff were interviewed about Red Knot use of South Carolina beaches, migration research, and conservation concerns by a South Carolina Radio Network reporter. This story was distributed to many South Carolina radio stations.
- Staff were interviewed by South Carolina Public Radio host Tut Underwood for a story about the birds of Crab Bank Seabird Sanctuary in Charleston Harbor. The story for *South Carolina Focus* highlighted the erosion of Crab Bank and plans to use dredge material from the Harbor deepening project to provide habitat for seabirds and shorebirds utilizing the island. Staff were also interviewed by *Woods and Water* radio show host and by the South Carolina Radio Network about efforts to raise funds for Crab Bank. These radio interviews were aired on hundreds of radio stations.
- Presented information about black rail habitat needs and conservation opportunities at the November 2018 ACE Basin Task Force Meeting.
- Distributed SC Best Management Practices (BMPs) for Use of Vehicles especially used for Sea Turtle Nest Protection projects. Presented seabird and shorebird conservation message at sea turtle nest protection meetings in 2017 and 2018 that were attended by hundreds of volunteers and by staff at beach sites such as county and state parks, USFWS, and private islands. We worked with sea turtle projects at some locations to delineate areas of the beach to avoid driving because of high concentrations of nesting birds.

Publications

Felicia Sanders served as an editor for a special publication of *Waterbirds* on Oystercatchers. This edition of *Waterbirds* was published in 2017.

Zinsser, L., F. Sanders, and P. Jodice. 2017. Daily survival rate and habitat characteristics of nests of Wilson's Plover. *Southeast Naturalist* 16: 149-156

Murphy, S. P., T. Virzi, F. J. Sanders. 2017. Exploring Differences in Adult Survival and Site Fidelity of Migratory and Non-Migratory Populations of American Oystercatchers (*Haematopus palliatus*). *Waterbirds* 40 (Special Publication 1): 32-43

- b) Link regional and local conservation goals.
- Invited by U.S. Fish and Wildlife Service to contribute to the comprehensive Eastern Black Rail Species Status Assessment as a core team member. This scientific assessment is the foundational document used to inform the federal listing decision for the subspecies. Contributed information about species ecology, habitat requirements, and management strategies in South Carolina. Provided feedback throughout the assessment process.
 - Participated as state black rail expert in meeting to educate the Atlantic Coast Joint Venture about black rail ecology and land management in South Carolina. The Atlantic Coast Joint Venture has adopted the eastern black rail as one of their three flagship species and are working to determine how they can be involved in black rail conservation efforts.
 - Attended and participated in annual Wood Stork Working Group meetings. South Carolina nesting data and an overview of the current management projects were presented to the group of researchers who make decisions about future priorities to promote the recovery of the species.
 - Participated in an International Shorebird Survey (ISS) meeting at Manomet, MA. The meeting was attended by shorebird biologists from North and South America to: 1) review the usefulness of ISS and 2) discuss improvements in survey methods and data storage.
 - Attended the annual American Oystercatcher Working Group meeting in Virginia. Presented current shorebird conservation issues in South Carolina and served on the group's steering committee.
 - Compiled Western Hemispheric Shorebird Reserve Network (WHSRN) nomination form for expansion of the International WHSRN Site, formally consisting of Cape Romain National Wildlife Refuge. The new site includes: the SCDNR properties of Yawkey Heritage Preserve, Santee Delta WMA, Santee Coastal WMA, N. Santee Bar Heritage Preserve, Capers Island Heritage Preserve, and the privately owned Dewees Island. The new site, Cape Romain-Santee Delta Region Site was accepted and recognized in 2018. Two dedication ceremonies were held with attendees ranging from the Regional Director of the USFWS, SCDNR leadership, and local citizens.
- c) Provide guidance about waterbird conservation needs and opportunities to public and private landowners and managers.
- SCDNR owns two properties with consistently active wood stork rookeries: Dungannon Plantation Heritage Preserve (Dungannon HP) and Donnelley Wildlife Management Area (Donnelley WMA). The wading bird biologist worked closely with the SCDNR biologists managing these properties and with the SCDNR Aquatic Nuisance Species Program staff to manage nesting habitat and provided guidance about repairs to a spillway damaged by Hurricane Matthew.
 - SCDNR worked with property owners who have significant stork colonies on their properties and the USFWS Coastal Program to manage aquatic vegetation within the colonies. With the technical assistance and expertise of SCDNR and USFWS staff, herbicide treatments were conducted at two rookeries on private land during October 2016 – September 2017. Details are available in a separate report for the project. (USFWS Cooperative Agreement No. F12AC01593.)
 - When the peak numbers of stork chicks were fledging (late June - July), private and public property managers who manage impounded wetlands in coastal South Carolina were

contacted *via* email. An update on the status of the stork nesting season and information about managing foraging habitat for storks was provided to encourage management that would benefit young storks as they fledged from their nests. Water level management in impoundments used as foraging areas was discussed with SCDNR property managers, and impoundments at Bear Island WMA and Donnelley WMA were managed to benefit wading birds as well as waterfowl.

- Shared information about black rail occurrence and ecology with a private landowner who has black rails on their property. Management options are limited due to tidal influence, and current management practices appear to be appropriate for maintaining black rail habitat.
- Met with private partners who are interested in creating black rail habitat on their property. Continuing to advise project and share information SCDNR has learned through studying black rails.
- SCDNR staff led an effort to raise funding for coastal bird conservation and the restoration of Crab Bank Seabird Sanctuary. The effort was initiated because funds are needed to use dredge material from the deepening of Charleston Harbor to restore and enlarge the much eroded Crab Bank. SCDNR started the South Carolina Coastal Bird Conservation Fund. This program describes other programs that will receive funding if not enough or too much money is raised. A team of conservation organizations, businesses, and citizens have united to raise money for and awareness of coastal bird needs. Developed a web site about this conservation effort.

Significant deviations:

None.

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Estimated Federal Cost: ~\$100,000 (amount spent this year 10/1-9/30)

Recommendations: Close the grant.

Acknowledgments:

This project could not have been completed without the work of many SCDNR biologists, technicians, pilots, administration staff and volunteers. We also received support from staff at the USFWS, County and State parks, Clemson University, Audubon Societies, private landowners, and many other organizations.

Special thanks to the seasonal technicians (Zena Casteel, Ben Donnelly, Tori Thorpe, Sammy Chandhok, Caitlin Walters, and Katie Gundermann), long-term volunteers (Debbie Albanese and Buddy Campbell), and SCDNR pilots (Owen Baker and Don Garbade) who dedicated their time and talents to the waterbird project.

We also wish to thank Elizabeth Znidersic, who provided valuable information about the technique of using camera traps to study rails and helped SCDNR to incorporate this technique into our project during the spring of 2015. During 2016, Elizabeth spent three months in South Carolina volunteering for SCDNR as a surveyor and collecting acoustic and camera trap data at the Tom Yawkey Wildlife Center as part of her PhD project at Charles Sturt University, Albury, Australia.

Figures and Tables:

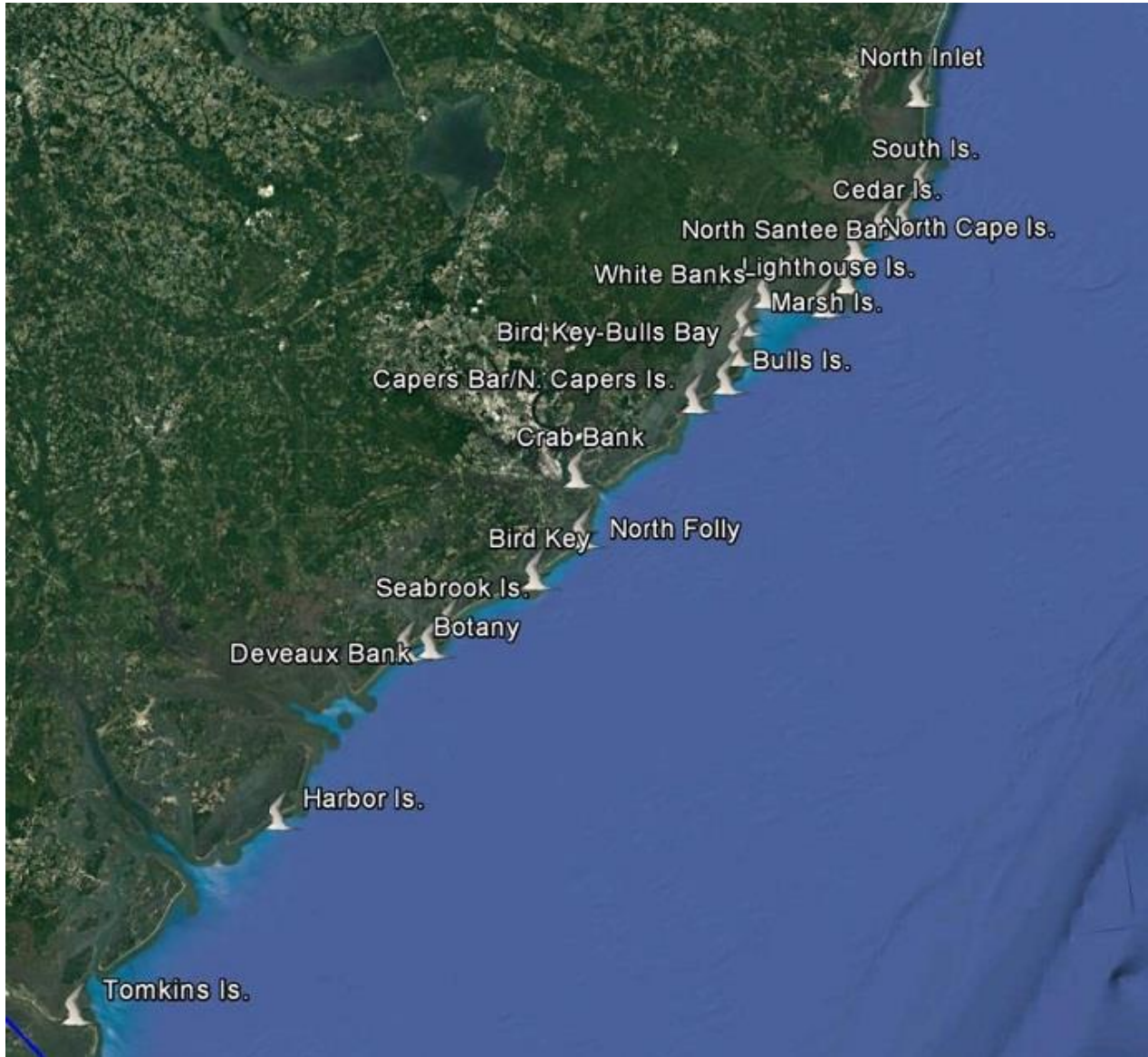


Figure 1. Locations of 20 sites (indicated by bird icons) in South Carolina where signs were placed in 2017 and 2018 to indicate beach closures. Closures help minimize human disturbance to beach-nesting birds and migratory shorebirds.

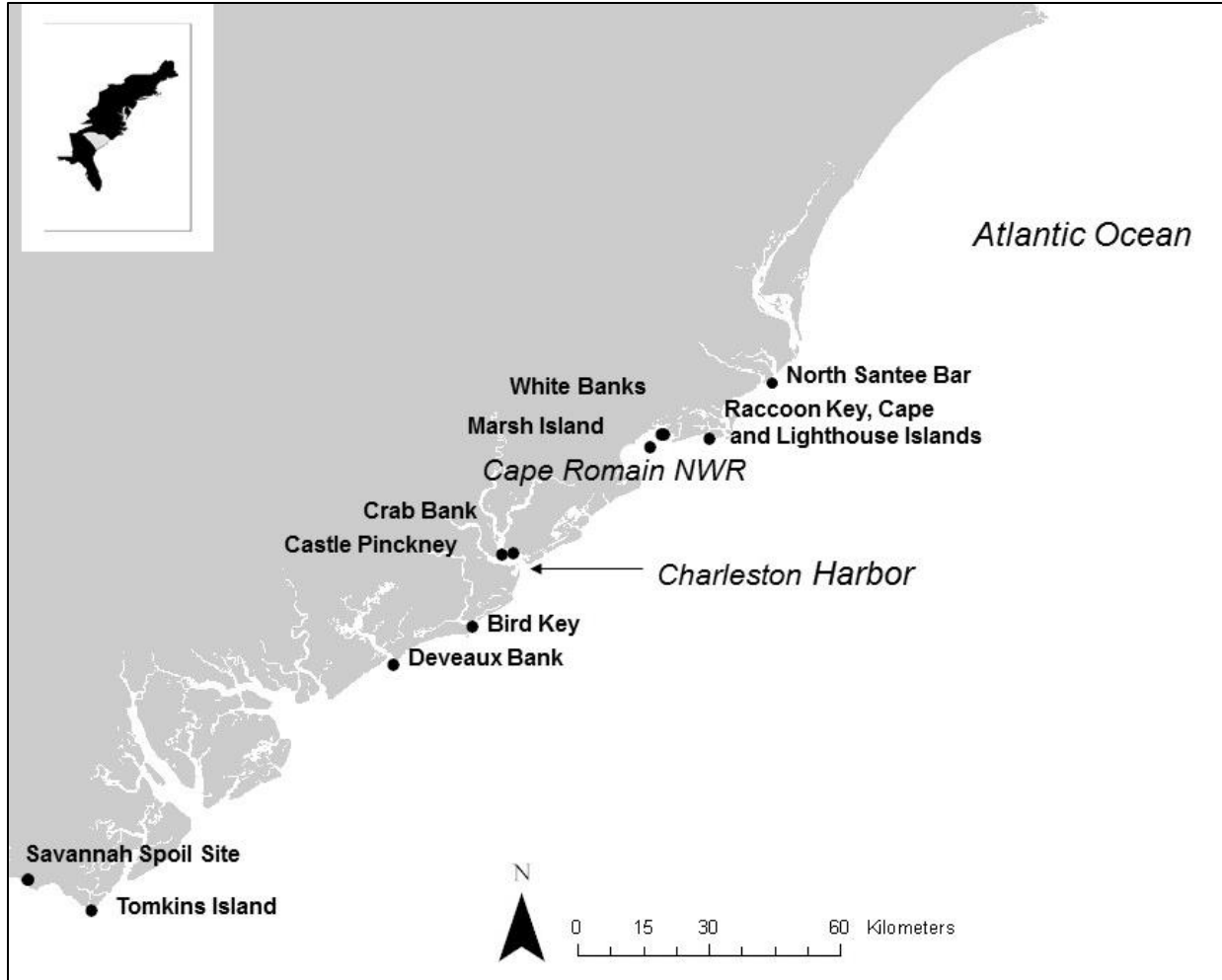


Figure 2. Locations of large seabird colonies in South Carolina from 2017 - 2018. Seabirds nested in other locations but the majority of nests were located at these sites.

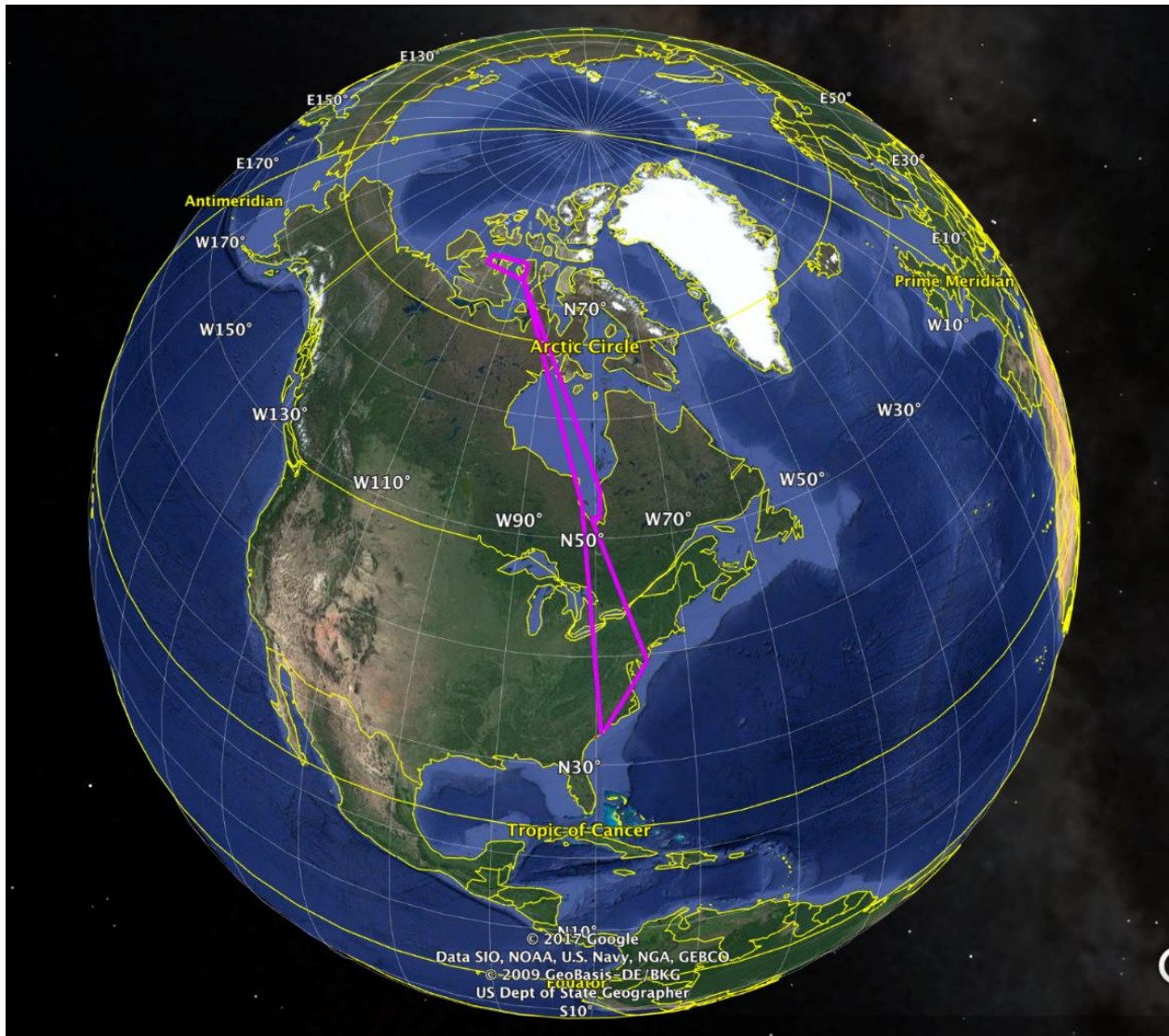


Figure 3. A map of a red knot's migration route as determined by a geolocator. The knot was originally captured in Cape Romain NWR at Marsh Island 16 Oct 2015. The knot spent the winter there and then left South Carolina on 24 May 2016 and flew directly to the James Bay shore, arriving the next day. It stayed above the Arctic Circle for 44 days but did not seem to nest. On 16 July it returned to James Bay and was spotted by Canadian researchers. Then 30 July it arrived in New Jersey and stayed 55 days. On 24 Sept 2016 it returned to South Carolina until it was captured on Seabrook Island, South Carolina on 29 April 2017. Thanks to Ron Porter who interpreted the geolocator data and many others who worked on this project.



Figure 4. One-year migration path of a Red Knot. A collaborative effort between SCDNR, Ron Porter, Larry Niles, and the UU Fish and Wildlife Service. This knot was captured in South Carolina in 2016 on Deveaux Bank and a geolocator was affixed to its leg. During the life of its transmitter, the bird traveled 2x to its nesting grounds above the Arctic Circle and 2x to its wintering grounds in Tierra Del Fuego, Chile at the southern tip of South America. The bird was captured again in January 2018, and the geolocator was retrieved.



Figure 5. Map of American oystercatcher and Wilson's plover nests at Botany Bay WMA, 2017.

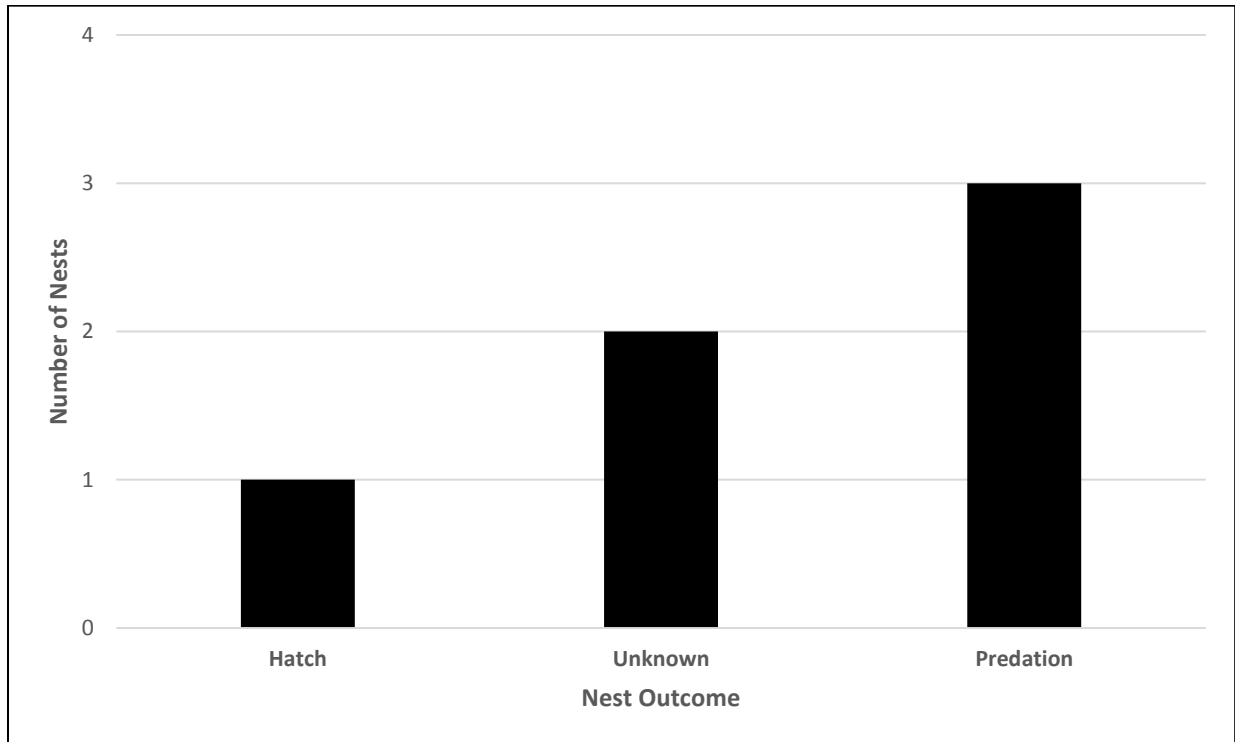


Figure 6. Nest outcome of American oystercatcher nests at Botany Bay WMA, 2017

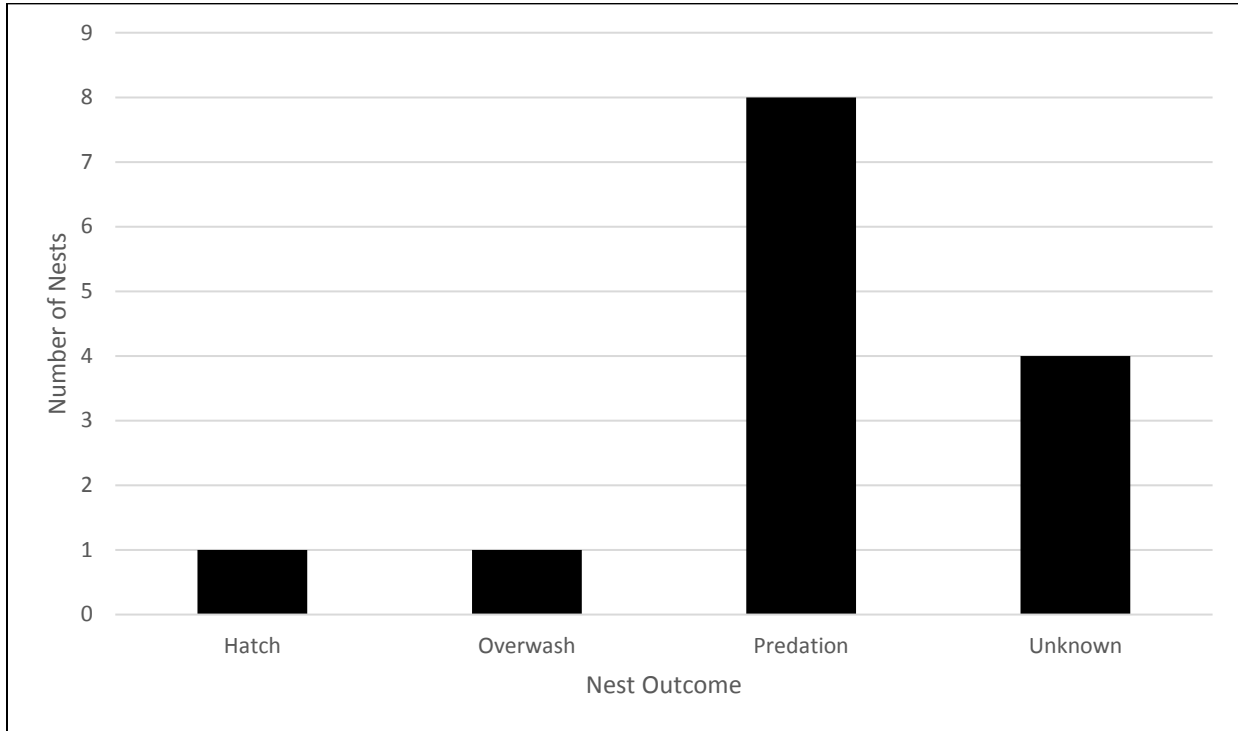


Figure 7. Nest outcome of Wilson's plover nests at Botany Bay WMA, 2017.

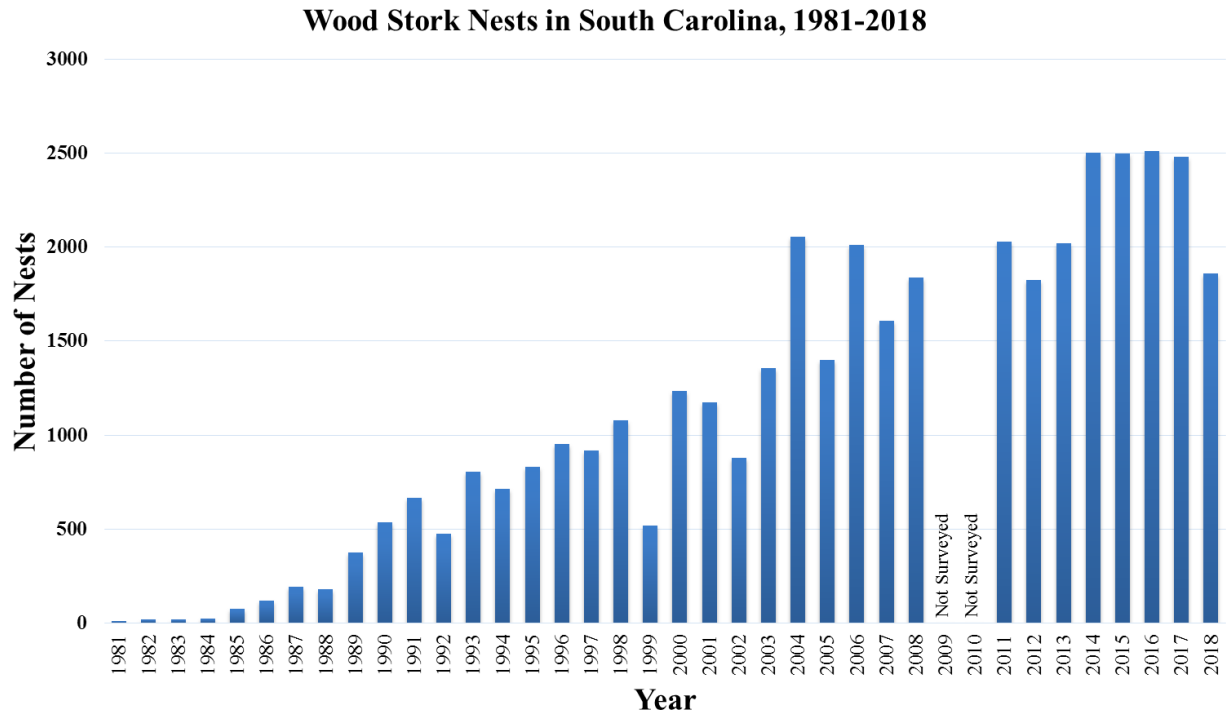


Figure 8. Number of wood stork (*Mycteria americana*) nests counted in South Carolina during annual censuses from 1981 – 2018.

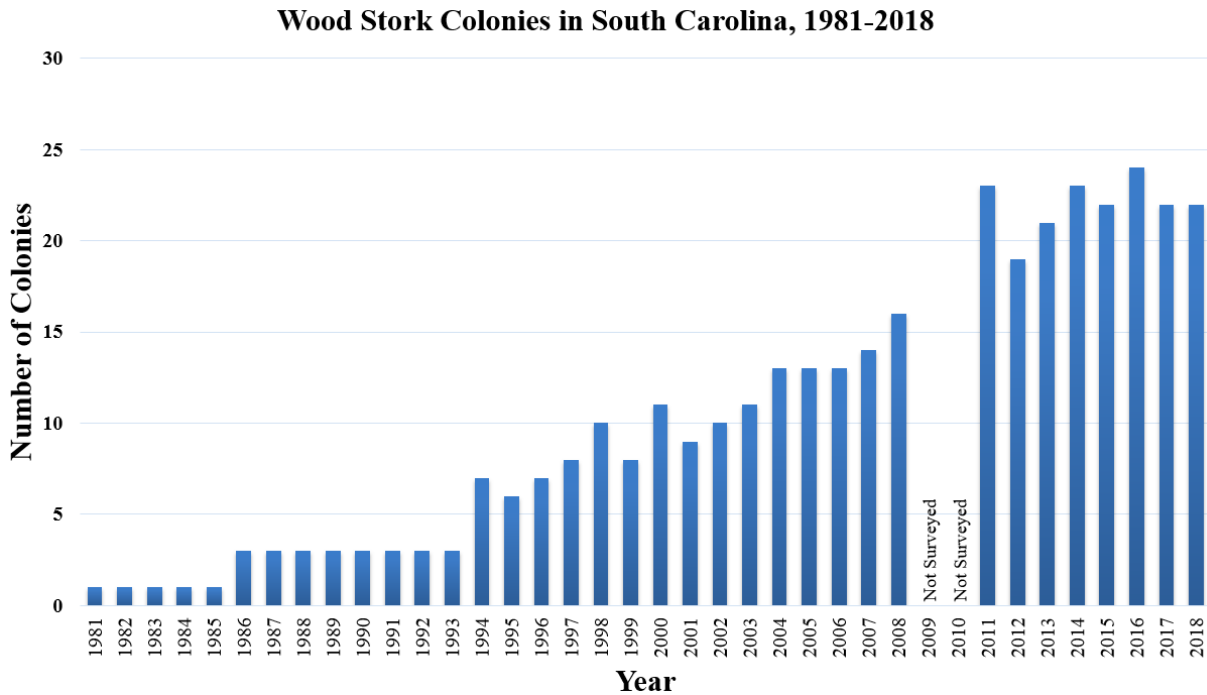


Figure 9. Number of colonies in which wood storks (*Mycteria americana*) nested in South Carolina from 1981 – 2018.

Diel Timing of Black Rail Responsiveness to Call-Playback

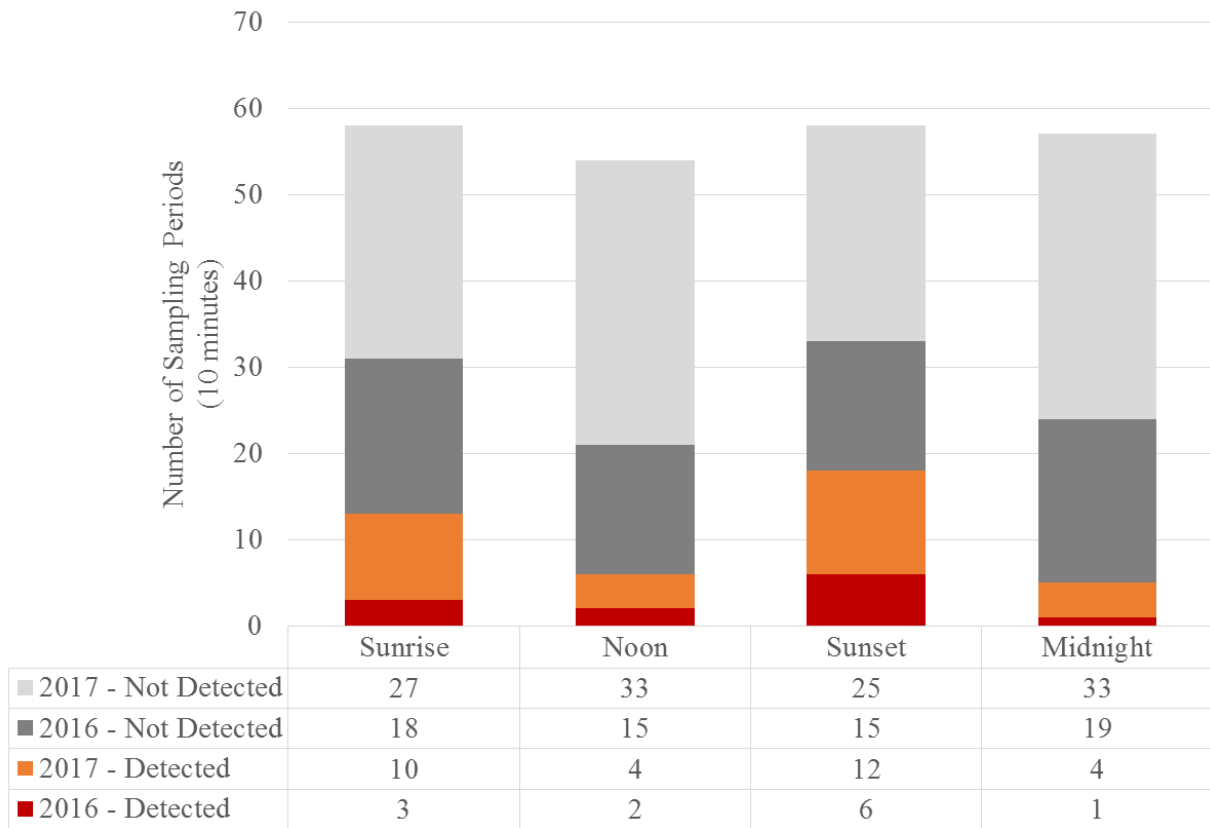


Figure 10. Comparison of responsiveness of black rails (*Laterallus jamaicensis*) to automated playback during four times of day (30 minutes after sunrise, 30 minutes before sunset, and midnight). Two minutes of call playback of black rail vocalizations followed by eight minutes of passive recording were manually reviewed using RavenPro software. Sampling occurred in Colleton County, South Carolina at 21 locations during April – June 2016 and at 37 locations during April – June 2017.

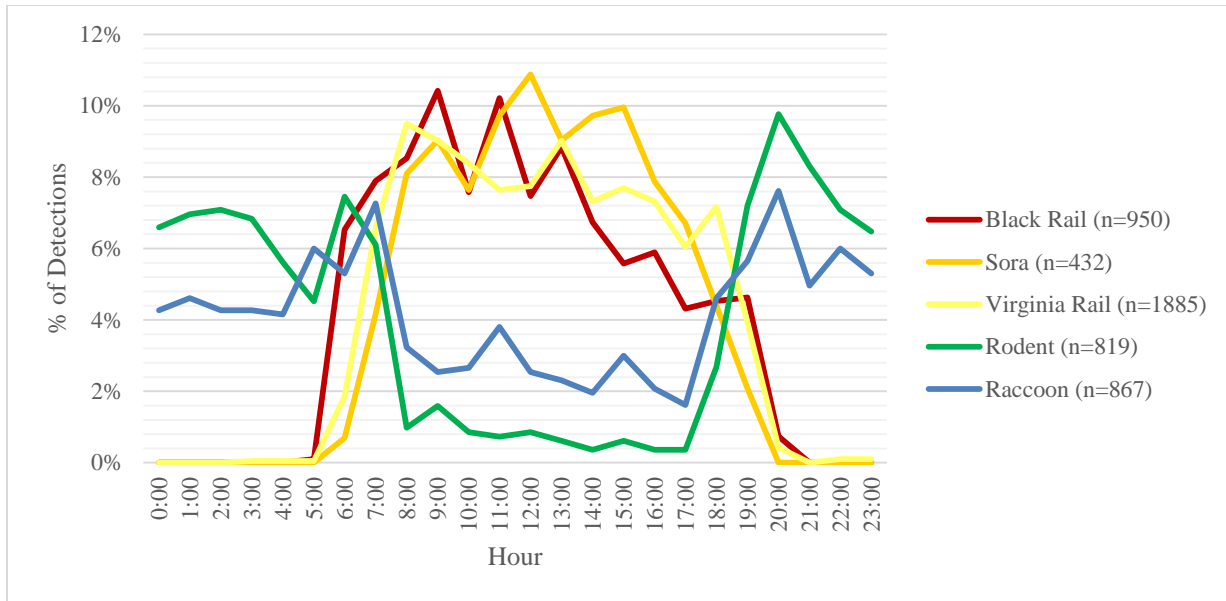


Figure 11. Diel activity patterns of rails, rodents, and raccoons in coastal South Carolina. Camera trap detections between January 2016 and September 2018. Trigger events of the same species by the same camera within 60 minutes of each other were considered to be a single detection. Data are preliminary. Additional data are under review.

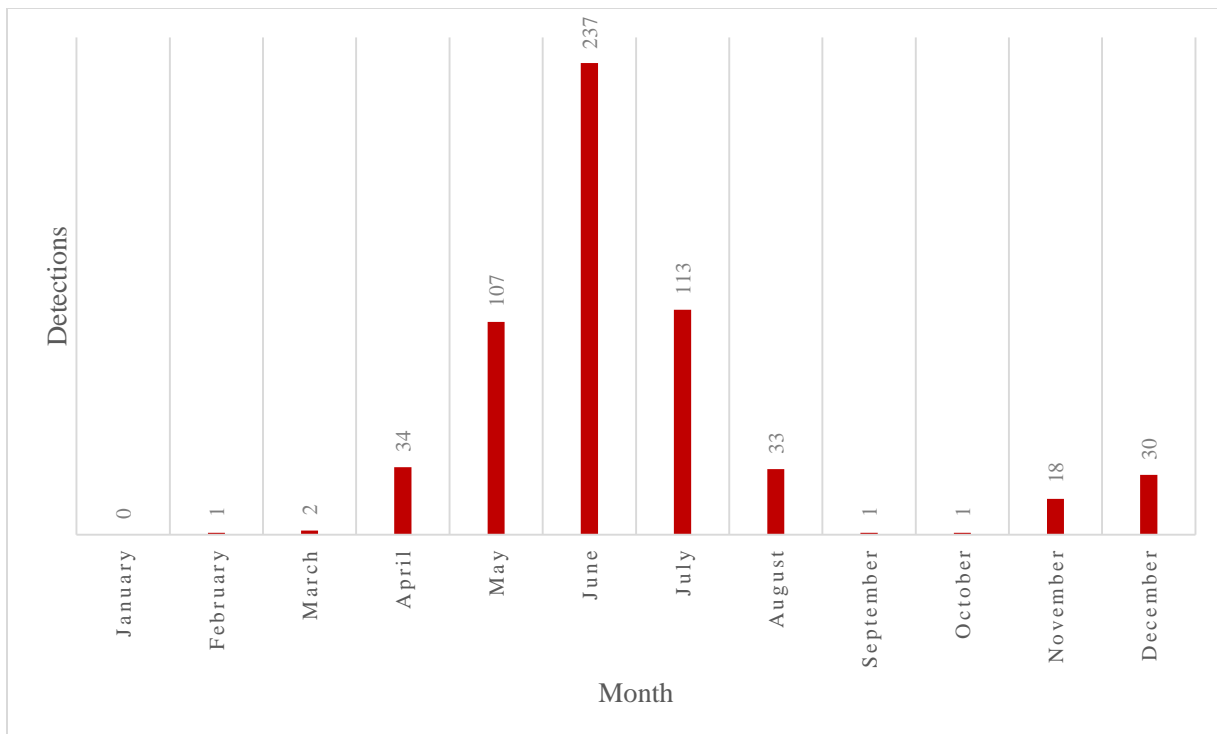


Figure 12. Monthly detections of black rails (*Laterallus jamaicensis*) by camera trap detections during January – December 2017. Trigger events by the same camera within 60 minutes of each other were considered to be a single detection. Sampling effort increased in April 2017 due to the acquisition of additional cameras and decreased temporarily during September and October 2017 due to Hurricane Irma and related damage. Data are preliminary.

Table 1. Breeding Season Summary of Seabird Colonies in SC in 2017. Number of nests, or if nest estimate not attainable, number of adults present at all known seabird nesting sites. Data were collected during peak nesting dates. Numbers are from ground counts except brown pelican, royal tern, and sandwich tern. These species were counted from aerial counts via digital photography taken from a SCDNR law enforcement aircraft. Least terns are reported separately.

Species	Survey Date	Site	Number of Adults	Number of Nests
BLACK SKIMMER	7/11/2017	NORTH SANTEE BAR		228
BLACK SKIMMER	6/14/2017	CASTLE PINCKNEY	236	118
BLACK SKIMMER	6/13/2017	DEVEAUX BANK		188
BLACK SKIMMER	6/13/2017	DEVEAUX BANK		43
BLACK SKIMMER	6/19/2017	NORTH CAPE ISLAND		117
BLACK SKIMMER	6/19/2017	LIGHTHOUSE ISLAND		11
BLACK SKIMMER	6/20/2017	WHITE BANKS		59
BLACK SKIMMER	6/20/2017	MARSH ISLAND		18
BLACK SKIMMER	6/20/2017	BIRD KEY, BULLS BAY		119
BLACK SKIMMER	7/13/2017	SAVANNAH SPOIL SITE	464	
BROWN PELICAN	5/17/2017	MARSH ISLAND		713
BROWN PELICAN	5/17/2017	CRAB BANK		93
BROWN PELICAN	5/17/2017	CASTLE PINCKNEY		499
BROWN PELICAN	6/15/2017	DEVEAUX BANK		59
BROWN PELICAN	5/17/2017	SKIMMER FLATS		3790
BROWN PELICAN	5/26/2017	TOMKINS ISLAND		325
COMMON TERN	5/30/2017	MARSH ISLAND		1
COMMON TERN	5/30/2017	WHITE BANKS		4
COMMON TERN	5/21/2017	NORTH CAPE ISLAND		1
COMMON TERN	6/19/2017	NORTH CAPE ISLAND		2
COMMON TERN	6/20/2017	BIRD KEY, BULLS BAY		1
FORSTER'S TERN	6/20/2017	MARSH ISLAND		14
GULL-BILLED TERN	5/30/2017	WHITE BANKS		16
GULL-BILLED TERN	7/11/2017	NORTH SANTEE BAR		52
GULL-BILLED TERN	6/14/2017	CASTLE PINCKNEY	46	23
GULL-BILLED TERN	6/13/2017	DEVEAUX BANK		69
GULL-BILLED TERN	6/13/2017	DEVEAUX BANK		28
GULL-BILLED TERN	6/19/2017	NORTH CAPE ISLAND		4
GULL-BILLED TERN	6/20/2017	MARSH ISLAND		25
GULL-BILLED TERN	6/20/2017	BIRD KEY, BULLS BAY		21
GULL-BILLED TERN	7/13/2017	SAVANNAH SPOIL SITE	103	
LAUGHING GULL	5/26/2017	TOMKINS ISLAND		307
ROYAL TERN	5/30/2017	MARSH ISLAND		2733
ROYAL TERN	5/17/2017	CRAB BANK		1955
ROYAL TERN	5/17/2017	SKIMMER FLATS		677
ROYAL TERN	6/20/2017	BIRD KEY, BULLS BAY		22
ROYAL TERN	5/26/2017	TOMKINS ISLAND		2720

Table 1. Continued.

Species	Survey Date	Site	Number of Adults	Number of Nests
SANDWICH TERN	5/30/2017	MARSH ISLAND		1318
SANDWICH TERN	5/17/2017	CRAB BANK		20
SANDWICH TERN	5/17/2017	SKIMMER FLATS		548
SANDWICH TERN	6/20/2017	BIRD KEY, BULLS BAY		12
SANDWICH TERN	5/26/2017	TOMKINS ISLAND		738
SOOTY TERN	5/30/2017	WHITE BANKS		1

Table 2. Breeding Season Summary of Seabird Colonies in SC in 2018. Number of nests, or if nest estimate not attainable, number of adults present at all known seabird nesting sites. Data were collected during peak nesting dates. Numbers are from ground counts except brown pelican, royal tern and sandwich tern. These species were counted from aerial counts via digital photography taken from a SCDNR law enforcement aircraft. Least terns are reported separately.

Species	Survey Date	Site	Number of Adults	Number of Nests
BLACK SKIMMER	6/14/2018	BIRD KEY, BULLS BAY		268
BLACK SKIMMER	6/14/2018	NORTH CAPE ISLAND		265
BLACK SKIMMER	6/14/2018	WHITE BANKS		104
BLACK SKIMMER	6/19/2018	DEVEAUX BANK-N EDISTO		283
BLACK SKIMMER	6/19/2018	DEVEAUX BANK-BOTANY		269
BLACK SKIMMER	6/15/2018	CASTLE PINCKNEY	290	145
BLACK SKIMMER	6/19/2018	SAVANNAH SPOIL SITE	300	150
BROWN PELICAN	5/30/2018	MARSH ISLAND		697
BROWN PELICAN	5/30/2018	CASTLE PINCKNEY		627
BROWN PELICAN	6/19/2018	DEVEAUX BANK		131
BROWN PELICAN	5/30/2018	SKIMMER FLATS		3313
BROWN PELICAN	6/08/2018	TOMKINS ISLAND		238
COMMON TERN	6/01/2018	WHITE BANKS		5
FORSTER'S TERN	6/01/2018	MARSH ISLAND		10
GULL-BILLED TERN	6/01/2018	WHITE BANKS		18
GULL-BILLED TERN	6/15/2018	CASTLE PINCKNEY	30	15
GULL-BILLED TERN	6/19/2018	DEVEAUX BANK-N EDISTO		82
GULL-BILLED TERN	6/19/2018	DEVEAUX BANK-BOTANY		57
GULL-BILLED TERN	6/14/2018	NORTH CAPE ISLAND		4
GULL-BILLED TERN	6/04/2018	BIRD KEY, BULLS BAY		35
GULL-BILLED TERN	7/13/2018	SAVANNAH SPOIL SITE	40	20
LAUGHING GULL	6/08/2018	TOMKINS ISLAND		246
ROYAL TERN	5/30/2018	MARSH ISLAND		5812
ROYAL TERN	5/30/2018	CASTLE PINCKNEY		368
ROYAL TERN	5/30/2018	SKIMMER FLATS		584
ROYAL TERN	6/14/2018	BIRD KEY, BULLS BAY		62
ROYAL TERN	6/08/2018	TOMKINS ISLAND		2345
ROYAL TERN	6/20/2018	DEVEAUX BANK		169
SANDWICH TERN	5/30/2018	MARSH ISLAND		2767
SANDWICH TERN	5/30/2018	CASTLE PINCKNEY		119
SANDWICH TERN	5/30/2018	SKIMMER FLATS		90
SANDWICH TERN	6/08/2018	TOMKINS ISLAND		509
SANDWICH TERN	6/14/2018	BIRD KEY, BULLS BAY		35
SANDWICH TERN	6/20/2018	DEVEAUX BANK		5

Table 3. Least Tern Ground Nesting Sites in 2017 at natural sites. 10 sites supported least tern nesting. 7 sites were in Cape Romain National Wildlife Refuge (CRNWR). 2 sites were on state managed properties: Capers Bar managed by SCDNR and 60 Bass Creek managed by Hobcaw Barony. The remaining site was located on the east end of Kiawah Island, a privately managed property.

SITE NAME	LOCATION	# NESTS	OUTCOME
60 Bass Creek	North Inlet	41	Successful
North Cape Is. - North End	CRNWR	147	Successful
North Cape Is. - Midway	CRNWR	13	Successful
North Cape Is. - South End	CRNWR	143	Successful
South Cape Is. - Midway	CRNWR	7	Successful
South Cape Is. - South End	CRNWR	51	Successful
Lighthouse Is. - South End	CRNWR	7	Failed
Middle White Banks	CRNWR	2	Failed
Capers Bar	Price's Inlet	30	Failed
East Kiawah Is.	Kiawah Island	50	Successful

Table 4. Least Tern Artificial Substrate Nesting Sites in 2017. Least Terns in South Carolina nested on 10 flat gravel-covered roofs, an adapted pier (Pier Romeo), gravel-covered dikes around impoundments (BP Cooper River Plant), a sand dike (Jacks Creek Impoundment on Bulls Island, CRNWR), and a dredge spoil area (Savannah Spoil Site).

SITE NAME	COUNTY	SUBSTRATE	# NESTS	OUTCOME
Carolina Forest Kroger	Horry	Gravel Roof	167	Successful
Dunes Reality	Horry	Gravel Roof	14	Failed
Pavilion Roof	Horry	Gravel Roof	25	Failed
Garden City Chapel	Horry	Gravel Roof	10	Failed
Petco	Georgetown	Gravel Roof	19	Successful
Georgetown H. S.	Georgetown	Gravel Roof	14	Failed
Mt. Pleasant Belk	Charleston	Gravel Roof	10	Failed
Burke H. S.	Charleston	Gravel Roof	4	Failed
4750/4760 Goer Dr.	Charleston	Gravel Roof	285	Successful
Pier Romeo	Charleston	Adapted Old Pier	1	Failed
BP Cooper R. Plant	Berkeley	Gravel Dike	10	Failed
Century Aluminum	Berkeley	Gravel Roof	64	Failed
Savannah Spoil Site	Jasper	Dredge Spoil Site	323	Successful
Bulls Island	Charleston	Sand Dike	27	Failed

Table 5. Least Tern Ground Nesting Sites at natural sites in 2018. 13 sites supported least tern nesting. 4 sites were in Cape Romain National Wildlife Refuge (CRNWR). 5 sites were on state managed properties. One site was located on a privately managed property. 3 sites were located on ephemeral sandbars without designated jurisdiction.

SITE NAME	LOCATION	# NESTS	OUTCOME
Huntington Beach	N. End of St. Park	78	Failed
60 Bass Crk	North Inlet	1	Failed
North Cape Is. (2 sites)	CRNWR	241	Successful
Lighthouse Is.-Sound End	CRNWR	4	Failed
White Banks	CRNWR	28	Successful
Caper's Bar	Price's Inlet	24	Failed
Morris Is. Sandbar	N. of Folly Island	14	Failed
Seabrook Is	North End	53	Successful
Deveaux Bank	N. Edisto	60	Successful
Botany Bay Plantation	Edisto Island	45	Successful
Edisto Beach	Edisto Beach SP	14	Successful
Harbor Is. Sandbar	N. of Hunting SP	22	Failed

10. International Shorebird Surveys conducted in the Cape Romain and Capers Region, South Carolina from October 1, 2016 to September 30, 2017.

MONTH	SURVEY	# DAYS	# LOCATIONS	MILES
October	Cape Romain Region	4	9	36.0
November	Cape Romain Region	4	9	36.0
December	Cape Romain Region	4	9	36.0
January	Cape Romain Region	4	9	36.0
February	Cape Romain Region	4	9	36.0
March	Cape Romain Region	4	9	36.0
April	Cape Romain Region	4	9	36.0
May	Cape Romain Region	3	8	31.5
August	Capers Bar, North Capers, Bird Key	2	3	2.5
September	Capers Bar, North Capers, Bird Key	2	3	2.5

Table 11. Numbers of wood stork (*Mycteria americana*) nests counted in South Carolina during April – May 2017 and April – May 2018. Colonies are listed in the order that they were first known to be active. Colonies that have not been active since the 1990s were not surveyed during 2017 and 2018. Aerial surveys were used to locate colonies and to determine the status of colonies. Several of the active colonies were also surveyed from the ground so nests could be counted more accurately.

Colony Name	County	2017 Nest Count	2018 Nest Count	2018 Outcome
Colony 01	Colleton	No Survey	No Survey	No Survey
Colony 02	Colleton	No Survey	No Survey	No Survey
Colony 03	Hampton	254	225	Successful
Colony 04	Colleton	0	0	
Colony 05	Colleton	No Survey	No Survey	No Survey
Colony 06	Colleton	291	204	Successful
Dungannon Pltn HP	Charleston	10	15	Successful
Washo Reserve	Charleston	147	62	Successful
Colony 09	Hampton	No Survey	No Survey	No Survey
Colony 10	Bamberg	142	140	Successful
Colony 11	Jasper	0	0	
Colony 12	Georgetown	No Survey	No Survey	No Survey
Colony 13	Horry	102	24	Successful
Colony 14	Berkeley	No Survey	No Survey	No Survey
Colony 15	Colleton	No Survey	No Survey	No Survey
Wannamaker County Park	Charleston	0	0	
Colony 17	Horry	0	0	
Colony 18	Charleston	No Survey	No Survey	No Survey
Colony 19	Georgetown	125	132	Successful
Colony 20	Colleton	281	208	Successful
Colony 21	Georgetown	216	171	Successful
Colony 22	Beaufort	0	0	
Colony 23	Charleston	229	131	Successful
Colony 24	Beaufort	37	32	Successful
Donnelley WMA	Colleton	172	128	Successful
Hunting Island State Park	Beaufort	22	8	Failed
Colony 27	Horry	0	0	
Colony 28	Charleston	104	84	Successful
Colony 29	Beaufort	0	0	
Colony 30	Jasper	54	5	Successful
Colony 31	Beaufort	0	0	
Pinckney Island NWR	Beaufort	0	0	
Colony 33	Horry	0	0	
Colony 34	Beaufort	72	33	Successful
Colony 35	Charleston	0	26	Failed
Colony 36	Williamsburg	No Survey	No Survey	No Survey
Colony 37	Jasper	0	0	
Colony 38	Beaufort	30	5	Failed
Colony 39	Beaufort	87	62	Successful

Colony Name	County	2017 Nest Count	2018 Nest Count	2018 Outcome
Colony 40	Berkeley	0	0	
Colony 41	Beaufort	0	0	
Colony 42	Beaufort	12	10	Failed
Colony 43	Beaufort	0	0	
Colony 44	Beaufort	0	0	
Colony 45	Beaufort	0	0	
Colony 46	Beaufort	0	No survey	No Survey
Colony 47	Horry	13	27	Successful
Colony 48	Horry	43	32	Successful
Colony 49	Berkeley	37	67	Successful
Colony 50	Charleston	0	27	Successful
Statewide Total		2,480	1,858	Successful

Table 12. Summary of wood stork (*Mycteria americana*) nest monitoring data collected by South Carolina Department of Natural Resources staff, US Fish and Wildlife Service staff, and volunteers during 2017.

Colony Number and County	Colony 6 Colleton	Colony 7 Charleston	Colony 20 Colleton	Colony 23 Charleston	Colony 25 Colleton	Colony 34 Beaufort	All Monitored Colonies
Ownership	Private	Dungannon HP	Private	Private	Donnelley WMA	Private	
Total Number of Stork Nests in Colony*	291	10***	281	229	172	72	1055
Number of Monitored Nest Sites	91	2	64	30	8	37	232
Average Fledglings per Nest Site	1.5	2.5***	2.2	1.9	1.8	1.4	1.7
Average Fledglings per Successful Nest Site	2.0	2.5	2.6	2.2	2.3	2.1	2.0
0 Fledglings	22	0	10	5	2	13	52
1 Fledgling	12	0	3	4	1	3	23
2 Fledglings	47	1	22	12	2	16	100
3 Fledglings	10	1	25	8	3	4	51
4 Fledglings	0	0	4	1	0	1	6
% Successful**	77%	100%***	86%	83%	88%	65%	79%

*Total number of nests counted in the colony during the annual colony survey.

** Number of successful nest sites divided by the total number of nest sites that were monitored. Successful is defined as producing at least one fledgling. A chick was considered to be a fledgling if it survived to at least 7 weeks of age.

*** Storks abandoned the majority of the nests initiated at Dungannon HP (26 of 30 nest sites monitored) before they met the criteria for a "nesting attempt". Most nests were abandoned prior to the annual nest count.

Table 13. Summary of wood stork (*Mycteria americana*) nest monitoring data collected by South Carolina Department of Natural Resources staff and volunteers during 2018.

Colony Number and County	Colony 6 Colleton	Colony 20 Colleton	Colony 23 Charleston	Colony 34 Beaufort	All Monitored Colonies
Ownership	Private	Private	Private	Private	
Total Number of Stork Nests in Colony*	204	208	131	33	576
Number of Monitored Nest Sites	60	43	18	32	153
Average Fledglings per Nest Site	1.8	1.6	2.3	1.4	1.7
Average Fledglings per Successful Nest Site	2.2	2.3	2.4	2.2	2.2
0 Fledglings	12	13	1	11	37
1 Fledgling	5	2	1	4	12
2 Fledglings	29	17	8	10	64
3 Fledglings	14	11	8	6	39
4 Fledglings	0	0	0	1	1
% Successful**	81%	71%	94%	66%	76%

*Total number of nests counted in the colony during the annual colony survey.

** Number of successful nest sites divided by the total number of nest sites that were monitored. Successful is defined as producing at least one fledgling. A chick was considered to be a fledgling if it survived to at least 7 weeks of age.

Table 14. Detections of black rail (*Laterallus jamaicensis*) vocalizations in 10-minute samples (acoustic recordings) by autonomous recording units (Wildlife Acoustics SM3 and SM4) in Colleton County, South Carolina.

Year and Time of Day	Total Number of Vocalizations Detected	Mean Number of Vocalizations Detected	Maximum Number of Vocalizations Detected	Number of Sampling Periods with Detections	Percentage of Sampling Periods with Detections	Number of Sampling Periods
2016	126	1.59	56	12	15.19%	79
Sunrise	59	2.81	56	3	14.29%	21
Noon	6	0.35	5	2	11.76%	17
Sunset	59	2.81	22	6	28.57%	21
Midnight	2	0.10	2	1	5.00%	20
2017	1359	9.18	266	30	20.27%	148
Sunrise	587	15.86	266	10	27.03%	37
Noon	274	7.41	263	4	10.81%	37
Sunset	377	10.19	139	12	32.43%	37
Midnight	121	3.27	115	4	10.81%	37