



Landbird Community Monitoring: 2022 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 in Alabama, Florida, Georgia, South Carolina, and North Carolina are mainly located 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 2024). 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 red-bellied woodpecker (*Melanerpes carolinus*), one of many species detected during monitoring in 2022. It was detected at 100% of the sampling sites. NPS photo (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 2022 at Canaveral 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 14 to June 14 at six spatially-balanced random sampling locations.
- A subset of 360 minutes of audio derived from 30 recordings was analyzed and all discernable bird vocalizations were reviewed and classified to species.
- We detected 38 species of native landbirds. We did not detect any non-indigenous species nor any previously undocumented species.

Significant Results (continued)

- The most frequently-detected species were red-bellied woodpecker (*Melanerpes carolinus*), Carolina wren (*Thryothorus ludovicianus*), and northern cardinal (*Cardinalis cardinalis*), which were detected at 100% of sampling locations, and for pileated woodpecker (*Dryocopus pileatus*) and white-eyed vireo (*Vireo griseus*), which were detected at 83.3% of sampling locations.
- Landbird communities at this park will be resampled in 2025.

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

- [Data Summary Brief](https://irma.nps.gov/DataStore/Reference/Profile/2305464) (https://irma.nps.gov/DataStore/Reference/Profile/2305464)
- [Species Distribution Maps](https://irma.nps.gov/DataStore/Reference/Profile/2305466) (https://irma.nps.gov/DataStore/Reference/Profile/2305466)
- [Full Dataset and Metadata](https://doi.org/10.57830/2305163) (https://doi.org/10.57830/2305163)

Study Area

Canaveral National Seashore lies on the east coast of central Florida, in Volusia and Brevard Counties, just north of Kennedy Space Center. The Seashore protects the longest stretch of undeveloped coastline in Florida. The park is approximately 23,335 hectares (57,661 acres), including Mosquito Lagoon. The southern portion of the Seashore is jointly managed by the NPS and the U. S. Fish and Wildlife Service's Merritt Island National Wildlife Refuge. The natural resources at the Seashore include a diverse assemblage of wildlife, vegetation communities, geophysical features, and natural processes that reflect the complexity of the land/lagoon/sea interface of east-central Florida. Mosquito Lagoon, extending along the backside of the barrier island, is the northernmost part of the Indian River Lagoon and was designated an Estuary of National Significance by the U.S. Environmental Protection Agency in 1991. The lagoon acts as an important nursery area for a wide variety of wildlife species.

Unlike many barrier islands, Canaveral National Seashore has a simplified dune system separating the lagoon from the ocean, generally consisting of a single primary dune averaging 3.7 meters (12 feet) in height. Surface water, including the nearshore Atlantic Ocean, comprises 68% of the Seashore's total area, while five dominant vegetative classes make up 22.7% of the remaining area: mangroves, oak-palmetto shrubland, pine woodlands, oak-cabbage palmetto hammock, and salt wort-salt grass. The distribution of vegetation community types at the park generally follows subtle variations in topography, salinity gradients, and differences in hydrologic properties. The Seashore's unique and complex habitat mosaic supports a high species diversity representing many taxa.



A Carolina wren (*Thryothorus ludovicianus*), one of many species detected during monitoring in 2022. It was detected at 100% of the sampling sites. NPS Photo / Macaulay Library, CLO, Evan Lipton (NPGallery).

Canaveral National Seashore had 320 previously documented landbird species when sampling occurred in 2022 (Parrish and Kurimo-Beechuk 2022; NPS 2024). A table listing all avian species documented on NPSpecies (NPS 2024), as well as avian species documented during SECN's 2022 monitoring, is available from the NPS data store at [Full dataset and metadata](https://doi.org/10.57830/2305163) (https://doi.org/10.57830/2305163).

Methods

Sampling Design

The Southeast Coast Network established a randomly-selected, spatially-balanced set of sample locations ($n = 30$) during an initial field season in 2014 (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 are revisited on a three-year rotation. In 2022, Canaveral National Seashore requested we discontinue sampling at 20 sites located in Merritt Island National Wildlife Refuge, reducing the set of permanent sampling locations to $n = 10$. This report pertains to 2022 sampling only. More comprehensive details regarding study design, data collection, and data analyses can be found in the SECN Landbird Community Monitoring Protocol (Byrne et al. 2014).

Data Collection

In 2022, we deployed automated recording devices (ARDs) at nine of 10 permanent sampling locations (Figure 1) from March 14 to June 14 (site 09 was inaccessible due to high water). One ARD was subsequently vandalized, and two other units experienced equipment failure, reducing our final sample size to $n = 6$. We programmed each ARD to record audio from 08:00 to 08:12, every other day, for a period of 93 days. Forty-seven recordings were captured by 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.



Audio Sampling Locations

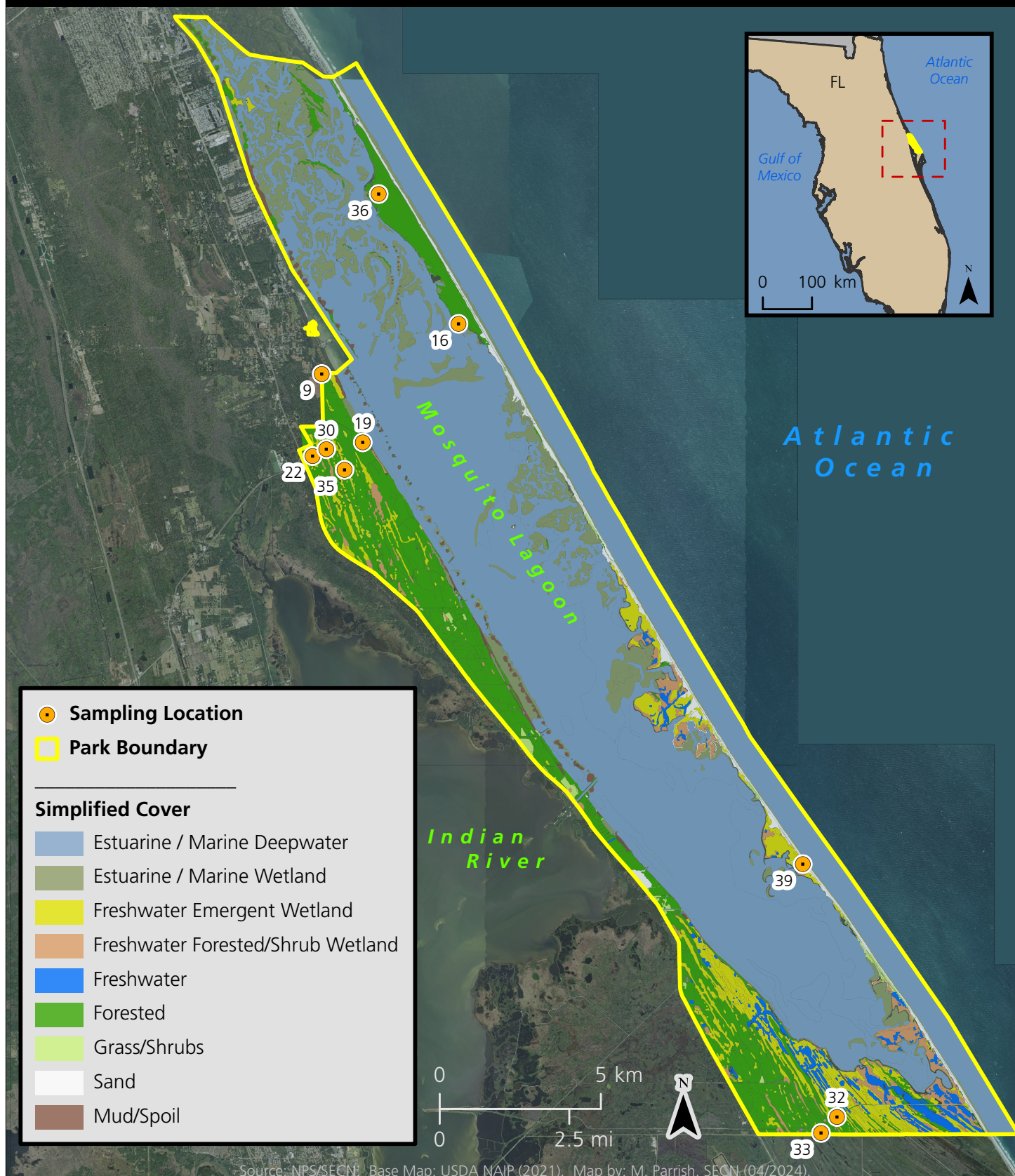


Figure 1. Permanent audio sampling locations within Canaveral National Seashore ($n = 10$). Sampling location ID numbers are indicated at each point.

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. Thus, recordings made on the above dates were initially screened using the software package Kaleidoscope Pro (Wildlife Acoustics, Inc. 2024) 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 United States. 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 2024). The National Park Service maintains the online database NPSpecies (NPS 2024), which documents the occurrence and status of species found in parks.

Data Analysis

Our focus for this effort 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 360 minutes of audio from 30 recordings across six 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 extend the latter 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



A white-eyed vireo (*Vireo griseus*), one of many species detected during monitoring in 2022. NPS photo (NPgallery).

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).

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 2022 was 38 (Table 1). Mean $\pm$ SD observed species richness of native birds per sample location was 14.83 ± 3.66 (range: 9–20; Figure 2, Table 1). We detected no non-indigenous species and no previously undocumented native species. The *iChao2* species richness estimate for native species in the park was 125.5 (95% CI: 61.6, 361.6); this wide confidence interval was likely due to a relatively small sample size at the park in 2022.

Table 1. Landbird species detections (indicated with “X”) and observed species richness at each sampled location ($n = 9$) within Canaveral National Seashore in 2022. Refer to Figure 1 for labeled sampling location ID numbers. EF = Equipment Failure; Ø = no data.

Common Name	09	16	22	30	32	33	35	36	39
Northern bobwhite	Ø	–	–	X	Ø	X	X	–	Ø
Mourning dove	Ø	–	X	X	Ø	–	X	X	Ø
Clapper rail	Ø	X	–	–	Ø	–	–	–	Ø
Common gallinule	Ø	–	–	–	Ø	X	–	–	Ø
Black-bellied plover	Ø	X	–	–	Ø	–	–	–	Ø
Willet	Ø	X	–	–	Ø	–	–	–	Ø
Greater yellowlegs	Ø	X	–	–	Ø	–	–	–	Ø
Royal tern	Ø	X	–	–	Ø	–	–	–	Ø
Great blue heron	Ø	X	–	–	Ø	–	–	–	Ø
Green heron	Ø	X	–	–	Ø	–	–	–	Ø
Osprey	Ø	–	–	–	Ø	–	X	–	Ø
Bald eagle	Ø	–	–	X	Ø	–	–	–	Ø
Red-shouldered hawk	Ø	–	–	X	Ø	–	–	–	Ø
Red-bellied woodpecker	Ø	X	X	X	Ø	X	X	X	Ø
Downy woodpecker	Ø	–	–	X	Ø	–	–	–	Ø
Northern flicker	Ø	X	–	X	Ø	X	–	–	Ø
Pileated woodpecker	Ø	X	X	–	Ø	X	X	X	Ø
Great crested flycatcher	Ø	X	X	–	Ø	–	X	–	Ø
White-eyed vireo	Ø	–	X	X	Ø	X	X	X	Ø
Red-eyed vireo	Ø	–	X	X	Ø	–	–	–	Ø
Blue jay	Ø	–	X	–	Ø	–	–	–	Ø
Florida scrub-jay	Ø	–	–	–	Ø	X	X	–	Ø
Fish crow	Ø	–	X	–	Ø	–	–	–	Ø
Tufted titmouse	Ø	–	X	X	Ø	–	X	–	Ø
Cedar waxwing	Ø	–	X	–	Ø	–	–	–	Ø
Blue-gray gnatcatcher	Ø	–	X	X	Ø	–	–	X	Ø
Marsh wren	Ø	–	–	X	Ø	–	–	–	Ø
Carolina wren	Ø	X	X	X	Ø	X	X	X	Ø
Gray catbird	Ø	–	–	X	Ø	X	X	X	Ø
Chipping sparrow	Ø	–	–	X	Ø	–	–	–	Ø
Eastern towhee	Ø	–	X	X	Ø	X	X	–	Ø
Red-winged blackbird	Ø	X	–	–	Ø	–	–	–	Ø
Common grackle	Ø	–	X	X	Ø	X	X	–	Ø
Common yellowthroat	Ø	–	–	X	Ø	X	X	–	Ø
American redstart	Ø	X	–	–	Ø	–	–	–	Ø
Northern parula	Ø	–	–	–	Ø	–	–	X	Ø
Pine warbler	Ø	–	X	X	Ø	–	X	–	Ø
Northern cardinal	Ø	X	X	X	Ø	X	X	X	Ø
Observed Species Richness	EF	15	16	20	EF	13	16	9	EF



Species Richness at Sample Location

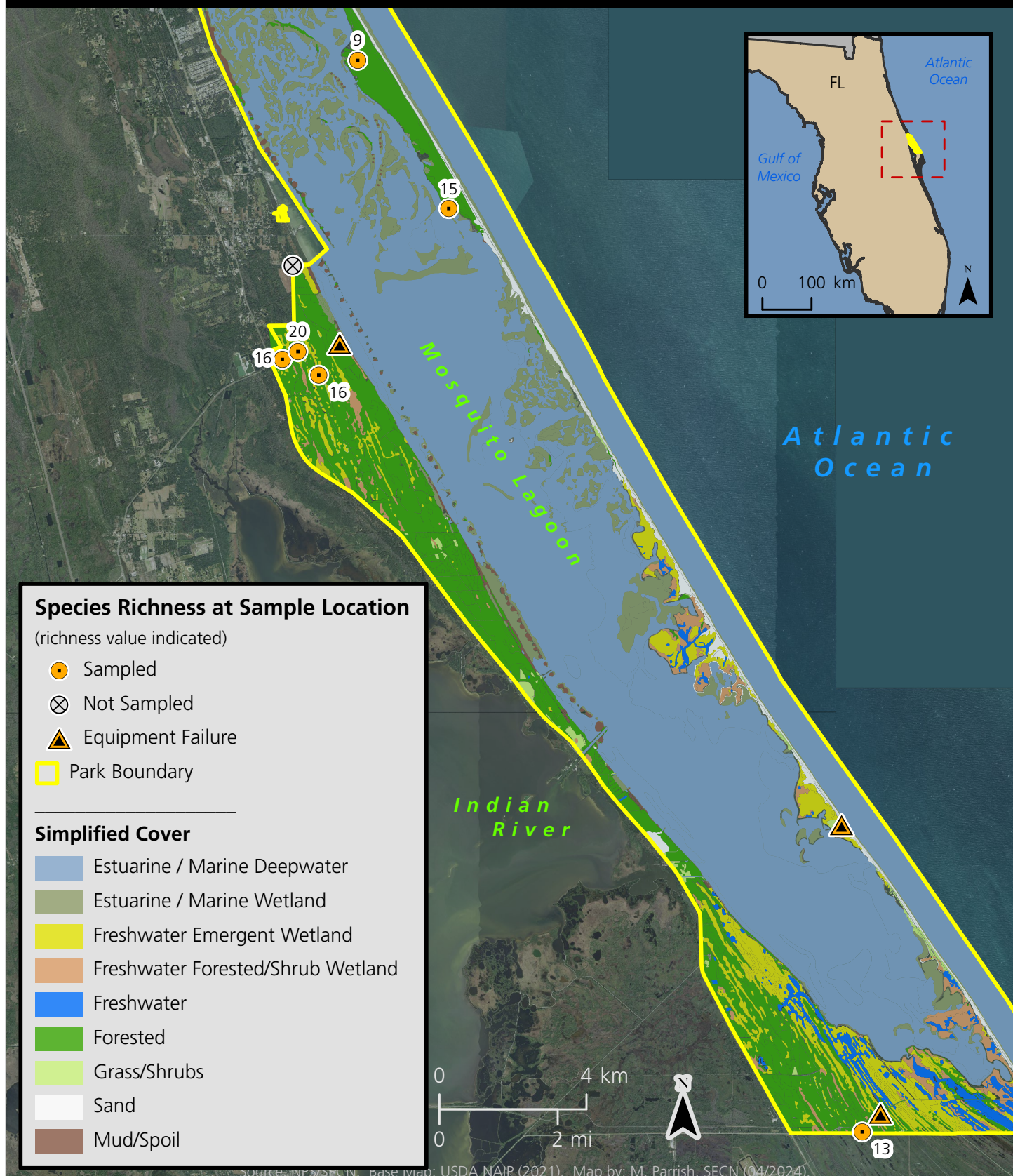


Figure 2. Landbird species richness at sampled locations within Canaveral National Seashore ($n = 9$), based on audio recording detections in 2022.

Results (continued)

Occupancy and Spatial Distribution

Naïve occupancy was greatest for red-bellied woodpecker (*Melanerpes carolinus*), Carolina wren (*Thryothorus ludovicianus*), and northern cardinal (*Cardinalis cardinalis*), which were detected at 100% ($n = 6$) of sampling locations, and for pileated woodpecker (*Dryocopus pileatus*) and white-eyed vireo (*Vireo griseus*), detected at 83.3% of sampling locations (Table 1, Table 2). Approximately 53% of species were infrequently detected; 20 species were detected at less than or equal to 17% ($n \leq 1$) of sample locations (Table 2).

Species Distribution Maps

Distribution maps for all detected species are available from the NPS data store at the [Integrated Resource Management Applications portal](https://irma.nps.gov/DataStore/Reference/Profile/2305466) (<https://irma.nps.gov/DataStore/Reference/Profile/2305466>).

Table 2. Landbird naïve occupancy estimates at each sampled location ($n = 9$) within Canaveral National Seashore in 2022, ranked descending. Refer to Figure 1 for labeled sampling location ID numbers.

Common Name	Scientific Name	Naïve Occupancy ¹
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	100.0%
Carolina wren	<i>Thryothorus ludovicianus</i>	100.0%
Northern cardinal	<i>Cardinalis cardinalis</i>	100.0%
Pileated woodpecker	<i>Dryocopus pileatus</i>	83.3%
White-eyed vireo	<i>Vireo griseus</i>	83.3%
Mourning dove	<i>Zenaida macroura</i>	66.7%
Gray catbird	<i>Dumetella carolinensis</i>	66.7%
Eastern towhee	<i>Pipilo erythrophthalmus</i>	66.7%
Common grackle	<i>Quiscalus quiscula</i>	66.7%
Northern bobwhite	<i>Colinus virginianus</i>	50.0%
Northern flicker	<i>Colaptes auratus</i>	50.0%
Great crested flycatcher	<i>Myiarchus crinitus</i>	50.0%
Tufted titmouse	<i>Baeolophus bicolor</i>	50.0%
Blue-gray gnatcatcher	<i>Poliophtila caerulea</i>	50.0%
Common yellowthroat	<i>Geothlypis trichas</i>	50.0%
Pine warbler	<i>Setophaga pinus</i>	50.0%
Red-eyed vireo	<i>Vireo olivaceus</i>	33.3%
Florida scrub-jay	<i>Aphelocoma coerulescens</i>	33.3%
Clapper rail	<i>Rallus longirostris</i>	16.7%
Common gallinule	<i>Gallinula chloropus</i>	16.7%
Black-bellied plover	<i>Pluvialis squatarola</i>	16.7%
Willet	<i>Tringa semipalmata</i>	16.7%
Greater yellowlegs	<i>Tringa melanoleuca</i>	16.7%
Royal tern	<i>Thalasseus maximus</i>	16.7%
Great blue heron	<i>Ardea herodias</i>	16.7%
Green heron	<i>Butorides virescens</i>	16.7%
Osprey	<i>Pandion haliaetus</i>	16.7%
Bald eagle	<i>Haliaeetus leucocephalus</i>	16.7%
Red-shouldered hawk	<i>Buteo lineatus</i>	16.7%
Downy woodpecker	<i>Dryobates pubescens</i>	16.7%

¹ Proportion of sampling locations where species was observed.



A northern cardinal (*Cardinalis cardinalis*), one of many species detected during monitoring in 2022. It was detected at 100% of the sampling sites. NPS photo / David Hypes (NPgallery).

Table 2 (continued). Landbird naïve occupancy estimates at each sampled location ($n = 9$) within Canaveral National Seashore in 2022, ranked descending. Refer to Figure 1 for labeled sampling location ID numbers.

Common Name	Scientific Name	Naïve Occupancy ¹
Blue jay	<i>Cyanocitta cristata</i>	16.7%
Fish crow	<i>Corvus ossifragus</i>	16.7%
Cedar waxwing	<i>Bombycilla cedrorum</i>	16.7%
Marsh wren	<i>Cistothorus palustris</i>	16.7%
Chipping sparrow	<i>Spizella passerina</i>	16.7%
Red-winged blackbird	<i>Agelaius phoeniceus</i>	16.7%
American redstart	<i>Setophaga ruticilla</i>	16.7%
Northern parula	<i>Setophaga americana</i>	16.7%

¹ Proportion of sampling locations where species was observed.

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Literature Cited

- Begon, M., J. L. Harper, and C. R. Townsend. 1986. *Ecology: Individuals, Populations and Communities*. Blackwell Scientific Publications, Oxford, U.K.
- Byrne, M. W., C. J. Wright, E. Thompson, and C. D. Jones. 2014. Protocol for monitoring landbird communities in Southeast Coast Network Parks. Natural Resource Report NPS/SECN/NRR—2014/853. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2216122> (last accessed August 2024).
- Chao, A., K. H. Ma, T. C. Hsieh, and C. H. Chiu. 2016. SpadeR (Species-richness Prediction And Diversity Estimation in R): an R package in CRAN. Program and User's Guide available online at: <https://www.doi.org/10.13140/RG.2.2.20744.62722> (last accessed August 2024).
- Chiu, C. H., and Y. T. Wang, B. Walther, and A. Chao. 2014. An Improved Nonparametric Lower Bound of Species Richness via a Modified Good-Turing Frequency Formula. *Biometrics*. 70. 10.1111/biom.12200. Available at: <https://doi.org/10.1111/biom.12200> (last accessed August 2024).
- Integrated Taxonomic Information System (ITIS). 2024. Integrated Taxonomic Information System Online Database. Available at: <http://www.itis.gov> (last accessed August 2024).
- Montoya, J. M., and D. Raffaelli. 2010. Climate Change, Biotic Interactions and Ecosystem Services. *Philosophical Transactions of the Royal Society B* 365:2013–2018. Available at: <https://royalsocietypublishing.org/doi/10.1098/rstb.2010.0114> (last accessed August 2024).
- National Park Service (NPS). 2024. NPSpecies: Information on species in national parks. Available at: <https://irma.nps.gov/NPSpecies/> (last accessed August 2024).
- Parrish, M. C. 2024. Southeast Coast Network Landbird Monitoring in the Southeastern United States, 2024 cumulative data package. National Park Service, Fort Collins, Colorado. Available at: <https://doi.org/10.57830/2305163>
- Parrish, M. C. and E. Kurimo-Beechuk. 2022. Canaveral National Seashore: Landbird Community Monitoring: 2017 Data Summary. Southeast Coast Network, Athens, Georgia. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2288412> (last accessed August 2024).
- Wildlife Acoustics, Inc. 2024. Kaleidoscope Pro Analysis Software, version 5.x for Windows OS. Wildlife Acoustics, Inc.: Maynard, Massachusetts, USA. Available at: <https://www.wildlifeacoustics.com> (last accessed August 2024).

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.

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/>)