



Landbird Community Monitoring 2021: Data Summary

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Overview

Birds play several critical roles in park ecosystems, where they occupy and interact with multiple levels of the food web. Predatory birds regulate prey species populations, notably helping to control rodents and insects. Scavenging species remove dead animals from the environment. Many other bird species act as important pollinators or seed dispersers. Because many avian species are associated with specific habitat types and ecosystem services, we can gain insights about the condition of specific habitat components in a park by monitoring what birds are present and where in the landscape they occur.

Many active members of the recreational birding community enjoy opportunities to engage in bird and wildlife watching in protected park settings. Birds contribute beauty and song to the natural setting and provide great appeal to the public. Birding has become one of the most popular outdoor recreational activities pursued by Americans. Birders substantially contribute to local economies while pursuing their hobby.

The Southeast Coast Network (SECN) parks, located in Alabama, Florida, Georgia, South Carolina, and North Carolina, are mainly within the Atlantic Flyway, and host high bird diversity. More than 400 avian species use SECN parks while breeding, wintering, or stopping over during migration (NPS 2023). Surrounded by human-altered landscapes in a region of increasing urbanization and land conversion, the inland and coastal parks of the Southeast Coast Network represent important, ecologically-intact areas that contain a multitude of habitat types important to the conservation of wildlife diversity.

Bird communities respond quickly to environmental stressors. Changes in avian species composition, richness, and distribution on the landscape may indicate changes in the underlying ecological condition of park resources. Shifting species distributions alter species interactions and the food-web structure, thereby producing cascading effects on ecosystem processes (Montoya and Raffaelli 2010). Long-term monitoring projects can potentially detect trends in breeding bird populations and use them to assess ecosystem integrity and sustainability. Park managers can use monitoring data as a tool to inform land management decisions.



A blue-gray gnatcatcher (*Polioptila caerulea*), one of many species detected during monitoring in 2021. NPS photo/Jim Schmidt (NPgallery).

Objectives

This report summarizes data collected with the SECN landbird community monitoring protocol (Byrne et al. 2014) to address the following Vital Signs Monitoring Program objectives:

1. Evaluate landbird community species richness in the park during the breeding season.
2. Assess landbird occupancy and spatial distribution in the park during the breeding season.

We use the term ‘community’ herein to refer to an assemblage of species populations occurring together in time and space (Begon et al. 1986). We consider the landbird species assemblage within the park as a *de facto* community (Byrne et al. 2014).

Significant Results

This brief summarizes data collected in 2021 at Cumberland Island National Seashore during implementation of the Southeast Coast Network’s landbird community monitoring protocol (Byrne et al. 2014).

- Automated recording devices (ARDs) captured landbird vocalizations from March 15, 2021 to June 15, 2021 at 31 spatially-balanced random sampling locations.
- A subset of 1,860 minutes of audio derived from 155 recordings was analyzed and all discernable bird vocalizations were reviewed and classified to species.
- We detected 66 species of native landbirds in 2021. We did not detect any introduced species. We recorded one previously undocumented species (black-bellied whistling duck [*Dendrocygna autumnalis*]).

Significant Results (continued)

- The species with greatest site occupancy were: blue-gray gnatcatcher (*Polioptila caerulea*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis*), red-bellied woodpecker (*Melanerpes carolinus*), white-eyed vireo (*Vireo griseus*), tufted titmouse (*Baeolophus bicolor*), northern parula (*Setophaga americana*), yellow-throated warbler (*Setophaga dominica*), and great-crested flycatcher (*Myiarchus crinitus*), each detected at greater than or equal to 80% ($n \geq 26$) of sampling locations.
- Landbird communities at this park will be resampled in 2024.

Visit the NPS data store at the Integrated Resource Management Application portal for:

- [Data Summary Brief](https://irma.nps.gov/DataStore/Reference/Profile/2291580) (<https://irma.nps.gov/DataStore/Reference/Profile/2291580>)
- [Species Distribution Maps](https://irma.nps.gov/DataStore/Reference/Profile/2291578) (<https://irma.nps.gov/DataStore/Reference/Profile/2291578>)
- [Full Dataset and Metadata](https://irma.nps.gov/DataStore/Reference/Profile/2299423) (<https://irma.nps.gov/DataStore/Reference/Profile/2299423>)

Study Area

Largest and southernmost of the Georgia Sea Islands, Cumberland Island comprises roughly 14,709 hectares (36,346 acres) of mostly undeveloped barrier island habitats. Most of the island is conserved as Cumberland Island National Seashore, including over 3,966 hectares (9,800 acres) of Congressionally-designated wilderness. Cumberland Island was formed during the glacial recession at the end of the Pleistocene, as rising ocean levels separated former inland sandy ridges from the mainland. By 4,000 to 5,000 years before present, Cumberland Island became isolated, along with its extant flora and fauna (Shoop and Ruckdeschel 2003).

Cumberland Island hosts a diverse array of at least 45 identified vegetation associations (McManamay 2017) containing at least 213 vascular plant taxa (Boyle and Rico 2022). Several of the largest terrestrial vegetation classes include: Live Oak–Cabbage Palmetto Maritime Hammock (3,747 hectares [9,259 acres]); Southern Atlantic Coast Salt Marsh / Salt Flat (3,679 hectares [9,091 acres]); Maritime Southern Yellow Pine Forest (517 hectares [1,278 acres]); Sea-oats Temperate Herbaceous Alliance (300 hectares [741 acres]); and Wet Longleaf Pine – Pond Pine Flatwoods (224 hectares [554 acres]). The National Seashore also protects approximately 28.2 kilometers (17.5 miles) of undeveloped beach. Relatively little of the island is developed, despite a history of human habitation dating back hundreds of years.

Cumberland Island National Seashore had 330 previously documented landbird species when sampling occurred in 2021 (NPS 2023). A table listing avian species previously documented on NPSpecies (NPS 2023), as well as avian species documented during SECN's 2021

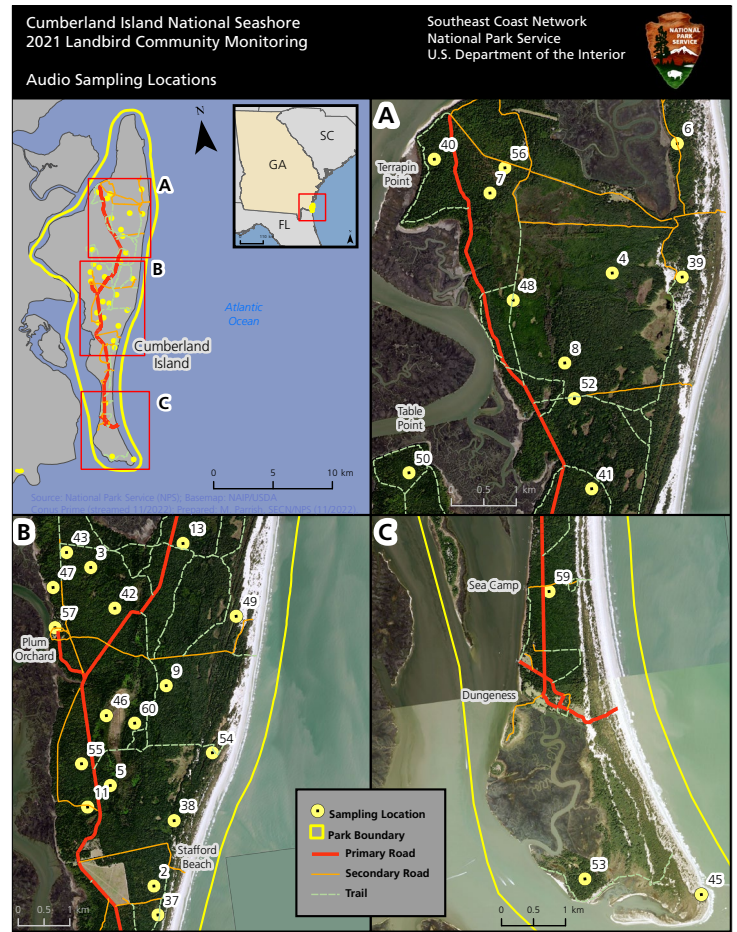


Figure 1. Permanent audio sampling locations ($n = 31$) at Cumberland Island National Seashore. Sampling location ID numbers are indicated at each point.

monitoring, is available from the NPS data store on the [Integrated Resource Management Applications portal](https://irma.nps.gov/DataStore/Reference/Profile/2291580).

Methods

Sampling Design

We established a randomly-selected, spatially-balanced set of sample locations ($n = 31$) during an initial field season in 2012 (Figure 1). Our sample size was chosen based on considerations including park size, hypothesized variability in wildlife populations, and logistics. Sample locations are permanent and revisited on a three-year rotation. More comprehensive details regarding study design, data collection, and data analyses are in the SECN landbird community monitoring protocol (Byrne et al. 2014). This report pertains to 2021 sampling only.

Data Collection

In 2021, we deployed automated recording devices (ARDs) at 31 permanent sampling locations (Figure 1) from March 15 to June 15. We programmed each ARD to record audio from 08:00 to 08:12, every other day, for a period of 92 days. Forty-seven recordings were captured on each unit during the sampling period. The ARDs were collected from the field after recordings were completed and recordings were downloaded to a computer for classification and analyses.

Methods (continued)

Manual Classification of Recordings

We systematically selected recordings from the following dates: April 1, April 15, April 30, May 15, and May 30. Loud ambient noise (e.g., traffic, surf, insect droning, or wind) in recordings negatively affects discernment of wildlife vocalizations. Recordings made on the above dates were initially screened using the software package Kaleidoscope Pro (Wildlife Acoustics, Inc. 2023) to assess clarity and determine whether background noise was disruptive to the listener's ability to interpret bird sounds. If recording quality was poor on a given date, we systematically evaluated and selected for analysis alternate recordings from proximate dates.

Selected recordings were methodically reviewed by an experienced technician with strong familiarity with the vocalizations of birds of the southeastern US. The technician evaluated recordings using Kaleidoscope Pro, which allowed them to view spectrograms (graphical representations of vocalizations) and to manipulate playback on the fly to maximize acoustical clarity. The technician classified all vocalizations identifiable to the species level, a process requiring from one-half to two hours per 12 minute recording depending on the complexity of the captured soundscape. A wildlife biologist later reviewed the technician's classifications for data quality assurance and control.

Taxonomic Standards

Our use of taxonomic nomenclature followed the Integrated Taxonomic Information System (ITIS 2023). The National Park Service maintains the online database NPSpecies (NPS 2023), which documents the occurrence and status of species found in parks

Data Analysis

Our focus was limited to the analysis of species richness and related characteristics, including occupancy and spatial distribution of the park's breeding-season landbird community. We derived results from our manual evaluation of 1,860 minutes of audio from 155 recordings across 31 sample locations. We only included in analyses detections of birds that were identified to the species level. We calculated metrics separately for native versus non-native species, as managers may consider the latter a special consideration.

Species Richness and Composition

Using the SpadeR package (Chao et al. 2016) in program R, we calculated species richness for the park as well as mean species richness per sample location at the sample location scale, as well as at the park scale. Species richness was defined as the number of unique species detected at the scale of interest.

Field methods for sampling species richness (e.g., point-counts or audio sampling) inherently produce incomplete counts, due to imperfect detection of cryptic species that may be present but are difficult to record during surveys. Observed species richness, therefore,

is expected to be an underestimate of true species richness, though it offers utility as an index of the true diversity of a sample unit. Various methods exist to adjust incidence data to provide an estimated species richness that may be closer to the true value. We used the SpadeR package in R to calculate the *iChao2* estimator of species richness with an associated 95% confidence interval (Chiu et al. 2014). The *iChao2* estimator uses the detection frequencies of rarely-detected species to adjust the observed richness upward to account for species that may be present but not detected. The *iChao2* estimator is expected to perform well for communities that are highly heterogeneous with regard to species incidence or occupancy (Chiu et al. 2014).

Incidental Detections of Nocturnal Birds

The Southeast Coast Network concurrently monitored vocal anurans at night, at the same sample locations and during the same study period as the present bird study. On the resulting overnight anuran recordings, we sometimes incidentally detected vocalizations from nocturnal birds, such as owls and nightjars. While we do not currently survey nocturnal avian species in a systematic way, we nevertheless consider any nocturnal bird detections to be of interest. We therefore report them herein as incidental observations; but, we refrained from including nocturnal detections in summary statistics and report them separately from estimates of species richness at sample locations and the park as a whole.

Occupancy

We calculated naïve occupancy (i.e., frequency of occurrence) as the percent of sampling locations where a species was detected in one or more reviewed recordings. We did not adjust occupancy estimates for probability of detection (i.e., detectability). Species with greater naïve occupancy occur at more locations than those with low values.

Spatial Distribution

We mapped species detections in the park to provide a means of visually assessing spatial distributions of vocal birds. An understanding of landbird distribution is crucial for informed management of species and their requisite habitats. Following future park visits, we plan to examine species records across time to identify trends in community makeup and species distribution. This has potential to provide insights into influences on park diversity (e.g., land use change and habitat condition, climate issues, and hydrological processes).

Results

Species Richness

Observed species richness of native breeding landbirds at the park in 2021 was 66 (Table 1). Mean $\pm$ SD observed species richness of native birds per sample location was 20.4 ± 3.2 (range: 13–26; Table 1, Figure 2). We detected no introduced species. We detected one previously undocumented native species, black-bellied whistling duck (*Dendrocygna autumnalis*). The *iChao2* species richness estimate for native species in the park was 90.1 (95% CI: 77.5, 116.5).

Table 1. Species detections (indicated with “X”) and observed species richness (“OSR”) at each sampling location ($n = 31$) for landbirds at Cumberland Island National Seashore in 2021. Refer to Figure 1 for labeled sampling locations. Incidental nocturnal species detections are indicated with “N.”

Common Name	02	03	04	05	06	07	08	09	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60
Black-bellied whistling-duck	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–
Wild turkey	X	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–
Mourning dove	–	X	–	X	–	–	X	–	X	–	X	–	–	–	–	–	X	–	X	–	X	–	–	–	X	–	X	X	X	X	–
Yellow-billed cuckoo	X	X	X	X	X	–	X	X	X	–	–	X	X	X	X	–	X	–	–	X	X	X	–	X	–	–	X	X	X	–	–
Chuck-will's-widow ^{1,2}	N	N	N	N	N	N	X,N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Chimney swift	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–
Clapper rail	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
Black-bellied plover	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–
Willet	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–
Laughing gull	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	X	X	–	–	X	–
Royal tern	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	X	–
Green heron	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	X	–	–	–	–	–	–	X	–	–
Osprey	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Red-shouldered hawk	–	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	X	–	X	–	–	–	–
Eastern screech-owl ¹	N	N	–	N	–	N	–	N	N	N	–	–	–	N	–	–	N	–	–	–	N	N	N	N	–	N	N	N	N	–	–
Great horned owl ¹	–	–	–	–	N	N	–	–	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N	–	–	N	N	–	–
Barred owl ¹	–	–	–	N	–	–	–	–	–	–	–	N	–	–	–	–	–	–	N	–	–	N	–	–	–	–	–	–	–	–	N
Red-headed woodpecker	–	X	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	X	–	–	–
Red-bellied woodpecker	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	X	X
Downy woodpecker	X	X	–	X	–	–	–	X	X	–	–	X	X	–	X	–	X	–	X	X	X	–	–	–	X	X	–	X	X	X	X
Pileated woodpecker	X	X	X	X	–	X	X	X	X	X	X	–	–	X	X	–	–	–	X	X	–	X	X	X	–	X	X	X	–	–	–
Great crested flycatcher	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	–	X	X	X	X	–	–	X	X	X	X	X	–	X
Eastern wood-pewee	–	–	–	–	–	–	–	–	X	–	X	–	–	–	X	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Acadian flycatcher	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–
White-eyed vireo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-throated vireo	X	X	–	X	X	–	–	–	X	X	X	–	X	X	X	X	X	–	–	X	–	–	–	–	–	–	X	X	–	–	–
Blue-headed vireo	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Red-eyed vireo	X	X	X	X	X	–	X	X	X	–	X	X	X	X	X	–	X	–	–	–	–	–	X	X	X	X	X	X	X	–	X
Blue jay	–	X	–	–	X	X	–	X	–	X	–	–	X	X	X	X	–	–	X	X	X	–	X	X	X	X	X	X	X	X	–
American crow	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fish crow	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–

¹ Incidental nocturnal observation.

² Chuck-wills-widow was detected at 3.2% of locations (1 site) during morning surveys; it was detected at 100% of locations via incidental nocturnal detections.

Table 1 (continued). Species detections (indicated with “X”) and observed species richness (“OSR”) at each sampling location ($n = 31$) for landbirds at Cumberland Island National Seashore in 2021. Refer to Figure 1 for labeled sampling locations. Incidental nocturnal species detections are indicated with “N.”

Common Name	02	03	04	05	06	07	08	09	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60
Carolina chickadee	X	X	–	X	–	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	X	X	X	–	–	X
Tufted titmouse	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	X	X
Barn swallow	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	X	–	–	–	–	–	–	–	–	–	–	–	X	–
Ruby-crowned kinglet	X	–	–	X	X	–	–	X	X	–	X	X	X	–	–	–	X	–	–	X	–	X	–	–	–	–	–	–	–	–	X
Cedar waxwing	–	–	X	–	–	–	X	X	–	–	–	–	–	–	–	–	–	–	–	–	X	–	X	–	–	–	–	–	–	X	–
White-breasted nuthatch	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
Brown-headed nuthatch	–	X	–	X	–	–	–	–	X	–	X	–	X	X	–	–	–	–	–	X	–	–	–	–	–	–	X	–	X	–	–
Blue-gray gnatcatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
House wren	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–
Carolina wren	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gray catbird	–	–	–	–	X	X	X	X	X	X	–	X	–	–	–	–	–	–	X	X	X	X	–	X	X	–	–	–	X	–	–
Brown thrasher	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	X	–	–
Northern mockingbird	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
Wood thrush	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
American goldfinch	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–
Chipping sparrow	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–
Eastern towhee	–	X	X	X	X	X	–	–	–	–	X	X	X	X	X	–	–	X	–	–	X	–	X	X	–	–	–	X	–	–	X
Yellow-breasted chat	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Orchard oriole	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
Red-winged blackbird	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	X	X	–	–	–	–	–	–	–	–	X	–	–
Brown-headed cowbird	X	X	–	–	X	–	–	X	X	–	–	X	–	–	–	–	–	–	–	–	–	–	X	–	X	–	–	–	–	X	X
Common grackle	–	–	–	X	–	–	–	–	X	–	–	X	–	–	–	–	–	–	X	–	–	X	–	X	X	X	–	–	X	–	–
Ovenbird	–	–	–	–	–	X	–	–	X	X	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–
Black-and-white warbler	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
Kentucky warbler	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Common yellowthroat	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	X	X	–	–	X	X	–	–	–	–	–	–	–	X
Hooded warbler	–	–	X	–	–	–	–	X	–	–	–	X	X	–	–	–	–	–	–	–	–	–	X	X	–	–	–	–	–	–	X
American redstart	X	–	–	–	–	–	–	X	–	–	–	X	–	–	–	–	–	–	–	–	–	–	X	–	X	–	–	–	–	X	–
Cape May warbler	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–
Northern parula	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-throated blue warbler	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–

¹ Incidental nocturnal observation.

² Chuck-wills-widow was detected at 3.2% of locations (1 site) during morning surveys; it was detected at 100% of locations via incidental nocturnal detections.

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Pine warbler	–	X	–	X	–	X	–	X	X	X	X	–	X	–	X	–	–	–	–	X	X	–	–	X	–	–	X	X	–	–	–	
Yellow-throated warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	X	X	
Prairie warbler	–	–	–	–	X	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	
Summer tanager	X	X	–	X	X	–	X	–	X	X	–	X	X	X	X	–	X	–	X	X	X	X	X	X	X	X	–	X	X	–	X	X
Scarlet tanager	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Northern cardinal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Painted bunting	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	
Observed Species Richness	20	24	15	22	24	18	19	22	25	19	19	23	26	19	22	13	20	14	22	23	21	19	18	19	22	17	23	23	24	19	18	

¹ Incidental nocturnal observation.

² Chuck-wills-widow was detected at 3.2% of locations (1 site) during morning surveys; it was detected at 100% of locations via incidental nocturnal detections.

Results (continued)

Occupancy and Spatial Distribution

Naïve occupancy was greatest for blue-gray gnatcatcher (*Poliophtila caerulea*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis*), red-bellied woodpecker (*Melanerpes carolinus*), white-eyed vireo (*Vireo griseus*), tufted titmouse (*Baeolophus bicolor*), northern parula (*Setophaga americana*), yellow-throated warbler (*Setophaga dominica*), and great-crested flycatcher (*Myiarchus crinitus*), each detected at greater than or equal to 80% ($n \geq 26$) of sampling locations (Table 1, Table 2). Blue-gray gnatcatcher, Carolina wren, northern cardinal were detected at all sample locations. Approximately 61% of species were infrequently detected; 40 species were detected at less than or equal to 20% ($n \leq 6$) of sample locations. Seventeen of the aforementioned 40 species were detected at only one sample location.

Table 2. Landbird naïve occupancy estimates (i.e., percent of permanent sampling locations [$n = 31$] where a species was detected) at Cumberland Island National Seashore in 2021, ranked by descending percentage of locations occupied. Four species observed via incidental nocturnal detections are also indicated.

Common Name	Scientific Name	Native Occupancy ¹
Chuck-will's-widow ^{2, 3}	<i>Antrostomus carolinensis</i>	100.0%
Blue-gray gnatcatcher	<i>Poliophtila caerulea</i>	100.0%
Carolina wren	<i>Thryothorus ludovicianus</i>	100.0%
Northern cardinal	<i>Cardinalis cardinalis</i>	100.0%
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	96.8%
White-eyed vireo	<i>Vireo griseus</i>	96.8%
Tufted titmouse	<i>Baeolophus bicolor</i>	96.8%
Northern parula	<i>Setophaga americana</i>	96.8%
Yellow-throated warbler	<i>Setophaga dominica</i>	96.8%
Great Crested flycatcher	<i>Myiarchus crinitus</i>	83.9%
Carolina chickadee	<i>Poecile carolinensis</i>	77.4%
Summer tanager	<i>Piranga rubra</i>	74.2%
Red-eyed vireo	<i>Vireo olivaceus</i>	71.0%
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	64.5%
Pileated woodpecker	<i>Dryocopus pileatus</i>	64.5%
Blue jay	<i>Cyanocitta cristata</i>	61.3%
Downy woodpecker	<i>Dryobates pubescens</i>	58.1%
Eastern screech-owl ²	<i>Megascops asio</i>	54.8%
Eastern towhee	<i>Pipilo erythrophthalmus</i>	51.6%
Yellow-throated vireo	<i>Vireo flavifrons</i>	48.4%
Gray catbird	<i>Dumetella carolinensis</i>	45.2%
Pine warbler	<i>Setophaga pinus</i>	45.2%
Mourning dove	<i>Zenaida macroura</i>	41.9%
Ruby-crowned kinglet	<i>Regulus calendula</i>	38.7%
Brown-headed cowbird	<i>Molothrus ater</i>	32.3%

¹ Proportion of sampling locations where species was observed.
² Incidental nocturnal observation.
³ Chuck-wills-widow was detected at 3.2% of locations (1 site) during morning surveys; it was detected at 100% of locations via incidental nocturnal detections.

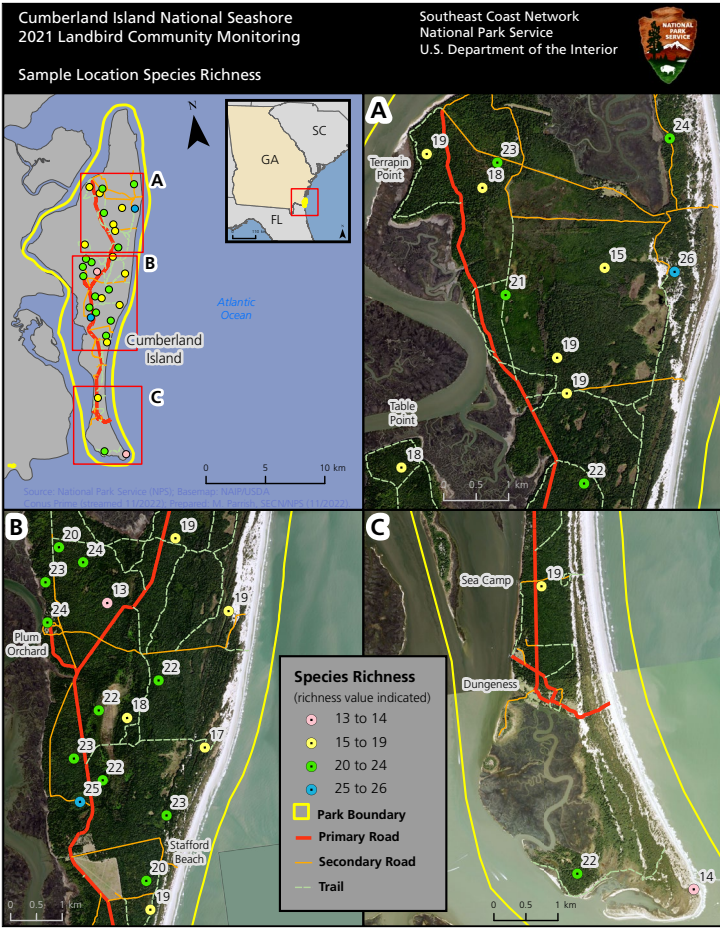


Figure 2. Landbird species richness at permanent sampling locations ($n = 31$) at Cumberland Island National Seashore, based on audio recording detections in 2021.

Table 2 (continued). Landbird naïve occupancy estimates (i.e., percent of permanent sampling locations [$n = 31$] where a species was detected) at Cumberland Island National Seashore in 2021, ranked by descending percentage of locations occupied. Four species observed via incidental nocturnal detections are also indicated.

Common Name	Scientific Name	Native Occupancy ¹
Brown-headed nuthatch	<i>Sitta pusilla</i>	29.0%
Common grackle	<i>Quiscalus quiscula</i>	29.0%
Hooded warbler	<i>Setophaga citrina</i>	22.6%
Great Horned owl ²	<i>Bubo virginianus</i>	19.4%
Cedar waxwing	<i>Bombycilla cedrorum</i>	19.4%
Common yellowthroat	<i>Geothlypis trichas</i>	19.4%
American redstart	<i>Setophaga ruticilla</i>	19.4%
Laughing gull	<i>Leucophaeus atricilla</i>	16.1%
Red-shouldered hawk	<i>Buteo lineatus</i>	16.1%
Barred owl ²	<i>Strix varia</i>	16.1%
Ovenbird	<i>Seiurus aurocapilla</i>	16.1%
Wild turkey	<i>Meleagris gallopavo</i>	12.9%

¹ Proportion of sampling locations where species was observed.
² Incidental nocturnal observation.
³ Chuck-wills-widow was detected at 3.2% of locations (1 site) during morning surveys; it was detected at 100% of locations via incidental nocturnal detections.

Table 2 (continued). Landbird naïve occupancy estimates (i.e., percent of permanent sampling locations [$n = 31$] where a species was detected) at Cumberland Island National Seashore in 2021, ranked by descending percentage of locations occupied. Four species observed via incidental nocturnal detections are also indicated

Common Name	Scientific Name	Native Occupancy ¹
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	12.9%
Eastern wood-pewee	<i>Contopus virens</i>	12.9%
Red-winged blackbird	<i>Agelaius phoeniceus</i>	12.9%
Black-bellied plover	<i>Pluvialis squatarola</i>	9.7%
Royal tern	<i>Thalasseus maximus</i>	9.7%
Green heron	<i>Butorides virescens</i>	9.7%
Barn swallow	<i>Hirundo rustica</i>	9.7%
House wren	<i>Troglodytes aedon</i>	9.7%
Prairie warbler	<i>Setophaga discolor</i>	9.7%
Chimney swift	<i>Chaetura pelagica</i>	6.5%
Clapper rail	<i>Rallus longirostris</i>	6.5%
Willet	<i>Tringa semipalmata</i>	6.5%
American crow	<i>Corvus brachyrhynchos</i>	6.5%
Brown thrasher	<i>Toxostoma rufum</i>	6.5%
Northern mockingbird	<i>Mimus polyglottos</i>	6.5%
Cape May warbler	<i>Setophaga tigrina</i>	6.5%
Black-bellied whistling-duck	<i>Dendrocygna autumnalis</i>	3.2%
Osprey	<i>Pandion haliaetus</i>	3.2%
Acadian flycatcher	<i>Empidonax virescens</i>	3.2%
Blue-headed vireo	<i>Vireo solitarius</i>	3.2%
Fish crow	<i>Corvus ossifragus</i>	3.2%
White-breasted nuthatch	<i>Sitta carolinensis</i>	3.2%
Wood thrush	<i>Hylocichla mustelina</i>	3.2%
American goldfinch	<i>Spinus tristis</i>	3.2%
Chipping sparrow	<i>Spizella passerina</i>	3.2%
Yellow-breasted chat	<i>Icteria virens</i>	3.2%
Orchard oriole	<i>Icterus spurius</i>	3.2%
Black-and-white warbler	<i>Mniotilta varia</i>	3.2%
Kentucky warbler	<i>Geothlypis formosa</i>	3.2%
Black-throated blue warbler	<i>Setophaga caerulescens</i>	3.2%
Scarlet tanager	<i>Piranga olivacea</i>	3.2%
Painted bunting	<i>Passerina ciris</i>	3.2%

¹ Proportion of sampling locations where species was observed.

² Incidental nocturnal observation.

³ Chuck-wills-widow was detected at 3.2% of locations (1 site) during morning surveys; it was detected at 100% of locations via incidental nocturnal detections.



A Carolina wren (*Thryothorus ludovicianus*), one of many species detected during monitoring in 2021. NPS photo/Macaulay Library, CLO, Evan Lipton (NPGallery).

Results (continued)

We detected black-bellied whistling duck (Table 3) at one sample location (site 54) on two dates in mid- and late-April. Black-bellied whistling duck was previously undocumented on the official park list (NPS 2022). This species was independently reported from the approximate location by an eBird user in late May, 2021 (Jones 2021).

Incidental Detections of Nocturnal Birds

The Southeast Coast Network incidentally detected the following four nocturnal bird species: Chuck-wills-widow *Antrostomus carolinensis*, eastern screech-owl (*Megascops asio*), great horned owl (*Bubo virginianus*), and barred owl (*Strix varia*). We have included these detections in Tables 1 and 2 (while indicating they are incidental detections), but we omitted them from summary statistics (including species richness) above, because we did not systematically survey for these species under the SECN landbird monitoring protocol (Byrne et al. 2014). Each nocturnal species was previously documented at the park (NPS 2023). Notably, Chuck-wills-widow was detected at only one sample location during diurnal landbird sampling, but was incidentally detected at 100% of sample locations during nighttime recording. None of the three owl species were detected during morning recording sessions; however, eastern screech-owl vocalizations were incidentally captured at approximately 55% of locations during nighttime recording, while great horned owl and barred owl were incidentally detected at 19% and 16% of locations, respectively.

Spatial Distribution Maps

Distribution maps for all detected species (including incidentally detected nocturnal birds described above) are available from the NPS data store at the [Integrated Resource Management Applications portal](#) and indicate the sampling location(s) where detections of each recorded species occurred.

Table 3. New bird species detected at Cumberland Island National Seashore in 2021 using automated recording devices, with recommended NPSpecies classifications.

Common Name	Abundance	Residency	Native Status	Pest	Management Priority	Exploitation Concerns
Black-bellied whistling duck	Rare	Migratory	Native	No	No	No

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A white-eyed vireo (*Vireo griseus*), one of many species detected during monitoring in 2021. NPS photo (NPgallery).



A tufted titmouse (*Baeolophus bicolor*), one of many species detected during monitoring in 2021. NPS photo/Macaulay Library, CLO, Jesse White (NPgallery).

About the Southeast Coast Network

In 1999, the National Park Service initiated a long-term ecological monitoring program, known as “Vital Signs Monitoring,” to provide the minimum infrastructure to allow more than 270 national park system units to identify and implement long-term monitoring of their highest-priority measurements of resource condition. Monitoring resources in parks develops scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and determines how well current management practices are sustaining those ecosystems.

The NPS Vital Signs Monitoring Program addresses five goals for all parks with significant natural resources:

- Determine the status and trends in selected indicators of the condition of park ecosystem,
- Provide early warning of abnormal conditions,
- Provide data to better understand the dynamic nature and condition of park ecosystems,
- Provide data to meet certain legal and Congressional mandates, and
- Provide a means of measuring progress towards performance goals.

The Southeast Coast Network (SECN) includes eighteen administrative areas containing twenty park units, fifteen of which contain significant and diverse natural resources. In total, SECN parks encompass more than 184,000 acres of federally-managed land across North Carolina, South Carolina, Georgia, Alabama, and Florida. The parks serve a wide diversity of cultural and natural resource missions and include: five national monuments, four national seashores, three national battlefield parks, two national historic parks, a national memorial, a national recreation area, an ecological and historic preserve, and a single national park. The parks range in size from slightly more than 20 acres to nearly 60,000 acres, and when considered with non-federal lands jointly managed with NPS, the network encompasses more than 253,000 acres.



A yellow-throated warbler (*Setophaga dominica*), one of many species detected during monitoring in 2021. NPS photo/Jacob C. Cooper (NPgallery).



A northern parula (*Setophaga americana*), one of many species detected during monitoring in 2021. NPS photo/NPS/Neal Lewis (NPgallery).

For More Information

[SECN Home Page](https://www.nps.gov/im/secn/index.htm)

(<https://www.nps.gov/im/secn/index.htm>)

[SECN Reports and Publications](https://www.nps.gov/im/secn/reports-publications.htm)

(<https://www.nps.gov/im/secn/reports-publications.htm>)

[NPS Inventory and Monitoring Program](https://www.nps.gov/im/index.htm)

(<https://www.nps.gov/im/index.htm>)

Data Downloads via the [Natural Resource Information Portal](https://irma.nps.gov/portal/)

(<https://irma.nps.gov/portal/>)



A Carolina chickadee (*Poecile carolinensis*), one of many species detected during monitoring in 2021. NPS photo (NPgallery).