



Landbird Community Monitoring: 2020 Data Summary

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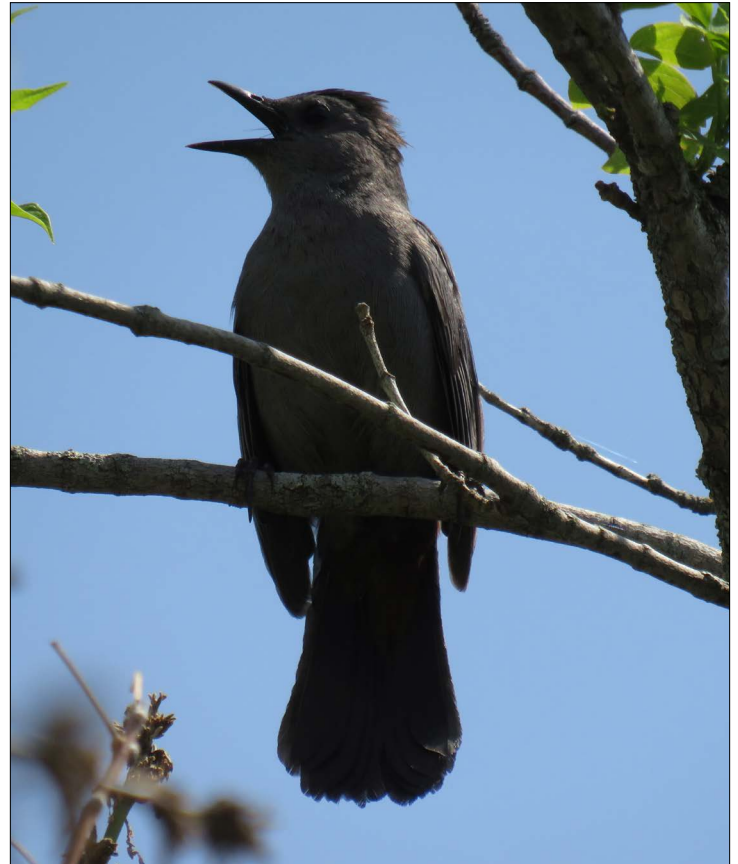
Overview

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 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 2022). Surrounded by human-altered landscapes in a region of increasing urbanization and land conversion, our inland and coastal parks 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 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 gray catbird (*Dumetella carolinensis*), one of many species detected during monitoring in 2020. NPS photo / G.Yellowhawk (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 2020 at Cape Hatteras National Seashore during implementation of the Southeast Coast Network's Landbird Community Monitoring Protocol.

- Automated recording devices (ARDs) captured landbird vocalizations from March 31 to June 1 at 14 spatially-balanced random sampling locations.
- Eight-hundred and forty minutes of audio from 70 recordings were analyzed and all discernable bird vocalizations were reviewed and classified to species.
- We detected 47 species of native landbirds. No non-native bird species were detected
- The most frequently-detected species were: laughing gull (*Leucophaeus atricilla*), Carolina wren (*Thryothorus ludovicianus*), eastern towhee (*Pipilo erythrophthalmus*), common yellowthroat (*Geothlypis trichas*), and red-winged blackbird (*Agelaius phoeniceus*), which were detected at greater than or equal to 85% ($n \geq 12$) of sampling locations.
- Landbird communities at this park will be resampled in 2023.

The full dataset and metadata are available from the NPS data store at the Integrated Resource Management Applications portal: (<https://irma.nps.gov/DataStore/Reference/Profile/2288414>).

Study Area

Cape Hatteras National Seashore (Figure 1) is located in the northern portion of the Outer Banks, a chain of barrier islands separating the Atlantic Ocean from mainland North Carolina. Pamlico Sound, located north and west of the Outer Banks, lies between the islands and the mainland. The 9,903 hectare (24,470 acre) National Seashore extends approximately 125 kilometers (78 miles), including substantial areas on Bodie Island, Hatteras Island, and Ocracoke Island. The northern end of Bodie Island contains Pea Island National Wildlife Refuge, which is included within the administrative boundaries of Cape Hatteras National Seashore, but is managed by the US Fish and Wildlife Service.

As a consequence of the exposed geographical location of the islands, the National Seashore is subject to intense effects from tides, storms, wind, and waves. Constantly shifting sand bars and severe weather create significant hazards to marine navigation, leading to the area's famous nickname, "Graveyard of the Atlantic." Coastal erosion, accretion, and sea overwash is an ongoing concern in the dynamic barrier island environment and dune construction has been undertaken to combat losses to the sea. North Carolina Highway 12 extends the length of the National Seashore, and requires ongoing maintenance. Water management and drainage began early in the 1900s for mosquito control and to encourage waterfowl usage.



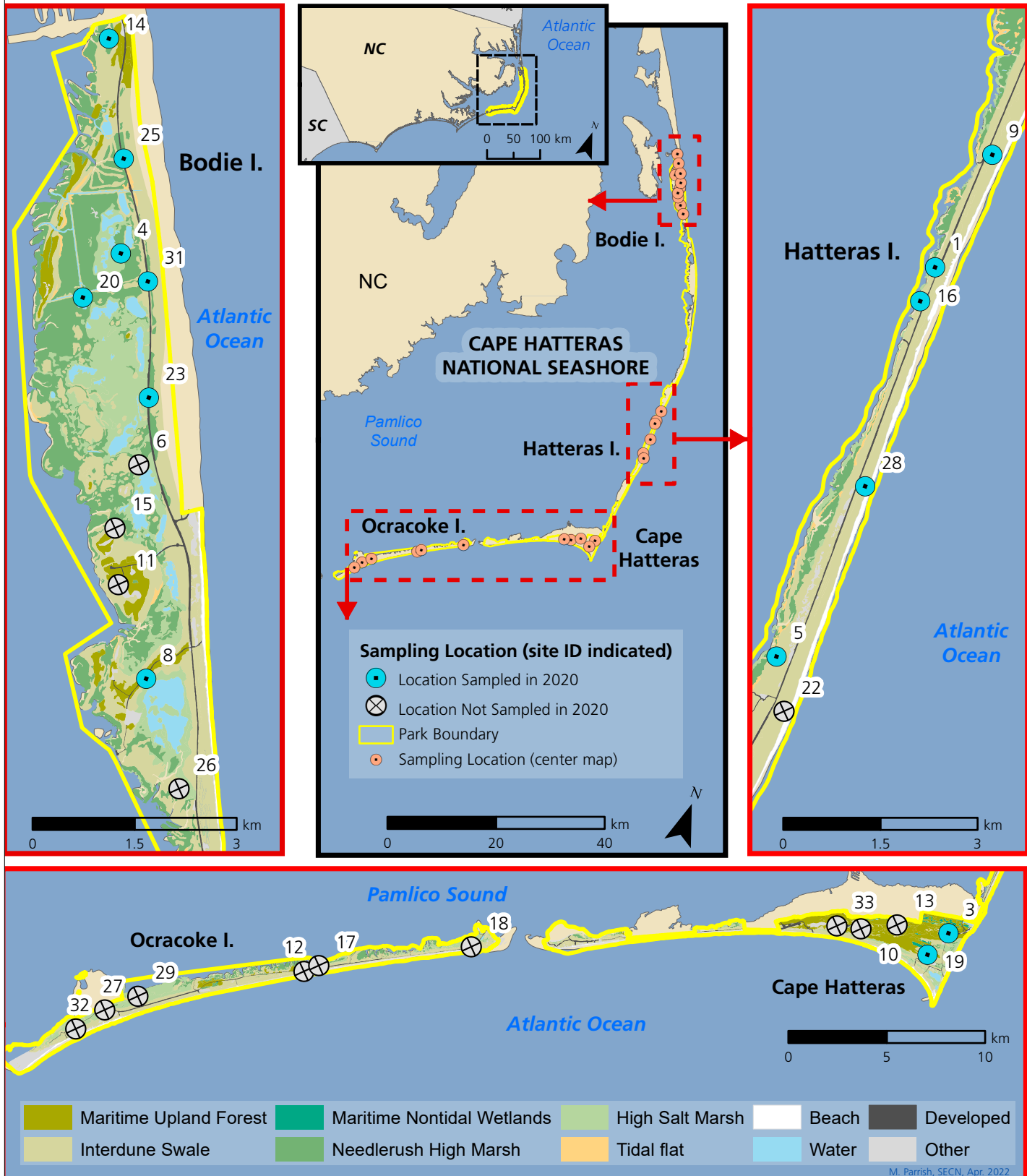
A Carolina wren (*Thryothorus ludovicianus*), one of many species detected during monitoring in 2020. NPS photo / Macaulay Library, CLO, Evan Lipton (NPGallery).

The need to balance pressure from public recreational use (and associated intensive development adjacent to NPS lands) with wildlife conservation needs also represent a notable management challenge.

The vegetative landcover of Cape Hatteras National Seashore can be broadly classified into four dominant communities: maritime tidal wetlands, maritime nontidal wetlands, maritime open uplands, and maritime upland forests / shrublands (Boyle and Rico 2022). Surveys by the SECN terrestrial plants team in 2019 identified the following dominant plants in each community (Boyle and Rico 2022):

- Maritime tidal wetlands: saltmeadow cordgrass (*Spartina patens*), swallow-wort (*Pattalia palustre*), and marsh fimbry (*Fimbristylis castanea*);
- Maritime nontidal wetlands: common wax-myrtle (*Morella cerifera*), saltmeadow cordgrass, eastern poison ivy (*Toxicodendron radicans* var. *radicans*), and saw greenbriar (*Smilax bona-nox*);
- Maritime open uplands: sea oats (*Uniola paniculata*), dune camphorweed (*Heterotheca subaxillaris*), and seabeach evening-primrose (*Oenothera humifusa*);
- Maritime upland forests and shrublands: loblolly pine (*Pinus taeda*), southern/eastern red cedar (*Juniperus silicicola* + *virginiana*), common waxmyrtle, and live oak (*Quercus virginiana*).

The NPS maintains the NPSpecies species occurrence list for Cape Hatteras National Seashore, which documented 314 avian species as 'present' in 2020 (NPS 2022). A table listing all non-vagrant avian species accepted as 'present' in NPSpecies (NPS 2022), as well as species documented during SECN's 2020 monitoring, is available from the NPS data store at the Integrated Resource Management Applications portal: (<https://irma.nps.gov/DataStore/Reference/Profile/2291579>).



Methods

Sampling Design

We established a randomly-selected, spatially-balanced set of sample locations ($n = 28$) during an initial field season in 2015 (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. This report pertains to 2020 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 2020, we deployed automated recording devices (ARDs) at 14 of 28 permanent sampling locations (Figure 1) from March 31 to June 1. ARDs could not be deployed at the remaining 14 sites due to COVID-19 related travel restrictions which prematurely terminated field work. In 2020, our final sample frame consisted of $n = 14$ sampling locations.

We programmed each ARD to record audio from 08:00 to 08:12, every other morning, for a period of 62 days. Thirty-one recordings were captured on each unit. The ARDs were collected from the field after recordings were completed and recordings were downloaded to a computer for classification and analyses.

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 bird sounds. Thus, recordings made on the above dates were initially screened using the software package Kaleidoscope Pro (Wildlife Acoustics, Inc. 2019) 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 2022). The National Park Service maintains the online database NPSpecies (NPS 2022), 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 840 minutes of audio from 70 recordings across 14 sample locations. We only included in analyses detections of birds that were identified to the species level. We calculated metrics separately for native vs. 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 (S_{obs}) as well as mean species richness per sample location (S_{SL}) 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).

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 (S_{obs}) for breeding landbirds at the park in 2020 was 47. Mean $\pm$ SD observed native landbird species richness per sample location (S_{SL}) was 13.2 ± 4.5 (range: 8–24; Table 1). We detected no non-native species. We detected one species (brown-headed nuthatch [*Sitta pusilla*], considered vagrant by the park (NPS 2022). The iChao2 native species richness estimate was 66.2 (95% CI: 52.9, 108.9).

Occupancy and Spatial Distribution

Naïve occupancy was greatest for laughing gull (*Leucophaeus atricilla*),

Carolina wren (*Thryothorus ludovicianus*), eastern towhee (*Pipilo erythrophthalmus*), common yellowthroat (*Geothlypis trichas*), and red-winged blackbird (*Agelaius phoeniceus*), which were detected at $\geq 86\%$ ($n \geq 12$) of sampling locations (Table 1, Table 2). Approximately 51% of species were infrequently detected; 24 species were detected at $\leq 14.2\%$ ($n \leq 2$) of sample locations. Seventeen of the aforementioned 24 species were detected at only one sample location.

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/2291577>). These maps indicate the sampling location(s) where detections of each recorded species occurred.

Table 1. Species detections (indicated with “X”) and native species richness at each sampling location ($n = 14$) for landbirds at Cape Hatteras National Seashore in 2020. Refer to Figure 1 for labeled sampling locations.

Common Name	01	03	04	05	08	09	14	16	19	20	23	25	28	31
Canada goose	–	X	X	–	–	–	–	–	X	–	–	–	–	–
Mourning dove	–	–	–	X	–	X	–	–	X	X	X	–	–	X
Yellow-billed cuckoo	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Common nighthawk	–	–	–	–	–	X	–	–	–	–	–	–	–	–
Clapper rail	X	–	X	–	X	–	–	–	–	X	–	–	–	–
Killdeer	–	–	–	–	–	X	–	–	X	–	–	–	–	–
Willet	–	–	–	–	X	–	–	–	–	–	–	–	X	–
Greater yellowlegs	–	–	X	–	–	–	–	–	–	–	–	–	–	–
Laughing gull	X	X	X	X	X	X	X	X	X	X	X	X	–	X
Least tern	–	–	–	X	–	–	–	–	–	–	–	–	–	–
Royal tern	X	–	–	X	–	–	–	–	X	–	–	–	X	–
Red-headed woodpecker	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Red-bellied woodpecker	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Pileated woodpecker	–	–	–	–	X	–	X	–	–	–	–	–	–	–
Great crested flycatcher	–	X	–	–	X	–	–	–	X	X	X	–	–	–
Eastern kingbird	–	–	–	–	X	–	X	–	–	–	X	–	–	–
White-eyed vireo	X	–	–	–	X	X	–	–	–	X	–	–	–	X
Red-eyed vireo	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Blue jay	–	X	–	–	–	–	–	–	–	–	–	–	–	–
American crow	–	X	–	–	X	–	–	–	X	–	–	–	–	X
Fish crow	–	–	–	–	–	–	X	–	–	X	X	–	–	X
Carolina chickadee	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Tufted titmouse	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Purple martin	–	X	–	–	–	–	X	–	–	–	–	X	–	–
Barn swallow	–	X	–	–	–	X	X	–	–	–	–	–	–	–
Cedar waxwing	–	–	–	–	X	X	–	–	–	–	–	–	–	–
Brown-headed nuthatch	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Blue-gray gnatcatcher	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Marsh wren	–	–	X	–	–	–	–	–	–	X	–	–	–	–
Carolina wren	X	X	–	X	X	X	X	X	X	X	X	X	X	X
Gray catbird	X	–	–	X	X	–	X	–	–	X	–	X	–	X
Brown thrasher	–	–	–	–	–	–	X	–	X	–	–	–	–	–
Northern mockingbird	–	–	–	–	–	X	–	–	–	–	–	–	X	–
Seaside sparrow	–	–	X	–	–	–	–	–	–	–	–	–	–	–
Eastern towhee	X	X	–	X	X	X	X	X	X	X	X	X	X	X

Table 1 continued. Species detections (indicated with “X”) and native species richness at each sampling location ($n = 14$) for landbirds at Cape Hatteras National Seashore in 2020. Refer to Figure 1 for labeled sampling locations.

Common Name	01	03	04	05	08	09	14	16	19	20	23	25	28	31
Eastern meadowlark	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Red-winged blackbird	X	-	X	X	X	X	X	X	X	X	X	X	-	X
Brown-headed cowbird	-	-	-	-	X	X	-	X	X	X	X	-	-	X
Common grackle	X	X	-	-	-	-	X	X	X	-	-	-	-	-
Boat-tailed grackle	X	-	X	-	-	X	X	X	-	X	X	-	X	X
Common yellowthroat	X	-	X	X	X	X	X	X	X	X	X	X	X	X
Blackpoll warbler	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Pine warbler	-	X	-	-	X	-	-	-	X	-	-	-	-	-
Prairie warbler	-	-	-	X	X	X	-	-	X	-	-	-	X	-
Summer tanager	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Northern cardinal	X	X	-	X	X	X	-	X	X	X	-	X	-	X
Indigo bunting	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Observed Species Richness	12	16	9	11	24	16	14	9	18	16	11	8	8	13

Table 2. Naïve occupancy estimates (i.e., percent of permanent sampling locations [$n = 14$] where a species was detected) for landbirds at Cape Hatteras National Seashore in 2020, ranked by descending percentage of locations occupied.

Common Name	Scientific Name	Naïve ¹ Occupancy
Laughing gull	<i>Leucophaeus atricilla</i>	93%
Carolina wren	<i>Thryothorus ludovicianus</i>	93%
Eastern towhee	<i>Pipilo erythrophthalmus</i>	93%
Common yellowthroat	<i>Geothlypis trichas</i>	93%
Red-winged blackbird	<i>Agelaius phoeniceus</i>	86%
Northern cardinal	<i>Cardinalis cardinalis</i>	71%
Boat-tailed grackle	<i>Quiscalus major</i>	64%
Gray catbird	<i>Dumetella carolinensis</i>	50%
Brown-headed cowbird	<i>Molothrus ater</i>	50%
Mourning dove	<i>Zenaidura macroura</i>	43%
Great Crested flycatcher	<i>Myiarchus crinitus</i>	36%
White-eyed vireo	<i>Vireo griseus</i>	36%
Common grackle	<i>Quiscalus quiscula</i>	36%
Prairie warbler	<i>Setophaga discolor</i>	36%
Clapper rail	<i>Rallus longirostris</i>	29%
Royal tern	<i>Thalasseus maximus</i>	29%
American crow	<i>Corvus brachyrhynchos</i>	29%
Fish crow	<i>Corvus ossifragus</i>	29%
Canada goose	<i>Branta canadensis</i>	21%
Eastern kingbird	<i>Tyrannus tyrannus</i>	21%
Purple martin	<i>Progne subis</i>	21%
Barn swallow	<i>Hirundo rustica</i>	21%

Common Name	Scientific Name	Naïve ¹ Occupancy
Pine warbler	<i>Setophaga pinus</i>	21%
Killdeer	<i>Charadrius vociferus</i>	14%
Willet	<i>Tringa semipalmata</i>	14%
Pileated woodpecker	<i>Dryocopus pileatus</i>	14%
Cedar waxwing	<i>Bombcilla cedrorum</i>	14%
Marsh wren	<i>Cistothorus palustris</i>	14%
Brown thrasher	<i>Toxostoma rufum</i>	14%
Northern mockingbird	<i>Mimus polyglottos</i>	14%
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	7%
Common nighthawk	<i>Chordeiles minor</i>	7%
Greater yellowlegs	<i>Tringa melanoleuca</i>	7%
Least tern	<i>Sternula antillarum</i>	7%
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	7%
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	7%
Red-eyed vireo	<i>Vireo olivaceus</i>	7%
Blue jay	<i>Cyanocitta cristata</i>	7%
Carolina chickadee	<i>Poecile carolinensis</i>	7%
Tufted titmouse	<i>Baeolophus bicolor</i>	7%
Brown-headed nuthatch	<i>Sitta pusilla</i>	7%
Blue-gray gnatcatcher	<i>Poliophtila caerulea</i>	7%
Seaside sparrow	<i>Ammodramus maritimus</i>	7%
Eastern meadowlark	<i>Sturnella magna</i>	7%
Blackpoll warbler	<i>Setophaga striata</i>	7%
Summer tanager	<i>Piranga rubra</i>	7%
Indigo bunting	<i>Passerina cyanea</i>	7%

¹ Percent of sampling locations where species was observed.

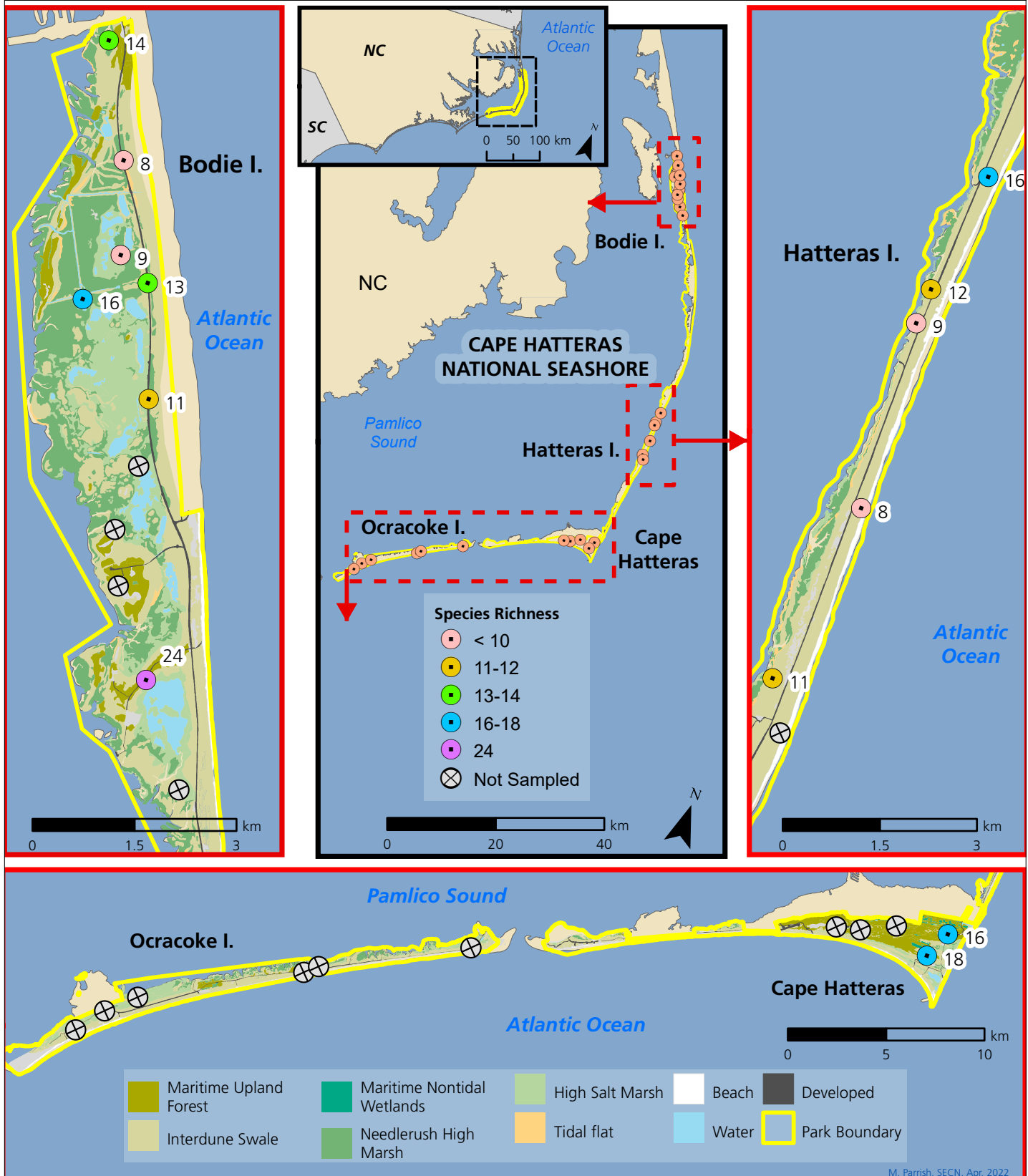


Figure 2. Landbird species richness at permanent sampling locations ($n = 14$) at Cape Hatteras National Seashore, based on audio recording detections in 2020.

Acknowledgements

We wish to thank Meaghan Johnson (Chief of Resource Management and Science, Cape Hatteras National Seashore), Tracy Ziegler (former Chief of Resource Management and Science, National Parks of Eastern NC), William Thompson (Hatteras Island Supervisory Biological Science Technician), and the CAHA staff for their kind assistance with sampling logistics and ARD retrievals during the COVID-19 pandemic.

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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>

SECN Reports & Publications:

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

About the NPS Inventory & Monitoring Program:

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

Data Downloads via the Natural Resource Information Portal:

<https://irma.nps.gov/Portal/>