



## Anuran Community Monitoring: 2014 Data Summary—Version 2.0

By Michael C. Parrish 

Southeast Coast Network, NPS, 135 Phoenix Road, Athens, Georgia 30605

### Revision Log

| Date   | Author     | Changes Made                                                                                                                                        | Reason for Change                                                                                                                                                                                                                                                                                                    | Version |
|--------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 5/2025 | M. Parrish | Complete revision of Smrekar and Byrne (2015) using modern Kaleidoscope Pro software to classify park anuran communities using 2014 recording data. | The original publication utilized now-depreciated software and classification approaches. We reviewed original 2014 recordings and classified species using modern-day software and current audio interpretation protocols to improve consistency and comparability with ongoing anuran monitoring work in the park. | 2.0     |

### Overview

Amphibian populations across all regions of North America are declining, with estimates of the mean annual trend in number of occupied sites ranging from -2.30% in the southeast US region to -5.17% for the US west coast (Grant et al. 2016). A variety of factors appear to contribute to observed population declines, often at a local scale, including: disease, aquatic and terrestrial habitat loss and conversion, changes in regional weather patterns and intensity, air and water pollution, and introduction of non-indigenous species (Grant et al. 2016; Grant et al. 2020; Luedtke et al. 2023). Partly due to their complex life cycles, which generally include an aquatic larval stage followed by an adult terrestrial phase, amphibians are often sensitive to perturbations of environmental conditions. Throughout their life cycle, amphibians rely heavily on availability of fresh, clean water to survive and successfully reproduce. Even apparently minor disruptions of the aquatic or terrestrial environments upon which amphibians depend may substantially impact the survival, reproduction, and persistence of a species. Many amphibian species in the United States, including those for which there is currently little or no conservation concern, may be experiencing widespread declines (Adams et al. 2013; Grant et al. 2020).

The southern region of the United States hosts the highest amphibian species richness in North America. The region contains at least 45 species of anurans (i.e., frogs, toads, and treefrogs), which represent 41% of the anuran species richness of North America, north of Mexico (Dorcas and Gibbons 2008; SSAR 2017). Within the 15 park units monitored by the National Park Service’s (NPS) Southeast Coast Inventory and Monitoring Network (SECN), at least 32 species of anurans have been documented to occur (NPS 2025).



Southern leopard frog (*Lithobates sphenoccephalus*), detected during monitoring in 2014. NPS / Briana Smrekar (NPGallery)

Anuran communities respond fairly quickly to environmental stressors or changes. Because of the conspicuous vocalization behavior exhibited by most species during breeding periods, anurans are relatively easy to detect and identify, compared with other amphibians. Changes in anuran species assemblages, richness, and distribution on the landscape may reflect alterations to underlying ecological conditions of park resources. In conjunction with other environmental measures (e.g., water quality, vegetation, fish assemblages), anuran assemblages can serve as effective indicators of ecological integrity (Zampella et al. 2006).

National parks comprise valuable protected landscapes where long-term monitoring can detect and track anuran population trends that can inform assessments of ecosystem integrity and sustainability (Halstead et al. 2022). Given the noteworthy species richness of amphibians in the Southeast, their sensitivity to environmental stressors, and their evident declines in recent decades, anuran communities represent a priority for SECN monitoring efforts. Our monitoring data contribute to understanding how park resources and natural communities respond to changing environmental conditions, informing park management decision making.

## Overview (continued)

### Objectives

This report summarizes data collected at Congaree National Park under the SECN Anuran Monitoring Protocol (Byrne et al. 2013). The data address the following protocol objectives:

1. Evaluate status of anuran species richness during the spring breeding season.
2. Assess anuran occupancy and spatial distribution at sampling locations during the breeding season.

## Significant Results

This report summarizes data collected in 2014 at Congaree National Park during implementation of the Southeast Coast Network's Anuran Monitoring Protocol (Byrne et al. 2013).

- Automated recording devices (ARDs) captured anuran (i.e., frog, toad, and treefrog) vocalizations from approximately March 21 to June 23 at 20 spatially-balanced random sampling locations.
- We extracted 10,431 potential audio signals from 11,529 minutes of audio recordings. We manually reviewed a systematically selected subset of 2,452 (23.5%) of the extracted signals and classified to species any identifiable anuran vocalizations found within that subset.
- Anurans were observed at all 20 sampled locations.
- We identified 12 native species of anurans, each of which was previously documented at the park. No non-indigenous anurans were detected.
- The most frequently detected species were southern leopard frog (*Lithobates sphenoccephalus*) and Cope's gray treefrog (*Dryophytes chrysoscelis*), which respectively occurred at 75% and 55% of permanent sampling locations.
- The next sampling of anuran communities was in 2017.

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

- [Data summary brief](https://irma.nps.gov/DataStore/Reference/Profile/2311252) (https://irma.nps.gov/DataStore/Reference/Profile/2311252)
- [Species distribution maps](https://irma.nps.gov/DataStore/Reference/Profile/2311280) (https://irma.nps.gov/DataStore/Reference/Profile/2311280)
- [Full dataset and metadata](https://irma.nps.gov/DataStore/Reference/Profile/2307457) (https://irma.nps.gov/DataStore/Reference/Profile/2307457)



Cope's gray treefrog (*Dryophytes chrysoscelis*), one of several species detected during monitoring in 2014. NPS / NPgallery

## Study Area

Congaree National Park is in central South Carolina approximately 30 kilometers (18.6 miles) southeast of the state capital, Columbia. The 10,802-hectare (26,693-acre) park is bordered to the south by the Congaree River and the Wateree River to the east. The park contains the largest contiguous old-growth bottomland hardwood forest remaining in the United States. As such, it represents a unique and uncommon assemblage of aquatic and terrestrial plant and wildlife community types.

Congaree National Park is predominantly a floodplain forest with nearly 90 native tree species, including many recognized as national and state champions for their size. A wide variety of forest communities occur at the park, with dominant tree species ranging from upland pines (*Pinus* spp.) to wetland cypress (*Taxodium* spp.) and tupelo (*Nyssa* spp.) often occurring with ubiquitous species such as sugarberry (*Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), and laurel oak (*Quercus laurifolia*).

Episodic and seasonal inundations in surface water are a critical component of the integrity of the park's floodplain forest. The frequency, magnitude, and duration of flooding events are primary drivers for many of the vegetation communities and serve as mechanisms for the delivery of sediment and nutrients to the floodplain. Although periodic inundations continue to occur, the regulated flow of water through the park since the introduction of the Saluda Dam in 1930 does not follow seasonal hydrologic fluctuations or represent a natural (i.e., historic) hydroperiod. The effects of this alteration on the floodplain ecosystem remain unknown.

Congaree National Park included 22 previously reported anuran species on the official park taxa list (Table 1; NPS 2025). This number excludes several taxa that warrant removal from the park list. Coastal plain cricket frog (*Acris gryllus gryllus*), northern spring peeper (*Pseudacris crucifer crucifer*) and bronze frog (*Lithobates clamitans clamitans*) are all considered invalid subspecies (ITIS 2025). Common gray treefrog (*Dryophytes versicolor*) does not occur in South Carolina (Dorcas and Gibbons 2008) and was likely confused with the similar Cope's gray treefrog (*D. chrysoscelis*).

**Table 1.** Anurans known to occur within Congaree National Park based upon records in NPSpecies (NPS 2025) and those detected during our 2014 sampling. Documented species indicated with “X.”

| Order | Family         | Species                           | Authority              | Common Name                 | NPSpecies (2025) <sup>1</sup> | SECN Monitoring (2014) |
|-------|----------------|-----------------------------------|------------------------|-----------------------------|-------------------------------|------------------------|
| Anura | Bufonidae      | <i>Anaxyrus fowleri</i>           | Hinckley 1882          | Fowler's toad               | –                             | X                      |
|       |                | <i>Anaxyrus terrestris</i>        | Bonnaterre 1789        | Southern toad               | X                             | X                      |
|       | Hylidae        | <i>Acris crepitans</i>            | Baird 1854             | Northern cricket frog       | X                             | –                      |
|       |                | <i>Acris gryllus</i>              | LeConte 1825           | Southern cricket frog       | X                             | –                      |
|       |                | <i>Dryophytes chrysoscelis</i>    | Cope 1880              | Cope's gray treefrog        | X                             | X                      |
|       |                | <i>Dryophytes cinereus</i>        | Schneider 1799         | Green treefrog              | X                             | –                      |
|       |                | <i>Dryophytes femoralis</i>       | Daudin 1800            | Pine woods treefrog         | X                             | –                      |
|       |                | <i>Dryophytes gratiosus</i>       | LeConte 1856           | Barking treefrog            | X                             | –                      |
|       |                | <i>Dryophytes squirellus</i>      | Daudin 1800            | Squirrel treefrog           | X                             | X                      |
|       |                | <i>Pseudacris brimleyi</i>        | Brandt and Walker 1933 | Brimley's chorus frog       | X                             | X                      |
|       |                | <i>Pseudacris crucifer</i>        | Wied-Neuwied 1838      | Spring peeper               | X                             | X                      |
|       |                | <i>Pseudacris feriarum</i>        | Baird 1854             | Upland chorus frog          | X                             | X                      |
|       |                | <i>Pseudacris nigrita</i>         | LeConte 1825           | Southern chorus frog        | X                             | –                      |
|       |                | <i>Pseudacris ocularis</i>        | Bosc and Daudin 1801   | Little grass frog           | X                             | –                      |
|       |                | <i>Pseudacris ornata</i>          | Holbrook 1836          | Ornate chorus frog          | X                             | –                      |
|       | Microhylidae   | <i>Gastrophryne carolinensis</i>  | Holbrook 1835          | Eastern narrow-mouthed toad | X                             | X                      |
|       | Ranidae        | <i>Lithobates catesbeianus</i>    | Shaw 1802              | American bullfrog           | X                             | X                      |
|       |                | <i>Lithobates clamitans</i>       | Latreille 1801         | Green frog                  | X                             | X                      |
|       |                | <i>Lithobates heckscheri</i>      | Wright 1924            | River frog                  | X                             | –                      |
|       |                | <i>Lithobates palustris</i>       | LeConte 1825           | Pickerel frog               | X                             | X                      |
|       |                | <i>Lithobates sphenoccephalus</i> | Cope 1886              | Southern leopard frog       | X                             | X                      |
|       |                | <i>Lithobates virgatipes</i>      | Cope 1891              | Carpenter frog              | X                             | –                      |
|       | Scaphiopodidae | <i>Scaphiopus holbrookii</i>      | Harlan 1835            | Eastern spadefoot           | X                             | –                      |

<sup>1</sup> Omitted from this table are three invalid subspecies (*Acris gryllus gryllus*, *Pseudacris crucifer crucifer*, and *Lithobates clamitans clamitans*) and one out-of-range species (*Dryophytes versicolor*) that were incorrectly included in the NPSpecies list.

## Methods

### Sampling Design

The Southeast Coast Network established a randomly-selected, spatially-balanced set of sample locations ( $n = 33$ ) during an initial field season in 2014 (Figure 1). Our sample size was chosen based on considerations that included 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 2014 sampling only. More comprehensive details regarding study design, data collection, and data analyses can be found in the SECN Anuran Monitoring Protocol (Byrne et al. 2013).

### Data Collection

In 2014, we deployed automated recording devices (ARDs) at 22 permanent sampling locations (Figure 1) between March 21 to June 23. We were not able to access all 33 pre-selected sites due to complex ground conditions in the park. Two units subsequently experienced environmental damage, reducing our final sample size to  $n = 20$ . Exact deployment dates varied slightly among sampling locations; however, overall deployment duration averaged 81.9 days at 19 sites, and 9 days at one site (location 53; Figure 1), where premature equipment failure



Southern toad (*Anaxyrus terrestris*), one of several species detected during monitoring in 2014. NPS / Kristen Maxfield (NPgallery).

occurred. We programmed each ARD to record audio on every fourth night, in 30-second intervals every 10 minutes from 20:00 to 04:50, 20 to 23 nights of sampling per ARD. The ARDs captured 23,057 recordings (11,528.5 minutes of audio) during the recording period. The ARDs were collected from the field after recording was completed and audio files were downloaded to a computer for classification and analyses.



## Audio Sampling Locations

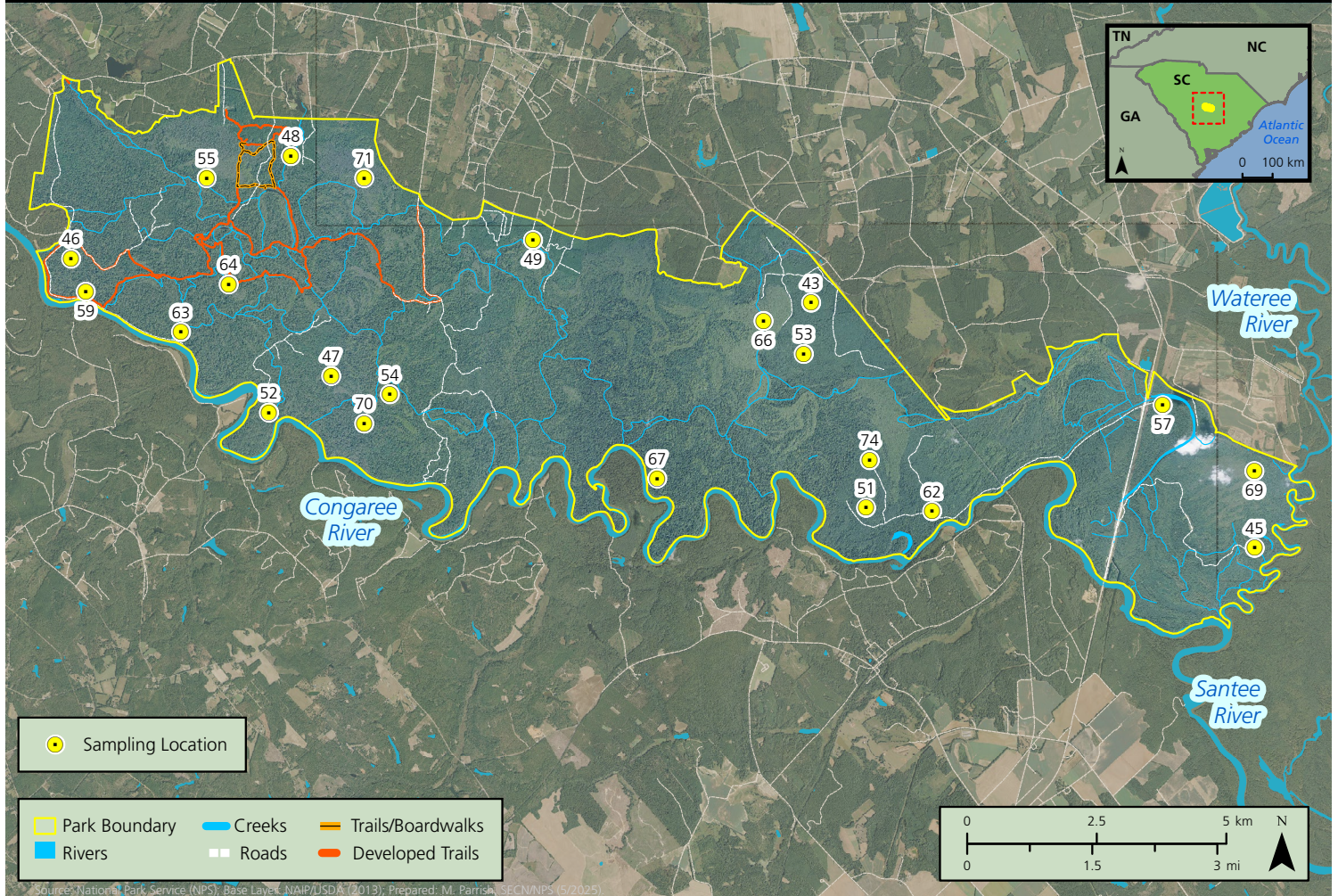


**Figure 1.** Permanent audio sampling locations ( $n = 22$ ) within Congaree National Park sampled in 2014. Sampling location ID numbers are indicated at each point. NPS / SECN.

## Methods (continued)

### *Manual Classification of Recordings*

It is not possible, given personnel constraints, to manually review all recordings for a park. Additionally, a full manual review of all audio recordings would not be an efficient use of resources, considering that a large proportion of the recordings do not contain signals of interest. We therefore began classification work by using computer program Kaleidoscope Pro (Wildlife Acoustics 2025) to automatically review all recordings at a sample location in the park and to extract as many signal detections as possible. Signal detections usually comprise natural or artificial acoustic departures from the background soundscape, and may include biological signals of interest (i.e., frog calls), biological signals not of interest (e.g., bird calls, insect noises, or human noises), natural environmental sounds not of interest (e.g., rain, wind, surf, or thunder), or anthropogenic noises not of interest

(e.g., planes, trains, and automobiles). After extracting signals from the raw recordings, Kaleidoscope Pro then grouped the isolated signals into clusters, according to mathematical similarity. The result was a set of clusters of unclassified, but potentially interesting signals and the simultaneous elimination of much of the inconsequential noise recorded in the field.

Ideally, this process would result in “pure” clusters each containing a single class of signal (e.g., a cluster consisting only of calls belonging to a single species). However, given the complex, overlapping, natural jumble of sounds present in the background soundscape, Kaleidoscope Pro tends to produce clusters that are more heterogeneous than would be optimally desired. This necessitates manual classification work performed by expert listeners who are familiar with the calls of anurans of the southeastern states.

## Methods (continued)

An expert in identification of anuran calls then manually reviewed the first five signals in each cluster (i.e., those closest to the mathematical center of the cluster), which represented the five signals most representative of that cluster. When a signal consisted of anuran vocalizations that could be classified to the species level, the signal was labeled accordingly. Once all manual signal reviews were completed, the listener reviewed all of the anuran classifications and selected one signal that was a representative example of each species. Each selected signal became the definitive record for a given species' occurrence at a given sample location. Later, the SECN Wildlife Biologist reviewed each definitive record individually to confirm species identification and to perform data quality assurance steps. The electronic records of each species occurrence were later validated, and the records were elevated to accepted status by the Wildlife Biologist.

### *Taxonomic Standards*

Our use of taxonomic nomenclature followed the Integrated Taxonomic Information System (ITIS 2025). The National Park Service maintains the online database NPSpecies (NPS 2025), which documents the occurrence and status of species found in parks.

### *Data Analysis*

We analyzed species richness and related characteristics, occupancy and spatial distribution, and frequency of detection of the park's anurans. Our results were derived from a semi-automated evaluation of 11,528.5 minutes of audio from 23,057 recordings captured across 20 sample locations. We extracted a total of 10,431 potential signals from the audio recordings, out of which we manually classified 2,452 (23.5% of signals). We included in analyses only detections of anurans that were identified to the species level. We calculated metrics separately for native vs. non-indigenous species if applicable.

### *Species Richness and Composition*

We defined species richness as the number of unique species detected at least once at the scale of interest. We began by calculating anuran species richness for the park as a whole, as the total number of unique species across all sample locations. We also calculated species richness at each sample location. We determined species richness separately for native versus non-indigenous anuran species when non-indigenous species were present.

Field methods for sampling species richness (e.g., point-counts or audio sampling) produce incomplete counts, due to imperfect detection of cryptic species that may be present but difficult to record during surveys. Observed species richness, therefore, is expected to be an underestimate of true species richness, though it offers utility as a richness index. Various methods exist to adjust incidence data to provide an estimated species richness that includes species present, but unobserved (e.g., multispecies occupancy models or non-parametric richness estimators, such as *iChao2*); however, these approaches perform poorly where average occupancy is low (Tingley et al. 2020). We therefore report only unadjusted species richness, with the caveat that it should be interpreted as described above.



American bullfrog (*Lithobates catesbeianus*), detected during monitoring in 2014. NPS / NPgallery

### *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 were detected at more locations than ones with low values.

### *Spatial Distribution*

We mapped species incidence records in the park to provide a means of visually assessing spatial distributions of detected anurans across the park. An understanding of anuran distribution is beneficial for informed management of species and their requisite habitats. Following further sampling, we plan to examine park data for trends in species composition and spatial distribution with the goal of providing insight into possible drivers (e.g., habitat condition or hydrological processes) of those ecological outcomes.

## Results

### *Species Richness*

Observed species richness for native anurans at Congaree National Park in 2014 was 12 (Table 1). We did not detect any non-indigenous anuran species. Mean  $\pm$  SD observed species richness of native anurans per sample location was  $2.75 \pm 1.55$  (range: 1–6; Table 2; Figure 2). We detected anurans at all sampled locations.

**Table 2.** Species detections (indicated with “X”) and observed species richness (native-only and inclusive of non-indigenous species) at each sampling location within Congaree National Park in 2014. Refer to Figure 1 for labeled sampling locations. Ø = Equipment failure / no data

| Common Name                        | 43 | 45 | 46 | 47 | 48 | 49 | 51 | 52 | 53 | 54 | 55 | 57 | 59 | 62 | 63 | 64 | 66 | 67 | 69 | 70 | 71 | 74 |
|------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Fowler's toad                      | –  | –  | –  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | –  | –  | –  | X  | –  | –  | –  | –  | –  | –  | –  |
| Southern toad                      | –  | X  | –  | –  | Ø  | X  | –  | Ø  | –  | –  | –  | –  | –  | X  | X  | –  | X  | –  | X  | –  | –  | –  |
| Cope's gray treefrog               | X  | –  | –  | –  | Ø  | X  | X  | Ø  | –  | X  | X  | –  | X  | X  | X  | X  | X  | X  | –  | –  | –  | –  |
| Squirrel treefrog                  | –  | –  | –  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | –  | –  | X  | –  | –  | –  | –  | –  | –  | –  | –  |
| Brimley's chorus frog              | X  | –  | –  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | X  | –  | –  | –  | X  | –  | –  | –  | X  | –  | –  |
| Spring peeper                      | –  | –  | X  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | X  | –  | –  | –  | –  | –  | –  | –  | –  | X  | –  |
| Upland chorus frog                 | –  | –  | X  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  |
| Eastern narrow-mouthed toad        | –  | –  | –  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | –  | –  | X  | –  | –  | –  | –  | –  | –  | –  | –  |
| American bullfrog                  | X  | X  | –  | –  | Ø  | –  | –  | Ø  | –  | –  | –  | –  | –  | X  | –  | X  | –  | –  | X  | –  | –  | –  |
| Green frog                         | X  | –  | –  | –  | Ø  | –  | –  | Ø  | –  | X  | –  | –  | –  | –  | X  | X  | X  | –  | –  | –  | X  | –  |
| Pickerel frog                      | –  | –  | –  | –  | Ø  | X  | –  | Ø  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  | –  |
| Southern leopard frog              | X  | X  | X  | X  | Ø  | X  | X  | Ø  | X  | X  | –  | X  | X  | X  | –  | X  | X  | –  | X  | –  | –  | X  |
| Observed Species Richness (Native) | 5  | 3  | 3  | 1  | Ø  | 4  | 2  | Ø  | 1  | 3  | 1  | 3  | 2  | 6  | 4  | 5  | 4  | 1  | 3  | 1  | 2  | 1  |



## Species Richness at Sampling Locations

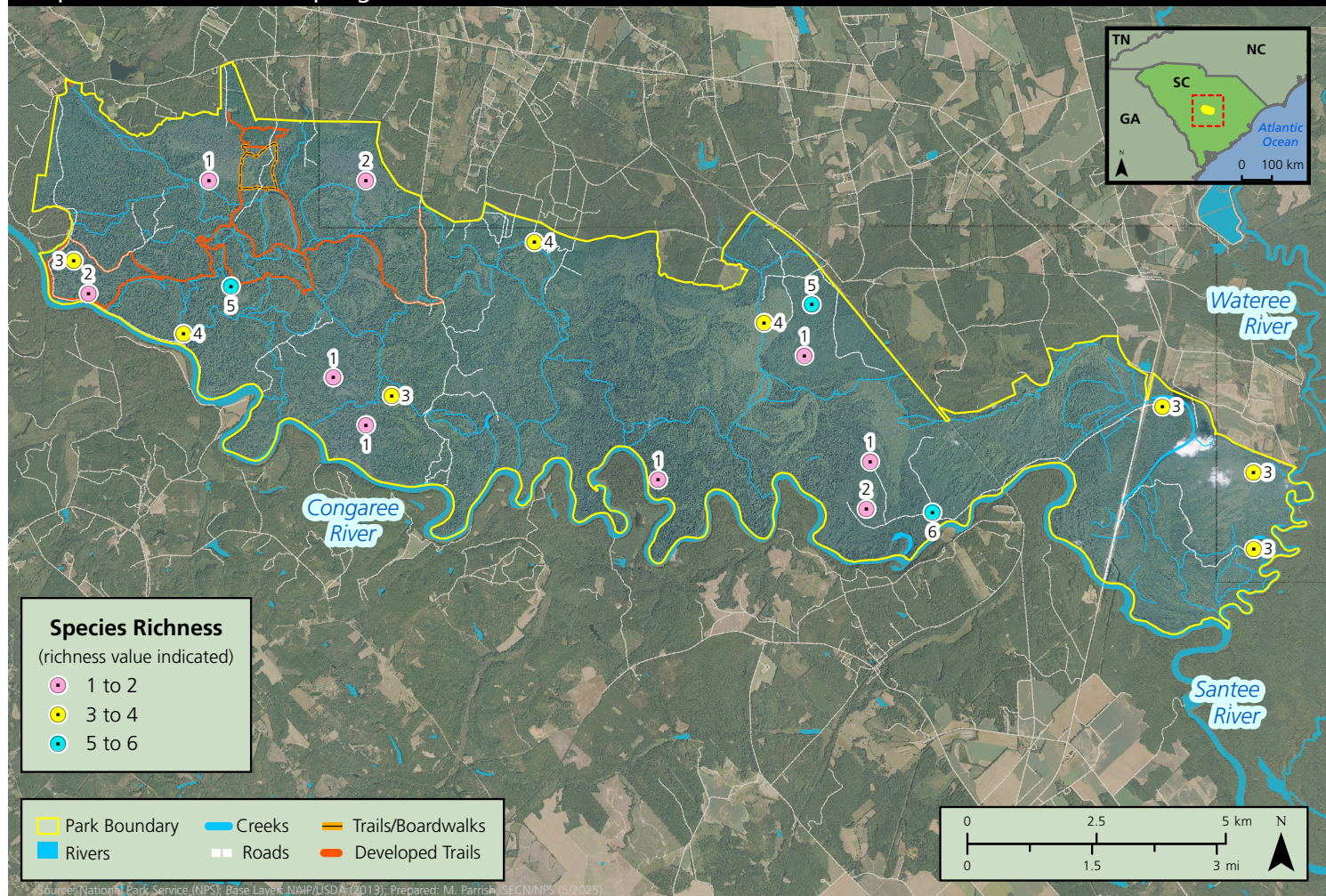


**Figure 2.** Vocal anuran species richness at sampling locations within Congaree National Park, based on audio recording detections in 2014. NPS / SECN

## Results (continued)

### Occupancy and Spatial Distribution

Naïve occupancy was greatest for southern leopard frog (*Lithobates sphenoccephalus*) and Cope's gray treefrog (*Dryophytes chrysoscelis*), which respectively occurred at 75% and 55% of permanent sampling locations (Table 3). Fowler's toad (*Anaxyrus fowleri*), squirrel treefrog (*D. squirellus*), upland chorus frog (*Pseudacris feriarum*), eastern narrow-mouthed toad (*Gastrophryne carolinensis*), and pickerel frog (*L. palustris*) were each detected at one sample location (Table 3).

Eleven of the 12 anuran species we detected in 2014 (all except Fowler's toad) were previously documented at Congaree National Park (NPS 2025; Table 1).

To our knowledge, our observation of Fowler's toad represents the only confirmed detection of the species within Congaree National Park (Table 4). Fowler's toad was detected at a single sampling location located near the Congaree River in an isolated area of the eastern end of the park (site 63; Figure 1). We documented 15 signals unambiguously identified as Fowler's toad vocalizations, all on the night of June 15 (Figure 3).

**Table 3.** Naïve occupancy estimates (i.e., proportion of permanent sampling locations where a species was detected) for vocal anurans within Congaree National Park in 2014, ranked by descending proportion of locations occupied.

| Common Name                 | Scientific Name                   | Naïve occupancy <sup>1</sup> |
|-----------------------------|-----------------------------------|------------------------------|
| Southern leopard frog       | <i>Lithobates sphenoccephalus</i> | 75%                          |
| Cope's gray treefrog        | <i>Dryophytes chrysoscelis</i>    | 55%                          |
| Southern toad               | <i>Anaxyrus terrestris</i>        | 30%                          |
| Green frog                  | <i>Lithobates clamitans</i>       | 30%                          |
| American bullfrog           | <i>Lithobates catesbeianus</i>    | 25%                          |
| Brimley's chorus frog       | <i>Pseudacris brimleyi</i>        | 20%                          |
| Spring peeper               | <i>Pseudacris crucifer</i>        | 15%                          |
| Fowler's toad               | <i>Anaxyrus fowleri</i>           | 5%                           |
| Squirrel treefrog           | <i>Dryophytes squirellus</i>      | 5%                           |
| Upland chorus frog          | <i>Pseudacris feriarum</i>        | 5%                           |
| Eastern narrow-mouthed toad | <i>Gastrophryne carolinensis</i>  | 5%                           |
| Pickerel frog               | <i>Lithobates palustris</i>       | 5%                           |

<sup>1</sup> Percent of sampling locations (n = 20) where species was observed

**Table 4.** Newly documented species of vocal anurans within Congaree National Park in 2014, with suggested park status information.

| Common Name   | Scientific Name         | Abundance | Residency | Native Status | Pest | Management Priority | Exploitation Concerns |
|---------------|-------------------------|-----------|-----------|---------------|------|---------------------|-----------------------|
| Fowler's toad | <i>Anaxyrus fowleri</i> | Unknown   | Resident  | Native        | No   | No                  | No                    |

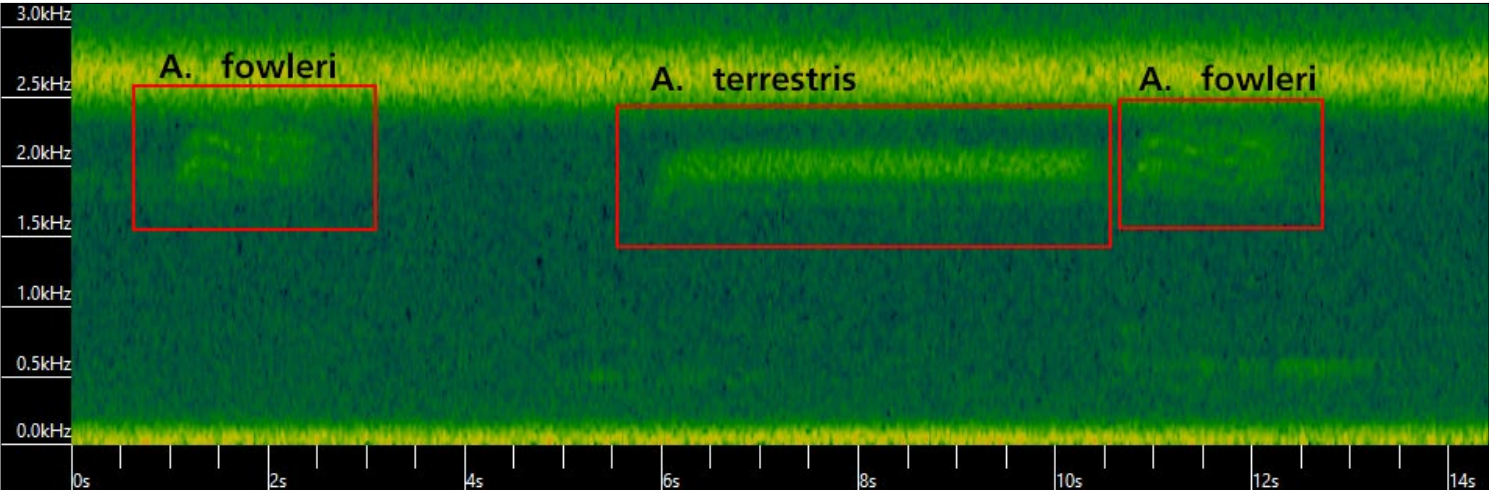


**Figure 3.** Frequency spectrogram illustrating two vocalizations of Fowler's toad (*Anaxyrus fowleri*), a species not previously documented at Congaree National Park (NPS 2025). Both of the Fowler's toad vocalizations plus a concurrent vocalization by southern toad (*A. terrestris*) are indicated by boxes. Spectrogram was produced using Kaleidoscope 5.6.8 (Wildlife Acoustics Inc. 2025) using a recording captured June 15, 2014 (Parrish 2025).

Results (continued)

Brimley’s chorus frog (*P. brimleyi*) is a noteworthy species in South Carolina; its distribution throughout the state remains poorly understood, and the majority of what few records exist are from a small population at the Savannah River Site (Luhring 2008). We are aware of only one previous 2003 record from Richland County, at Congaree National Park from 2003 sampling (Tuberville 2005; Willson 2019). Apart from the aforementioned Savannah River Site records and the Richland County record, online resources Herpmapper.org and iNaturalist.org contain less than 10 records of the species in

South Carolina, all of which are from counties in the middle Coastal Plain region. In 2014, we detected Brimley’s chorus frog at four sampled locations (20% naïve occupancy) in Congaree National Park (Tables 2, 3). In later sampling years, we again detected the species, at an even greater number of locations inside the park: in 2017 at 11 sampled locations (48% naïve occupancy; Parrish and Martin 2023) and in 2022 at six sampled locations (40% naïve occupancy; Parrish and Martin 2024). We speculate that Congaree National Park may represent an important, protected breeding area in South Carolina for this understudied species.

## Results (continued)

We failed to detect several species that are considered “accepted” on the park species list (NPS 2025) including: little grass frog (*P. ocularis*), ornate chorus frog (*P. ornata*), river frog (*L. heckscheri*), and carpenter frog (*L. virgatipes*). We consider the evidence for the occurrence of these species to be weak and/or outdated. Voucher specimens would greatly strengthen the argument for their occurrence (or persistence) in the park.

Cricket frogs (*Acris* spp.) and southern chorus frog (*Pseudacris nigrita*) are confirmed to occur at the park (e.g., Grego 2021; Grego 2024). Vocalizations of both species are usually readily discernable on ARD recordings, but we did not observe them in either 2014, 2017 (Parrish and Martin 2023), or 2022 (Parrish and Martin 2024), suggesting that our sampling locations may not intersect areas where either species occurs in the park.

### Distribution Maps

Distribution maps indicating the sampling location(s) where species detections occurred are available on the NPS Integrated Resource Management Application portal at [Species Distribution Maps](https://irma.nps.gov/DataStore/Reference/Profile/2311280) (<https://irma.nps.gov/DataStore/Reference/Profile/2311280>).

## Acknowledgements

Briana D. Smrekar (SECN/NPS), Michael W. Byrne (SECN/NPS), Lisa Kleinschmidt (SECN/NPS), and Nathan P. Schwartz (SECN/NPS) were responsible for 2014 ARD field recordings. Wayne Ryan (SECN intern, Cooperative Ecosystem Studies Unit / University of Georgia) and Myra Kincaid (SECN intern, Cooperative Ecosystem Studies Unit / University of Georgia) assisted with data entry. Lily Martin provided assistance with quality assurance. Audio classification and analyses were performed by the author.

## Literature Cited

- Adams M. J., D. A. W. Miller, E. Muths, P.S. Corn, E. H. C. Grant, et al. 2013. Trends in Amphibian Occupancy in the United States. *PLOS ONE* 8(5): e64347. Available at: <https://doi.org/10.1371/journal.pone.0064347> (last accessed May 2025).
- Byrne, M. W., B. D. Smrekar, L. M. Elston, J. C. DeVivo, C. J. Wright, and E. Thompson. 2013. Protocol for monitoring vocal anuran communities in Southeast Coast Network Parks. Natural Resource Report NPS/SECN/NRR—2013/720. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2203687> (last accessed May 2025).
- Dorcas, M. E. and J. W. Gibbons. 2008. *Frogs and Toads of the Southeast*. University of Georgia Press. ISBN: 978-0-8203-2922-2.
- Grant, E. H. C. et al. 2016. Quantitative evidence for the effects of multiple drivers on continental-scale amphibian declines. *Scientific Reports* 6, 25625. Available at: <https://www.nature.com/articles/srep25625> (last accessed May 2025).
- Grant, E. H. C., D. A. W. Miller, and E. Muths. 2020. A synthesis of evidence of drivers of amphibian declines. *Herpetologica* 76(2): 101-107. Available at: <https://doi.org/10.1655/0018-0831-76.2.101> (last accessed May 2025).
- Grego, J. (iNaturalist.org user: johngrego). 2021. iNaturalist.org observation: Southern Chorus Frog (*Pseudacris nigrita*). Available at: <https://www.inaturalist.org/observations/95400230> (last accessed May 2025).
- Grego, J. (iNaturalist.org user: johngrego). 2024. iNaturalist.org observation: Southern Cricket Frog (*Acris gryllus*). Available at: <https://www.inaturalist.org/observations/202336470> (last accessed May 2025).
- Halstead, B. J., A. M. Ray, E. Muths, E. H. C. Grant, R. Grasso, et al. 2022. Looking ahead, guided by the past: The role of US national parks in amphibian research and conservation. *Ecological Indicators* 136: 108631. Available at: <https://doi.org/10.1016/j.ecolind.2022.108631> (last accessed May 2025).
- Integrated Taxonomic Information System (ITIS). 2025. Integrated Taxonomic Information System Online Database. Available at: <https://www.itis.gov/> (last accessed May 2025).
- Luedtke, J. A., et al. 2023. Ongoing declines for the world’s amphibians in the face of emerging threats. *Nature* 622: 308-314. Available at: <https://doi.org/10.1038/s41586-023-06578-4> (last accessed May 2025).
- Luhring, T. M. (2008). ““Problem Species” of the Savannah River Site, such as Brimley’s Chorus Frog (*Pseudacris brimleyi*), demonstrate the hidden biodiversity concept on an intensively studied government reserve.” *Southeastern Naturalist* 7(2): 371-373. Available at: [https://doi.org/10.1656/1528-7092\(2008\)7\[371:PSOTSR\]2.0.CO;2](https://doi.org/10.1656/1528-7092(2008)7[371:PSOTSR]2.0.CO;2) (last accessed May 2025).
- National Park Service (NPS). 2025. NPSpecies: Information on species in national parks. Available at: <https://irma.nps.gov/NPSpecies> (last accessed April 2025).
- Parrish, M. C. and L. H. Martin. 2023. Vocal Anuran Monitoring in Southeast Coast Network Parks: 2017 Data Summaries (archive containing five data briefs). Park codes: CANA, CONG, FOFR, MOCR, OCMU. Available at: <https://doi.org/10.57830/2294566> (last accessed May 2025).
- Parrish, M. C. and L. H. Martin. 2024. Vocal Anuran Monitoring in Southeast Coast Network Parks: 2022 Resource Brief for Congaree National Park. Available at: <https://doi.org/10.57830/2305465> (last accessed May 2025).

## Literature Cited (continued)

- Parrish, M. C. 2025. CITATION TO ANAXYRUS FOWLERI VOUCHER (IN PROGRESS).
- Parrish, M. C. and W. Thorsdatter. 2025. Southeast Coast Network Anuran Monitoring in the Southeastern United States, January 2025 Cumulative Data Package. Available at: <https://doi.org/10.57830/2307457> (last accessed May 2025).
- Smrekar, B. D., and M. W. Byrne. 2015. Anuran community monitoring at Congaree National Park: 2014 data summary. Natural Resource Data Series NPS/SECN/NRDS—2015/988. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2224967> (last accessed May 2025).
- Society for the Study of Amphibians and Reptiles (SSAR). 2017. Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding. 8th ed. pp. 1–102. Crother, B. I. (ed.). SSAR Herpetological Circular 43. Available at: <https://ssarherps.org/publications/north-american-checklist/> (last accessed May 2025).
- Tingley, M. W., C. P. Nadeau, and M. E. Sandor. 2020. Multi-species occupancy models as robust estimators of community richness. *Methods in Ecology and Evolution* 11: 633–642. Available at: <https://doi.org/10.1111/2041-210X.13378> (last accessed May 2025).
- Tuberville, T. D., J. D. Willson, M. E. Dorcas, and J. W. Gibbons. 2005. Herpetofaunal Species Richness of Southeastern National Parks. *Southeastern Naturalist* 4(3): 537–569. Available at: [https://doi.org/10.1656/1528-7092\(2005\)004\[0537:HSROSN\]2.0.CO;2](https://doi.org/10.1656/1528-7092(2005)004[0537:HSROSN]2.0.CO;2) (last accessed May 2025).
- Wildlife Acoustics, Inc. 2025. Kaleidoscope Pro Analysis Software, version 5.5.0 for Windows OS. Wildlife Acoustics, Inc.: Maynard, Massachusetts, USA. Available at: <https://www.wildlifeacoustics.com/> (last accessed May 2025).
- Willson, J. D. (iNaturalist.org user: jdwillson). 2019. iNaturalist.org observation: Brimley's Chorus Frog (*Pseudacris brimleyi*). Available at: <https://www.inaturalist.org/observations/35728616> (last accessed May 2025).
- Zampella, R. A., J. F., Bunnell, K. J. Laidig, and N. A. Procopio. 2006. Using multiple indicators to evaluate the ecological integrity of a coastal plain stream system. *Ecological Indicators* 6(4): 644–663. Available at: <https://doi.org/10.1016/j.ecolind.2005.08.027> (last accessed May 2025).

## 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/>)