



Terrestrial Vegetation Monitoring at Congaree National Park

2021 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2023/1396





ON THIS PAGE

One of 64 vegetation monitoring plots established on Congaree National Park during the summer of 2021 by the Southeast Coast Network (SECN) vegetation field crew. From left to right, Wylie Paxton (Appalachian/Piedmont/Coastal Fire Management Zone Fire Ecologist), Julieanne Montaquila (SECN Scientists in Parks Intern), and Elizabeth Rico (SECN Biological Science Technician).

NPS photo / M. Forbes Boyle (SECN Botanist).

ON THE COVER

A typical "log garden" within the floodplain of the Congaree River within Congaree National Park. In recently flooded scour zones, ground cover plant diversity is often limited to these slightly elevated fallen trees.

NPS photo / M. Forbes Boyle.

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August 2023
U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible and technically accurate.

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Please cite this publication as:

Boyle, M. F. 2023. Terrestrial vegetation monitoring at Congaree National Park: 2021 data summary. Natural Resource Data Series NPS/SECN/NRDS—2023/1396. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2300302>

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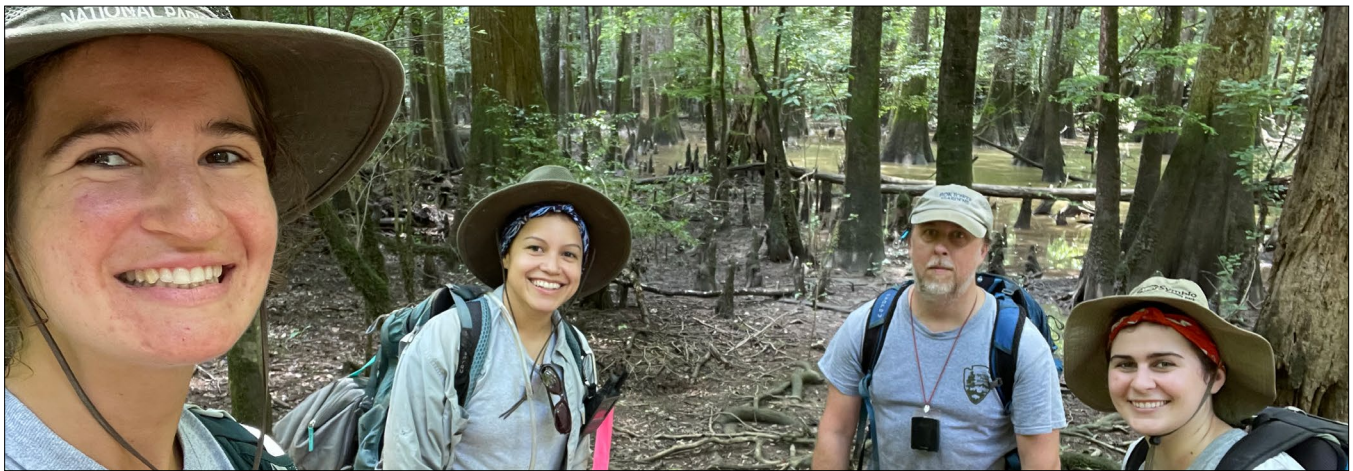
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From left, Claire Schmidt, Elizabeth Rico, Forbes Boyle, and Julieanne Montaquila. NPS photo / SECN staff.

Acknowledgments

The staff of Congaree National Park (CONG) provided valuable support throughout the duration of this monitoring effort. One of the trickiest aspects of working in remote areas of a park this size is determining the most efficient, practical, and safe ways of navigating to monitoring sites. Several park staff were instrumental in providing insight regarding how to best access many of the sites established during this monitoring effort including David Shelley (Integrated Resources Program Manager), Charles Aznive (Facility Operations Specialist), Jason Johnson (Chief Ranger), John Torrence (Maintenance Worker), and Theresa Yednock (Biological Technician). Thanks also to David and his resource staff, Theresa and Eric Frey (Biologist), for supplying site maps, keys, and always ensuring the field crew's logistical needs were met in a timely manner. Very special thanks to Charles and John for the work they put in to attempting to open the boat landing off West Boundary Road, so we could more efficiently access river plots on the park's southwestern border. Conversations with John about boating on the Congaree River (e.g., potential hazards, expected water levels, where to anchor along the riverbank) were extremely helpful, and provided added value to the safety of the field crew on days that required motorboats to access sites. Charles was very helpful in arranging the use of a UTV during the latter part of the summer, ensuring marine fuel was available for the SECN boat, and park housing logistics for the Southeast Coast Network's (SECN) Scientists in Parks (SIP) intern were dealt with in a timely manner. Thanks also to Lauren Serra and Amorita Bracket (Southeast Coast Invasive Plant Management Team) for arranging lodging for the SECN SIP intern during the field season at Congaree National Park. This project was aided by the many individuals who assisted



Above, Wylie Paxton. NPS photo / SECN staff.

with fieldwork and braved the numerous “guts” and “sloughs” of the Congaree floodplain at some point during the summer. Field crew members included Elizabeth Rico (SECN Biological Technician), Julieanne Montaquila (SECN SIP Intern), Wylie Paxton (Appalachian/Piedmont/Coastal Fire Management Zone fire ecologist), Claire Schmidt (former SECN Coastal Technician), Daniel McCay (former SECN Aquatic Technician), and David Scheutrum (CONG volunteer). Thanks to John Cely (retired wildlife biologist) who met with SECN staff to share his vast knowledge of navigating the broad terrain of Congaree National Park and whose hand drawn map of the park was indispensable to the vegetation monitoring field crew. Finally, thanks to Keith Bradley (South Carolina Department of Natural Resources Botanist) and Tom Govus (private contractor) for providing their expert botanical skills to aid in the identification of several unknown plants (mostly within the genus *Carex*!!) observed during this monitoring effort.

Executive Summary

The Southeast Coast Network (SECN) conducts long-term terrestrial vegetation monitoring as part of the NPS Inventory and Monitoring Program. The vegetation community vital sign is one of the primary-tier resources identified by SECN park managers, and monitoring is conducted at 15 network parks (DeVivo et al. 2008). Monitoring plants and their associated communities over time allows for targeted understanding of ecosystems within the SECN geography, which provides managers information about the degree of change within their parks' natural vegetation.

2021 marked the first year of conducting this monitoring effort at Congaree National Park (CONG). Sixty-four vegetation plots were established throughout the park from May through August. Data collected in each plot included species richness across multiple spatial scales, species-specific cover and constancy, species-specific woody stem seedling/sapling counts and adult tree (greater than 10 centimeters [3.9 inches {in}]) diameter at breast height (DBH), overall tree health, landform, soil, observed disturbance, and woody biomass (i.e., fuel load) estimates.

This report summarizes the baseline (year 1) terrestrial vegetation data collected at Congaree National Park in 2021. Data were stratified across two dominant broadly defined habitats within the park, Coastal Plain Upland Open Woodlands and Coastal Plain Alluvial Wetlands. Noteworthy findings include:

- 295 vascular plant taxa (species or lower) were observed across 64 vegetation plots, including 37 species not previously documented within the park.
- 27 unique species of sedge (*Carex* sp.) were found across all plots.
- The most frequently encountered species in each broadly defined habitat included:
 - Coastal Plain Alluvial Wetlands: green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), possumhaw (*Ilex decidua*), eastern poison ivy (*Toxicodendron radicans* var. *radicans*), muscadine (*Muscadinia rotundifolia* var. *rotundifolia*) and smallspike false nettle (*Boehmeria cylindrica*).
 - Coastal Plain Upland Open Woodlands: loblolly pine (*Pinus taeda*), muscadine, sweetgum (*Liquidambar styraciflua*), willow oak (*Quercus phellos*), roundleaf greenbrier (*Smilax rotundifolia*), and Carolina jessamine (*Gelsemium sempervirens*).
- Seven non-native species categorized as invasive (Significant or Severe Threat) by the South Carolina Exotic Pest Plant Council (SCEPPC 2014) were encountered within the park during this monitoring effort. These included sweet autumn virginsbower (*Clematis terniflora*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), Japanese climbing fern (*Lygodium japonicum*), Japanese stilt grass (*Microstegium vimineum*), marsh dew flower (*Murdannia keisak*), and Chinese wisteria (*Wisteria sinensis*).
- Four species listed as rare and tracked by the South Carolina Natural Heritage Program (SCNHP 2023) were encountered during this monitoring effort. These included Cherokee sedge (*Carex cherokeensis*), ravenfoot sedge (*Carex crus-corvi*), Santee azalea (*Rhododendron eastmanii*), and heartleaf nettle (*Urtica chamaedryoides*).
- Sweetgum, water tupelo (*Nyssa aquatica*), green ash, and bald-cypress were the most dominant species within the tree stratum of Coastal Plain Alluvial Wetland sites; loblolly pine was the most dominant species of Coastal Plain Upland Open Woodlands.
- Feral hog (*Sus scrofa*) rooting was observed in 73% of the Coastal Plain Alluvial Wetland plots, while 20% of the plots had over 60% damage from rooting behavior. Hog activity was observed throughout the Congaree National Park's floodplain, but largely absent from sites along the park's northern boundary with the private hunt club.
- Based on data collected from eight Coastal Plain Upland Open Woodland plots, the canopy and subcanopy composition and structure of the park's upland pine woodlands are not in a condition to maintain fire-dependency and thus promote healthy and sustainable longleaf pine woodlands. Densities of loblolly pine in the canopy and sweetgum in the sapling stratum are elevated. However, with continued fire and fire surrogate treatments to these upland units, thriving longleaf pine woodlands can be achieved.
- All plots are scheduled to be resampled during the summer of 2025.

List of Terms

Aspect: The compass direction that a slope faces.

Basal Area (BA): The cross-sectional area of woody stems at DBH; used to describe the amount of area occupied by a single or group of stems. BA is expressed in this report as m²/ha (square meters per hectare).

Coarse Woody Debris (CWD): Downed woody stems on the ground that are either lying prone on the ground, or at least one end of the broken bole of a dead tree is touching the ground at an angle of greater than 45° from vertical. Coarse woody debris includes pieces of wood greater than 8 centimeters (3.1 inch [in]) in diameter (approximately 1,000-hour fuel class).

Constancy: The percentage of plots in a given dataset in which a species occurs.

Cover: The vertical projection of vegetation from the ground as viewed from above, and in this protocol is estimated as a percentage of area that covers the ground above the ground surface (areal cover).

Density: The number of individual woody stems in a given area.

DBH: Diameter at breast height of an individual woody stem, or 1.37 meters (4.5 feet [ft]) above the ground surface.

Duff: An organic fuel layer that lies below the litter layer and above mineral soil. It is made up of litter material that has decomposed to the point where individual pieces are no longer identifiable. In general, the duff layer is darker than the litter layer.

Fine Woody Debris (FWD): Pieces of wood less than 8 centimeters (3.1 in) in diameter. They are either (1) not attached to the woody stem where they once grew and have fallen to the ground, (2) not attached to the stem where they once grew and are supported off the ground by live or dead material, or (3) attached to stems of woody material that are themselves considered “dead” and “down.” Fine woody debris is composed of the following fire size classes: 1-hour fuels (0–0.64 centimeters [0–0.2 in]), 10-hour fuels (0.64–2.54 centimeters [0.2–1 in]), and 100-hour fuels (2.54–8.1 centimeters [1–3.2 in]).

Global / State Status: Conservation status assessment ranks developed by NatureServe and individual state Natural Heritage Programs used to determine the extinction risk of species and ecosystems at the global and state scales. Global codes are as follows:

- G1: Critically imperiled-very high risk of extinction
- G2: Imperiled-high risk of extinction
- G3: Vulnerable-moderate risk of extinction
- G4: Apparently Secure-fairly low risk of extinction
- G5: Secure-very low risk of extinction

Growth Form: The shape and physical appearance of a species, reflecting site conditions and genetics. In this report, the following growth forms, following definitions set by USDA (2023a), are used:

- Tree: a perennial, woody plant with a single stem (trunk), normally greater than 4–5 meters (13.1–16.4 ft) in height
- Shrub: a perennial, multi-stemmed woody plant that is usually less than 4–5 meters (13.1–16.4 ft) in height
- Vine: a twining or climbing plant with relatively long stems; can be woody or herbaceous
- Herb/Forb: a plant without significant woody tissue and lacking significant thickening by secondary woody growth
- Graminoid: a grass or grass-like plant; includes grasses (*Poaceae*), sedges (*Cyperaceae*), and rushes (*Juncaceae*).

Litter: An organic fuel layer made up of twigs, dead grasses, recently fallen leaves, and pine or other needles where the individual pieces are still identifiable and not altered by decomposition.

Sapling: Any live woody stem more than 1.37 meters (4.5 ft) in height but less than 10 centimeters (3.9 in) in diameter at breast height (DBH).

Seedling: Any live woody stem with at least two true leaves that are less than 1.37 meters (4.5 ft) tall.

Slope: The rise and fall of a land surface.

Species Richness: The overall number of species, or group of species, within a defined area.

Terrain Shape Index (TSI): A quantitative expression of the geometric shape (ranging from concave to convex) of the land surface. Negative TSI values indicate convex shape, positive values indicate concavity, and values around 0 indicate flat surfaces.

Tree: Any woody stem more than 1.37 meters (4.5 ft) in height and greater than or equal to 10 centimeters (3.9 in) in diameter at breast height (DBH). This term is also used to describe a specific growth form (see Growth Form above).

Introduction

Overview

Vegetation communities are the primary drivers of a range of ecological processes and are integral to the proper function of park ecosystems. Moreover, vegetation communities integrate the biological and physical environment—they serve as the foundation for food webs, provide wildlife habitat for many species, function as a carbon sink, produce oxygen, and cycle nutrients and energy through an ecosystem. Parks within the Southeast Coast Network (SECN) host a diverse assemblage of plants and terrestrial communities. Vegetation communities vary widely. Approximately 180 vegetation associations (i.e., fine-resolution floristic description), as defined by the National Vegetation and Classification Standard, Version 2.0 (FGDC 2008), occur in SECN park units. A diversity of vegetation resources is found in these parks, including dry grassland dunes, maritime oak and pine dominated forests, pyrogenic pine flatwoods, black and brown water floodplain forests, and Piedmont upland forests.

Vegetation communities are dynamic entities whose species composition, abundance, distribution, and structure are influenced by environmental factors and impacted over time by natural and anthropogenic disturbances. For communities to be considered “natural,” native species must be predominately distributed across the landscape as a consequence of disturbance factors (i.e., stressors) or site condition (i.e., environmental factors, e.g., soil nutrients, landform; Comer et al. 2003). The timing, type, and extent of a disturbance generally evoke a distinguishable response in vegetation across the landscape (Turner et al. 1990; Foster et al. 1998). Natural disturbance processes in SECN parks include those brought about by fire regimes and weather patterns (e.g., hurricanes and drought), while anthropogenic influences include landscape fragmentation, fire suppression, altered hydrology, shifts in seasonal weather patterns, and non-native species introduction.

Determining trends in vegetation communities over time and identifying plant stressors is vital to understanding the ecological health of terrestrial ecosystems within SECN parks. Collectively, this information can be used to guide management actions that sustain a park’s ecological integrity and support plant conservation across a diversity of spatial scales. The Southeast Coast Network collects long-term data on vegetation communities using a protocol largely based on the forest monitoring approaches used by the Cumberland Piedmont Network (White et al. 2011) and Gulf Coast Network (Carlson et al. 2018).

This report provides a summary of data collected during summer 2021 within Congaree National Park (CONG) as part of the SECN’s terrestrial vegetation monitoring effort. This report is intended to provide CONG resource managers and partners with (a) baseline information on the composition, abundance, and structure of vegetation across broad habitat types, (b) documentation of observable stressors to park vegetation resources, and (c) a summary of ancillary data associated with terrestrial ecosystems (e.g., soil nutrient status and fuel abundance).

Monitoring Objectives

The overall objective of this effort is to detect meaningful changes in species composition and vegetation structure within natural and semi-natural vegetation communities of SECN parks and determine whether these changes are correlated with trends in key stressors.

The data presented herein are from the first iteration of sampling activities in Congaree National Park utilizing the SECN terrestrial vegetation monitoring protocol (Boyle et al. 2019). For this “baseline” status report, 2021 data were synthesized to answer the following questions across broad habitat types within the park:

- How does species richness vary across terrestrial vegetation communities?
- What is the status of composition and abundance among native versus non-native, invasive species?
- What are the most common plants encountered during the monitoring effort, and conversely, were there rare species detected?
- In forests, woodlands, and shrublands, what is the relative frequency of woody seedlings, saplings, and subcanopy or canopy species?
- Do observable stressors appear to impact vegetation communities?
- What is the current condition of soil nutrient chemistry and fuel volume?

Methods

Study Area

Congaree National Park (CONG) is located within the inner Coastal Plain of South Carolina, approximately 30 kilometers [km] (18.6 miles [mi]) southeast of the state capital, Columbia (Figure 1). The 10,780 hectare [ha] (26,640 acre [ac]) park is bordered on the south by the Congaree River and the west by the Wateree River. The park protects the largest remaining contiguous tract of old-growth bottomland forest in the United States and has been designated as an International Biosphere Reserve, National Natural Landmark, Globally Important Bird Area, Ramsar Wetland of International Importance, and (in part) Wilderness Area. Congaree National Park's bottomland is globally recognized as one of the tallest broad-leaved temperate deciduous forests in the world (Jones 1997) and includes many state champions (i.e., largest of its species) and the national champion loblolly pine (*Pinus taeda*; SC Champion Trees 2022).

Most of the park lies within the vast floodplain of the Congaree River, which provides a diverse assembly of bottomland tree species and forest community types (Landaal et al. 1998; Sharitz and Allen 2009). Forest communities within the Congaree floodplain range from semi-permanently flooded “sloughs” dominated by a combination of bald-cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), swamp tupelo (*Nyssa biflora*), and planertree (*Planera aquatica*) to higher terraces and levees dominated by sugarberry (*Celtis laevigata*), American sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), and laurel oak (*Quercus laurifolia*; Landaal et al. 1998). Most of the floodplain is occupied by alluvial flats, creating a hydrologic intermediate position between upper terraces or levees and permanently wet ponds and semi-permanently wet “sloughs”; these flats are dominated by green ash (*Fraxinus pennsylvanica*) and a combination of aforementioned species (Landaal et al. 1998).

The high level of woody plant biodiversity (e.g., trees, shrubs, lianas) within the floodplain of Congaree National Park can be attributed to two factors. First, the complex geomorphology of the floodplain produces a multitude of elevation gradients, or “habitats,” occurring over often small spatial scales—e.g., “sloughs,” flats, terraces, and levees—providing a continuum for species with varying tolerances of flooding (Sharitz and Allen 2009). Flooding brings in propagules and seeds from plants upstream, as well as seasonal flushes of soil nutrients, that contribute to the park's species richness (Sharitz and Allen

2009). A second factor contributing to the park floodplain's high biodiversity is related to the forest's exposure to severe wind events which topple large trees. These wind events, whether from hurricanes that have impacted large areas within the park (e.g., Hurricane Hugo) or smaller-scale storms and microbursts, promote regeneration of shade intolerant (and often less hydric) woody plants by creating canopy gaps which bring light and alter the soil moisture of the forest floor (Battaglia and Sharitz 2006). Furthermore, wind events that topple these large trees create tip-up mounds and increase the abundance of downed coarse woody debris on the forest floor (see cover image) providing refugia for less flood-tolerant species even within wetter areas of the floodplain (Sharitz and Allen 2009).

Current vegetation patterns across bottomlands of the southeastern Coastal Plain, including those across Congaree National Park, are also influenced by historical anthropogenic disturbances and land use. Evidence suggests that Native American tribes and early European settlers cleared land for agriculture and established dwellings in less flood-prone areas of the floodplain (Kinzer 2017). Large-scale timber operations began across much of the current park's footprint in the late 19th century and continued through the late 1960s until the land was designated a National Monument in 1976 (Kinzer 2017). Select logging of bald cypress in “sloughs” and “guts” of the floodplain likely enhanced regeneration and promoted dominance of water tupelo (Sharitz and Mitsch 1993). Although fire is not often thought of as a primary ecosystem driver in bottomlands of the southeastern U.S., there are historical accounts of extensive zones dominated by towering stands (up to 30 feet in height) of giant cane (*Arundinaria gigantea*) along banks of large rivers in South Carolina (Kinzer 2017). These “canebrakes” were sustained by periodic, stand-replacing fires of lightning and Native American tribe origin that killed floodplain trees and promoted monospecific stands of the native bamboo (Gagnon 2009). “Canebrakes” have significantly declined throughout the Atlantic and Gulf drainages of the southeastern U.S. since European arrival (Baldwin et al. 2009) due to a likely combination of 19th and 20th century fire suppression efforts, woodland cattle grazing, and the removal of Native Americans and their burning customs (Platt and Brantley 1997). Most, if not all, of the native bamboo currently present across Congaree National Park is the shorter stature switchcane (*Arundinaria tecta*; Kinzer 2017).

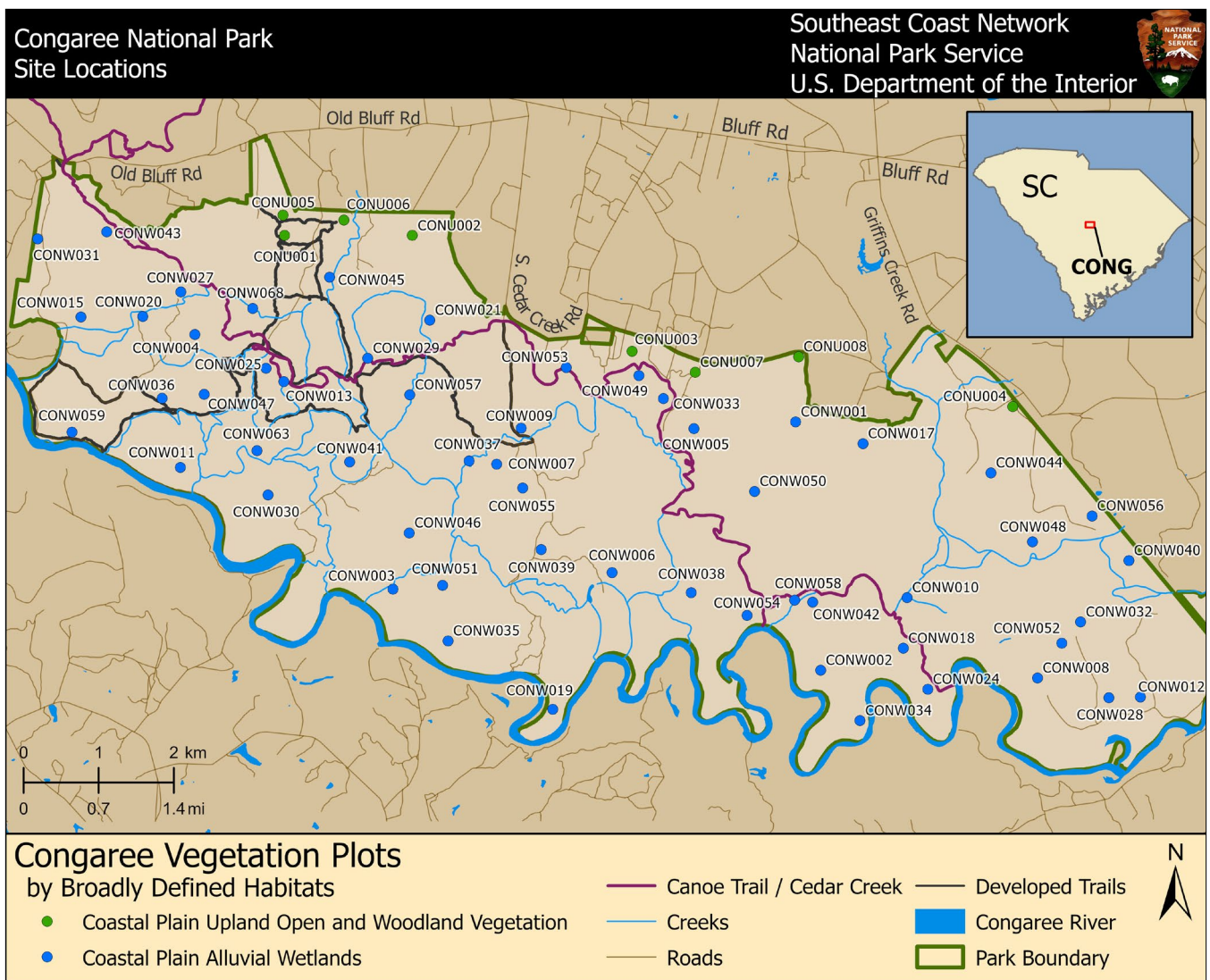


Figure 1. Southeast Coast Network terrestrial vegetation monitoring plot locations within Congaree National Park, Richland County, South Carolina.

In addition to its bottomland forests, Congaree National Park supports upland pine-dominated woodlands along its northern boundary. The southeastern Coastal Plain once contained a vast mosaic of pine woodlands, typically dominated by an open canopy of longleaf pine (*Pinus palustris*), that covered over 90 million acres (36.4 million ha) from Virginia to Florida and west to Mississippi (Ware et al. 1993). Land use patterns over the past several hundred years—such as conversion to agriculture, grazing, logging, and fire suppression—have eliminated all but 2% (3.8 million acres [1.2 million ha]) of these terrestrial communities (Landers et al. 1995). It is likely that the uplands of Congaree National Park would have historically (i.e., pre-European contact) included this ecosystem type (Frost and Wilds 2001). Although these woodlands could occur across a range of edaphic conditions—from xeric sandy soils of rolling uplands to wet-mesic soils of low-lying flats (“flatwoods”)—they all were maintained by relatively frequent (generally three years or less), low intensity fire. The uplands within Congaree National Park contain a mixture of loblolly pine-dominated early- to middle-aged forests, much of which was in plantation pine management prior to the park acquiring these lands as part of its boundary expansion in 1988 (NPS 2004). The park has a core multi-generational longleaf pine area at the previous red-cockaded woodpecker site (RCW) site with some older-aged longleaf. Parts of the uplands also contain older-aged shortleaf pine as well as hardwood dominated patches. Congaree National Park currently uses prescribed fire and other fire surrogate tools (e.g., mastication, mowing, herbicide) to thin out dense planted pine within historic plantations and remove undesirable hardwood species (e.g., sweetgum) for the goals of restoring historical forest structure, increasing diversity of native species, and decreasing susceptibility in pine bark beetle infestations (NPS 2017).

Because of its large size, diversity of habitats, and relatively pristine condition, Congaree National Park is home to a diverse flora. The most recent floristic survey within the park and its surrounding areas reported 713 vascular plant species (Gaddy and Nelson 2006) and NPSpecies lists over 850 species as present within the park (NPS 2023). Twenty-three species from the Gaddy and Nelson (2006) report are considered exotic invasive by the South Carolina Exotic Pest Plant Council

(SCEPPC 2014). Invasive species present on the park and its vicinity ranked as either a Significant Threat or Severe Threat by the SCEPPC include:

- Silktree (*Albizia julibrissin*; Significant Threat)
- Showy rattlesnake (*Crotalaria spectabilis*; Significant Threat)
- English ivy (*Hedera helix* var. *helix*; Severe Threat)
- Sericea lespedeza (*Lespedeza cuneata*; Severe Threat)
- Japanese privet (*Ligustrum japonicum*; Significant Threat)
- Chinese privet (*Ligustrum sinense*; Severe Threat)
- Japanese honeysuckle (*Lonicera japonica*; Severe Threat)
- Japanese climbing fern (*Lygodium japonicum*; Severe Threat)
- Chinaberry (*Melia azedarach*; Severe Threat)
- Japanese stiltgrass (*Microstegium vimineum*; Severe Threat)
- White mulberry (*Morus alba*; Significant Threat)
- Marsh dayflower (*Murdannia keisak*; Severe Threat)
- Dallas grass (*Paspalum dilatatum*; Significant Threat)
- Vasey grass (*Paspalum urvillei*; Significant Threat)
- Hardy orange (*Poncirus trifoliata*; Severe Threat)
- Kudzu (*Pueraria montana* var. *lobata*; Severe Threat)
- Johnson grass (*Sorghum halepense*; Severe Threat)
- Chinese wisteria (*Wisteria sinensis*; Severe Threat)

There were no federal or state threatened or endangered species found within the park during the previous floristic survey; however, the survey did include 12 species tracked by the South Carolina Natural Heritage Program (SCNHP 2023), including the federally at-risk Carolina bird’s-in-a-nest (*Macbridea caroliniana*).

Sampling Design

The Southeast Coast Network monitors vegetation in long-term plots located in natural and semi-natural habitats of targeted parks, including Congaree National Park. Sample size (i.e., number of plots) is determined by a combination of factors, including (1) priority plots are located in broadly defined habitats that cover more than 30% of the total area of the park's natural and semi-natural vegetation (i.e., dominant and co-dominant habitat); (2) the number of priority plots is scaled according to the overall size of dominant/co-dominant mapped polygons, such that the distribution of plots is between 1 and 25 per 100 hectares (247 ac) of these habitat types; (3) the secondary sample target is any broadly defined habitat that covers between 1 and 30% of a park's natural and semi-natural vegetation; (4) each of the secondary sample target habitat types is allotted four plots.

Sixty-four vegetation plots were established and sampled on the upland and alluvial land parcels of Congaree National Park from May through August 2021 (Figure 1). These plots were located in the following broadly defined habitats of the park: Coastal Plain Alluvial Wetlands (56 plots) and Coastal Plain Upland Open Woodlands (8 plots). Plot locations were determined using the generalized random-tessellation stratified (GRTS) sampling methodology, which creates a spatially-balanced array of sample points across an area of interest while maintaining flexibility in a project's sample size (Stevens and Olsen 2004).

Nomenclature Standard, Growth Form Determination, and Conservation Status

Species nomenclature for this report follows the Flora of the Southern and Mid-Atlantic States (Weakley 2020). Every attempt was made to identify all plants to species, variety, or subspecies; when this was not possible, the lowest level of identifiable taxa (e.g., genera, family) was used. Occasionally,

a taxonomic concept was created by “lumping” several species of the same genus of known occurrence within a park. For example, both southern red cedar (*Juniperus silicicola*) and eastern red cedar (*J. virginiana*) occur in the park; both species occur in abundance in the natural and semi-natural habitats targeted by this monitoring effort; both species can often be difficult to distinguish based on vegetative features; and, finally, no other species within the genus *Juniperus* are known to occur within the park. A taxonomic concept was created—*Juniperus [silicicola + virginiana]*—that combined the two species into a single concept. This “lumped” taxon is of finer scale taxonomic resolution than if these records had been identified as *Juniperus* sp. Once the final list was determined, each species was cross-referenced with the USDA Plants Database (USDA 2023a) to determine growth form, native status, federal/state noxious status, and to provide a unique common name. When a single taxon linked to multiple growth forms, the lead author subjectively chose a single growth form to link with the taxa. The species list was also cross-referenced with the tracked plant list in South Carolina to determine the state and federal conservation status (e.g., Endangered, Threatened, Rarity) of each species (SCNHP 2023) and the list of non-native invasive plants in South Carolina to determine the degree of invasiveness (SCEPPC 2014).

Sampling Methodology

The vegetation plot layout for this monitoring effort is based upon the plot design used by the Carolina Vegetation Survey (Peet et al. 1998; Lee et al. 2008) and the Cumberland Piedmont Network (White et al. 2011). The plot array consists of a 20 × 20 meters (65.6 × 65.6 ft) bounded square with multiple nested sampling frames ranging from 1 square meter (10.8 square feet [ft²]) to 400 square meters (4,305.5 ft²), three 25 meters (82.0 ft) fuel transects that cross both inside and outside the bounded square, and three soil sample frames located adjacent to the bounded square (Figure 2).

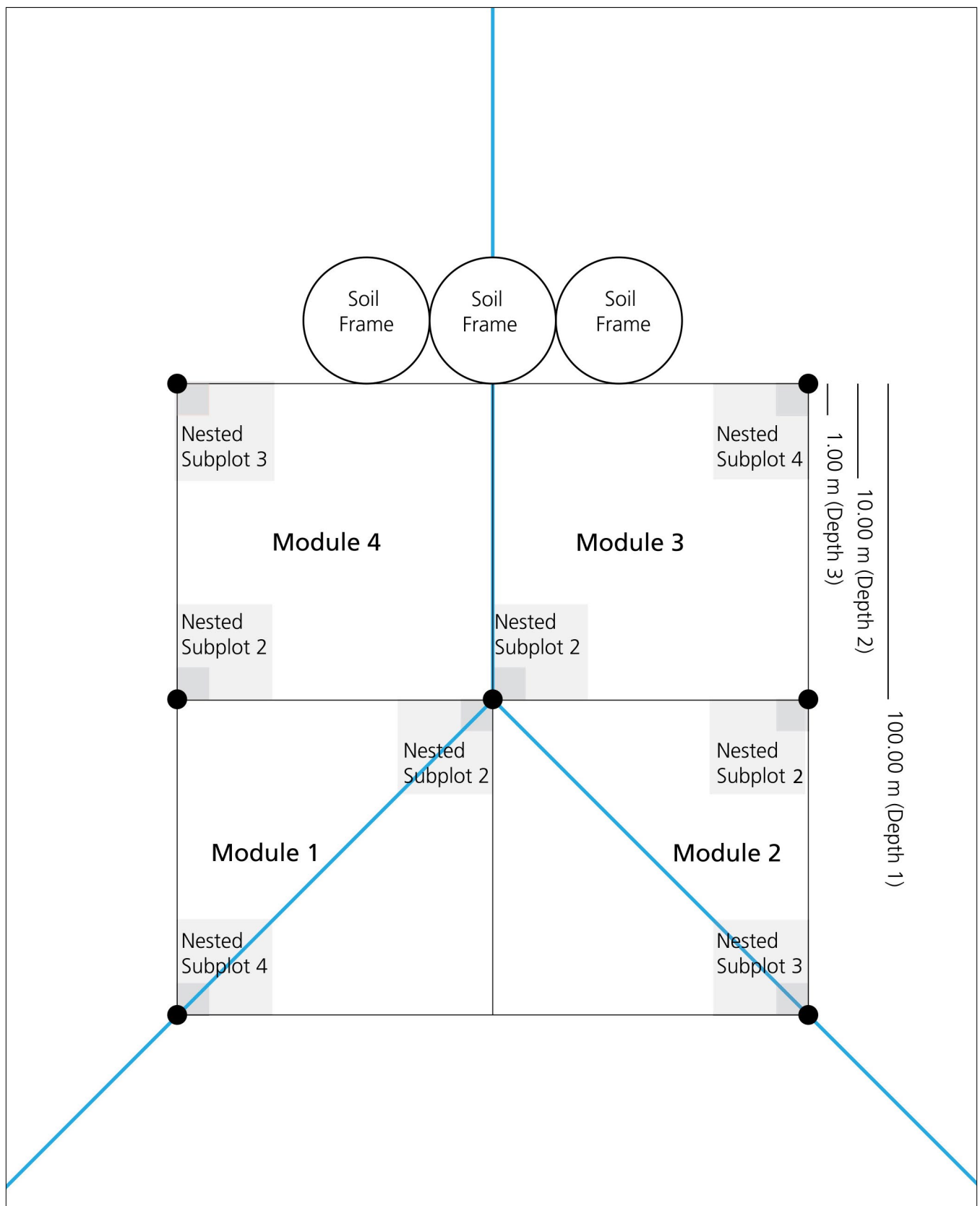


Figure 2. The layout of the sampling plot for the Southeast Coast Network, which is a modified version of the standard Level 5 Carolina Vegetation Survey plot. Ideal locations of rebar used as permanent structures to monument the plot are represented by black shaded circles. Blue lines represent locations of the three 25-meter (82-foot) fuel transects.

Vascular plant species presence was determined at three scales within each of the four 100 square meters (1,076.4 ft²) modules: the 1 square meter (10.8 ft²) nested depth, the 10 square meters (107.6 ft²) nested depth, and the full modular depth. The nested depth “quadrats” were located in two of the four corners within each module. For each species, either rooted in or overhanging a module, an areal cover value was assigned using the cover class codes developed by the Carolina Vegetation Survey (Peet et al. 1998; Table 1).

Table 1. Vascular plant cover metrics of the Carolina Vegetation Survey (Peet et al. 1998) and used by the SECN terrestrial vegetation monitoring protocol (Boyle et al. 2019).

Cover Class	Cover Range (%)	Geometric Mean
1	0–0.1	0.03
2	0.1–1.0	0.32
3	1.0–2.0	1.41
4	2.0–5.0	3.16
5	5.0–10.0	7.07
6	10.0–25.0	15.81
7	25.0–50.0	35.36
8	50.0–75.0	61.24
9	75.0–95.0	84.41
10	95.0–100.0	97.47

Individual woody stem data were also calculated within each module. For each stem greater than or equal to 10 centimeters (3.9 inches [in]; tree) in diameter at 1.4 meters (4.5 ft) linear distance from the ground layer, its species, DBH, and health status was recorded. Within the two 10 square-meter (107.6 ft²) nested depth “quadrats” used for detecting overall species presence (see above), each woody stem that reached 1.4 meters (4.5 ft) in linear distance from the ground layer but was less than 10 centimeters (3.9 in) in diameter at this height (sapling) was identified to species and DBH was determined.

Finally, each woody stem less than 1.4 meters (4.5 ft) in linear distance from the ground layer (seedling) was identified to species and a height class was determined: 5–15 centimeters (2–5.9 in); 15–30 centimeters (5.9–11.8 in); 30–50 centimeter (11.8–19.7 in); or 50–137 centimeters (19.7–53.9 in) within the two 1 square meter (10.8 ft²) nested depth “quadrats” used for detecting overall species presence (see above).

Surface fuels were assessed at each plot site using the planar transect method for the standard fuel size classes: 1-hour (0–0.6 cm), 10-hour (0.6–2.5 cm), 100-hour (2.5–7.6 cm), and 1000-hour (> 7.6 cm), and duff and litter depths (Brown 1974). Counts of each fuel size class were tallied across three fuel transects, with diameter and decay class recorded for each piece of 1000-hour fuel. These field data were incorporated into equations using constant multipliers defined by Brown (1974)—including quadratic mean diameter, nonhorizontal correction factor, specific gravity, and bulk density—to estimate fuel load weight (units=tons/acre) within each plot.

Additional site characteristics were also measured at each plot. Elements taken from the center of each plot included dominant slope, aspect, and terrain shape; basic hydrological condition; and presence and abundance of disturbance indicators. General canopy conditions were assessed, including canopy closure and average height. Closure was measured from the center of each module using a spherical densiometer, and height was taken from three representative trees within (or just outside) the plot. Soil samples were collected from the upper 10 centimeters (0.3 ft) of mineral soil in three sampling frames located adjacent to each vegetation plot. These samples were combined by plot upon return from the field and dried prior to shipping to a soil testing laboratory for standard nutrient analysis. Each plot was qualitatively assigned to one or two National Vegetation Classification (NVC) vegetation association types that best matched the sample site. Finally, two-dimensional photo points were taken with a point-and-shoot camera at the western and eastern center edge of each plot; a third photo point was made from the plot center using a 360-degree camera.

Results and Discussion

Two hundred and ninety-five vascular plant species were detected during this monitoring effort (Appendix A), including 37 taxa not detected in previous lists documented in Gaddy and Nelson (2006), Heath and Byrne (2016), or NPSpecies (NPS 2023; Table 2). One of the new-to-park species included the exotic invasive sweet autumn virginsbower (*Clematis terniflora*), listed as a Significant Threat by the SCEPPC (2014) (Table 2). Native richness ranged from six to 71 species per plot, and at least one non-native species was encountered in 44 of the 64 plots (Table 3). Seven invasive plants categorized as either a Significant Threat or Severe Threat by the SCEPPC (2014) were observed in these monitoring plots. In addition to the aforementioned sweet autumn virginsbower, these species included Chinese privet, Chinese wisteria, Japanese climbing fern, Japanese honeysuckle, Japanese stiltgrass, and marsh dayflower (Appendix A, Table A-1). Invasive species encountered frequently included Chinese privet (48% of plots), Japanese stilt grass (37.5%), Japanese honeysuckle (16%),

and Japanese climbing fern (16%; Figure 3). Native species observed in these plots are common throughout the Coastal Plain of South Carolina, and there were no federal- or state-listed species observed within the park during this monitoring effort. Two state tracked rare species with a conservation rank of S2 (imperiled) were observed on these plots during this monitoring effort and included heartleaf nettle (*Urtica chamaedryoides*) and Santee azalea (*Rhododendron eastmanii*). In the southeastern Coastal Plain, small-scale vegetation diversity patterns are largely influenced by complex edaphic factors, and those factors' associated relationship with steep environmental gradients (e.g., hydrology and substrate texture), and the variability of timing and impact from disturbance events (e.g., fire; Sorrie and Weakley 2001). What follows is a synopsis of vegetation and environmental data stratified by each of the broadly defined habitats sampled within the park.

Table 2. Vascular plant species, subspecies, or varieties not reported from Gaddy and Nelson (2006), Heath and Byrne (2016), or NPSpecies (NPS 2023) but found at Congaree National Park in 2021 through this current monitoring effort.

Scientific Name	Common Name ¹	Growth Form ¹	Native Status ¹	State Invasive Status ²	Global Rank ³	State Rank ³ (South Carolina)
<i>Acer floridanum</i>	southern sugar maple	Tree	Native	–	G4	SNR
<i>Andropogon gyrans</i>	Elliott's bluestem	Graminoid	Native	–	G5	S5
<i>Carex radiata</i>	eastern star sedge	Graminoid	Native	–	G5	SNR
<i>Clematis terniflora</i>	sweet autumn virginsbower	Vine	Non-native	Significant Threat	SNR	SNR
<i>Danthonia sericea</i>	downy danthonia	Graminoid	Native	–	G5	SNR
<i>Desmodium canescens</i>	hoary ticktrefoil	Forb/herb	Native	–	G5	SNR
<i>Desmodium lineatum</i>	sand ticktrefoil	Forb/herb	Native	–	G5	SNR
<i>Desmodium paniculatum</i>	panickedleaf ticktrefoil	Forb/herb	Native	–	G5	SNR
<i>Dichanthelium angustifolium</i>	blood panicgrass	Graminoid	Native	–	G5	SNR
<i>Dichanthelium tenue</i>	cypress panicgrass	Graminoid	Native	–	SNR	SNR
<i>Dichanthelium villosissimum</i> var. <i>villosissimum</i>	whitehair rosette grass	Graminoid	Native	–	T5	SNR
<i>Echium vulgare</i>	common viper's bugloss	Forb/herb	Non-native	–	SNR	SNR
<i>Elymus glaberrimus</i> var. <i>glaberrimus</i>	southeastern wildrye	Graminoid	Native	–	T5	SNR
<i>Eupatorium compositifolium</i>	yankeeweed	Forb/herb	Native	–	G5	SNR
<i>Eupatorium hyssopifolium</i>	hyssopleaf thoroughwort	Forb/herb	Native	–	G5	SNR
<i>Galium tinctorium</i> var. <i>floridanum</i>	stiff marsh bedstraw	Forb/herb	Native	–	G5	SNR
<i>Gentiana villosa</i>	striped gentian	Forb/herb	Native	–	G4	SNR
<i>Hypericum setosum</i>	hairy St. Johnswort	Forb/herb	Native	–	G4	SNR
<i>Hypericum stragulum</i>	St. Andrew's cross	Shrub, Subshrub	Native	–	T4	SNR
<i>Krigia virginica</i>	Virginia dwarfdandelion	Forb/herb	Native	–	G5	SNR
<i>Lactuca graminifolia</i> var. <i>graminifolia</i>	grassleaf lettuce	Forb/herb	Native	–	T4	SNR
<i>Lespedeza hirta</i> var. <i>curtissii</i>	Curtiss' lespedeza	Forb/herb	Native	–	SNR	SNR
<i>Lespedeza violacea</i>	violet lespedeza	Forb/herb	Native	–	G5	SNR
<i>Lespedeza virginica</i>	slender lespedeza	Forb/herb	Native	–	G5	SNR
<i>Panicum virgatum</i>	switchgrass	Graminoid	Native	–	G5	SNR
<i>Piptochaetium avenaceum</i>	blackseed speargrass	Graminoid	Native	–	G5	SNR
<i>Prunus caroliniana</i>	Carolina laurelcherry	Tree, Shrub	Native	–	G5	SNR
<i>Rhynchosia difformis</i>	doubleform snoutbean	Forb/herb, Vine	Native	–	G5	SNR
<i>Scleria ciliata</i>	fringed nutrush	Graminoid	Native	–	G5	SNR
<i>Scleria oligantha</i>	littlehead nutrush	Graminoid	Native	–	G5	SNR
<i>Sisyrinchium angustifolium</i>	narrowleaf blue-eyed grass	Forb/herb	Native	–	G5	SNR
<i>Solidago leavenworthii</i>	Leavenworth's goldenrod	Forb/herb	Native	–	G3	SNR
<i>Solidago tortifolia</i>	twistleaf goldenrod	Forb/herb	Native	–	G4	SNR
<i>Steironema lanceolatum</i>	lanceleaf loosestrife	Forb/herb	Native	–	G5	SNR
<i>Viburnum obovatum</i>	small-leaf arrowwood	Shrub, Tree	Native	–	G5	SNR
<i>Vitis baileyana</i>	graybark grape	Vine	Native	–	SNR	SNR
<i>Vitis labrusca</i>	fox grape	Vine	Native	–	G5	SNR

¹ Information obtained from the PLANTS database (USDA 2023a)

² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)

³ Conservation Status (G4: Species Apparently Secure; T4: Intraspecific (e.g., subspecies) Taxa Apparently Secure; G5/S5: Species Secure; T5 Intraspecific Taxa Secure) obtained from NatureServe Explorer 2.0 (NatureServe 2023)

Table 3. Vascular plant species richness across multiple spatial scales on Southeast Coast Network vegetation plots located within Congaree National Park. The data are summarized by total number of native versus non-native species/plot, and by vegetative growth forms (T: tree, S: shrub, V: vine, H: herbs/forbs, G: graminoids). Growth form information was obtained from the USDA Plants Database (USDA 2023a).

Broadly Defined Habitat	Plot	Native ¹	Non-native ¹	Unknown ¹	T ¹	S ¹	V ¹	H ¹	G ¹	T ²	S ²	V ²	H ²	G ²	T ³	S ³	V ³	H ³	G ³	T ⁴	S ⁴	V ⁴	H ⁴	G ⁴
Coastal Plain Upland Open Woodlands	CONU001	33.0	2.0	0.0	15.0	6.0	9.0	3.0	2.0	9.5	3.8	6.5	1.8	1.0	3.6	1.5	3.8	0.8	0.4	1.1	0.4	2.1	0.8	0.1
	CONU002	71.0	1.0	0.0	14.0	5.0	12.0	32.0	9.0	9.5	3.3	7.5	21.3	7.5	5.0	2.4	4.8	13.6	3.8	2.6	0.6	2.8	7.1	3.1
	CONU003	50.0	1.0	0.0	14.0	3.0	11.0	13.0	10.0	7.5	1.5	8.8	6.0	5.8	2.6	0.8	3.6	2.4	2.3	0.9	0.3	2.4	1.3	1.6
	CONU004	38.0	0.0	0.0	14.0	4.0	8.0	5.0	7.0	9.0	3.5	7.0	3.0	3.5	4.4	1.8	5.4	1.3	1.8	1.5	1.0	3.5	0.5	0.6
	CONU005	43.0	0.0	1.0	8.0	3.0	6.0	14.0	13.0	6.5	2.8	3.5	4.3	6.3	3.6	1.4	1.8	0.6	2.1	1.8	0.8	0.5	0.4	0.9
	CONU006	50.0	0.0	0.0	10.0	3.0	9.0	18.0	10.0	6.3	1.0	4.0	12.8	7.8	3.4	0.5	0.9	7.6	4.3	2.1	0.1	0.4	4.4	2.1
	CONU007	61.0	4.0	2.0	15.0	1.0	14.0	21.0	16.0	7.3	1.0	9.0	9.3	9.8	3.4	0.9	4.9	3.3	4.6	2.5	0.4	1.1	0.9	2.3
	CONU008	62.0	2.0	3.0	14.0	2.0	14.0	24.0	13.0	8.8	1.3	9.8	12.0	7.5	5.1	1.0	5.5	5.6	3.4	3.3	0.5	2.6	3.4	1.9
	average	51.0	1.3	0.8	13.0	3.4	10.4	16.3	10.0	8.0	2.3	7.0	8.8	6.1	3.9	1.3	3.8	4.4	2.8	2.0	0.5	1.9	2.3	1.6
	standard deviation	13.0	1.4	1.2	2.6	1.6	2.9	9.6	4.3	1.3	1.2	2.3	6.5	2.7	0.9	0.6	1.7	4.5	1.4	0.8	0.3	1.1	2.4	1.0
Coastal Plain Alluvial Wetlands	CONW001	12.0	0.0	0.0	7.0	2.0	2.0	1.0	0.0	4.8	0.8	1.3	0.3	0.0	1.1	0.4	0.8	0.0	0.0	0.1	0.0	0.3	0.0	0.0
	CONW002	43.0	5.0	0.0	13.0	1.0	8.0	15.0	11.0	9.8	1.0	6.0	9.5	9.3	4.9	0.8	4.1	4.4	6.6	2.9	0.5	2.4	1.9	3.9
	CONW003	22.0	1.0	0.0	9.0	0.0	6.0	6.0	2.0	6.8	0.0	3.0	3.8	0.5	3.4	0.0	0.6	1.1	0.1	1.3	0.0	0.0	0.6	0.0
	CONW004	32.0	0.0	0.0	14.0	1.0	6.0	5.0	6.0	10.0	1.0	5.3	2.5	5.3	5.3	1.0	2.5	0.6	3.1	2.9	0.4	1.0	0.3	2.0
	CONW005	57.0	2.0	2.0	20.0	0.0	11.0	22.0	8.0	12.0	0.0	7.3	11.8	4.3	5.8	0.0	3.3	5.4	2.3	3.0	0.0	1.6	2.9	1.1
	CONW006	42.0	4.0	1.0	13.0	0.0	9.0	13.0	12.0	10.0	0.0	6.3	6.3	8.5	5.0	0.0	4.0	2.6	4.8	1.8	0.0	2.0	0.8	2.6
	CONW007	17.0	0.0	0.0	9.0	1.0	4.0	1.0	2.0	4.5	0.3	1.3	0.3	0.5	1.3	0.1	0.6	0.1	0.3	0.5	0.0	0.0	0.1	0.1
	CONW008	46.0	2.0	0.0	14.0	1.0	10.0	12.0	11.0	10.0	1.0	6.3	7.3	8.8	5.0	0.4	4.6	3.1	6.5	1.8	0.0	2.5	1.3	4.4
	CONW009	40.0	1.0	0.0	12.0	1.0	8.0	9.0	11.0	9.5	1.0	5.0	6.0	7.8	3.9	1.0	2.4	2.8	3.3	2.4	0.4	0.9	1.6	1.5
	CONW010	34.0	3.0	0.0	12.0	1.0	8.0	9.0	7.0	7.8	0.5	6.3	4.0	6.0	4.1	0.1	2.6	1.3	2.9	2.5	0.0	1.1	0.1	0.6
	CONW011	26.0	3.0	0.0	9.0	0.0	5.0	9.0	6.0	7.0	0.0	2.8	5.0	4.5	3.5	0.0	1.0	2.1	2.9	0.9	0.0	0.4	0.6	1.8
	CONW012	44.0	2.0	1.0	13.0	1.0	12.0	15.0	6.0	8.0	0.8	7.8	6.8	4.0	3.0	0.5	2.6	2.6	1.8	1.3	0.4	0.8	1.5	0.9
	CONW013	30.0	2.0	0.0	15.0	1.0	6.0	5.0	5.0	10.3	0.8	4.5	2.8	3.8	4.6	0.9	2.0	0.6	2.4	2.4	0.5	0.8	0.1	1.6
	CONW015	52.0	2.0	0.0	13.0	0.0	9.0	17.0	15.0	9.3	0.0	6.0	8.0	11.3	5.5	0.0	3.0	3.0	6.1	2.0	0.0	1.5	1.5	3.6
	CONW017	35.0	0.0	0.0	11.0	2.0	9.0	9.0	4.0	6.3	0.5	5.5	5.0	2.0	3.5	0.1	2.5	1.6	0.6	2.3	0.0	1.4	0.4	0.5

¹ Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

² Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

³ Mean species richness at the nested 10 square meters (107.6 ft²) depth

⁴ Mean species richness at the nested 1 square meter (10.8 ft²) depth

Table 3 (continued). Vascular plant species richness across multiple spatial scales on Southeast Coast Network vegetation plots located within Congaree National Park. The data are summarized by total number of native versus non-native species/plot, and by vegetative growth forms (T: tree, S: shrub, V: vine, H: herbs/forbs, G: graminoids). Growth form information was obtained from the USDA Plants Database (USDA 2023).

Broadly Defined Habitat	Plot	Native ¹	Non-native ¹	Unknown ¹	T ¹	S ¹	V ¹	H ¹	G ¹	T ²	S ²	V ²	H ²	G ²	T ³	S ³	V ³	H ³	G ³	T ⁴	S ⁴	V ⁴	H ⁴	G ⁴
Coastal Plain Alluvial Wetlands	CONW018	31.0	1.0	1.0	11.0	1.0	6.0	9.0	6.0	6.3	1.0	4.0	4.5	4.8	2.9	0.9	2.4	2.1	2.3	1.4	0.5	1.3	0.9	1.0
	CONW019	33.0	2.0	1.0	10.0	1.0	6.0	13.0	6.0	7.0	0.5	4.0	6.3	3.8	3.9	0.1	1.5	1.8	1.1	2.3	0.0	0.5	0.1	0.4
	CONW020	45.0	1.0	0.0	14.0	1.0	10.0	11.0	10.0	9.0	1.0	6.0	5.8	7.8	2.8	1.0	3.6	3.3	5.1	0.6	1.0	2.3	1.8	2.9
	CONW021	65.0	2.0	0.0	17.0	1.0	13.0	23.0	13.0	10.5	1.0	7.0	10.3	10.0	5.1	0.9	3.8	2.8	4.1	2.0	0.3	2.0	1.3	2.9
	CONW024	22.0	0.0	0.0	9.0	1.0	3.0	6.0	3.0	6.5	0.3	2.0	2.5	1.5	3.8	0.0	0.5	0.8	1.0	1.4	0.0	0.0	0.0	0.1
	CONW025	35.0	2.0	0.0	13.0	2.0	8.0	6.0	8.0	9.8	1.0	5.0	3.0	5.8	5.1	0.6	1.4	0.5	2.1	3.0	0.3	0.5	0.3	1.1
	CONW027	32.0	3.0	0.0	13.0	1.0	6.0	10.0	5.0	9.8	1.0	4.5	4.5	4.0	5.3	0.6	2.5	1.8	2.5	2.8	0.3	1.1	1.0	1.5
	CONW028	9.0	0.0	0.0	7.0	1.0	1.0	0.0	0.0	5.0	0.8	1.0	0.0	0.0	2.5	0.6	0.8	0.0	0.0	0.6	0.4	0.5	0.0	0.0
	CONW029	32.0	1.0	0.0	13.0	1.0	5.0	5.0	9.0	9.5	0.8	3.5	2.8	7.8	5.0	0.4	2.3	0.9	4.0	3.1	0.1	0.9	0.5	2.1
	CONW030	31.0	2.0	0.0	12.0	1.0	6.0	8.0	6.0	8.8	1.0	4.5	4.8	4.5	4.5	1.0	2.6	1.9	2.4	1.5	0.9	1.3	1.0	1.6
	CONW031	19.0	0.0	1.0	11.0	2.0	4.0	1.0	2.0	6.0	1.8	3.0	0.3	1.0	0.9	0.5	1.1	0.0	0.1	0.0	0.0	0.3	0.0	0.0
	CONW032	29.0	1.0	1.0	14.0	1.0	7.0	4.0	5.0	9.5	0.5	4.0	1.5	2.5	4.6	0.1	1.9	0.8	1.1	2.1	0.0	0.8	0.0	0.4
	CONW033	24.0	0.0	0.0	14.0	1.0	5.0	3.0	1.0	6.3	0.3	2.3	1.5	0.3	1.6	0.0	0.8	0.3	0.0	0.6	0.0	0.4	0.1	0.0
	CONW034	32.0	2.0	1.0	13.0	0.0	7.0	6.0	9.0	9.0	0.0	4.5	4.0	7.0	5.5	0.0	2.8	2.1	3.1	2.8	0.0	1.3	1.0	2.0
	CONW035	28.0	3.0	0.0	9.0	0.0	8.0	7.0	7.0	7.8	0.0	6.0	3.8	5.8	4.8	0.0	2.4	1.4	2.5	1.8	0.0	0.9	0.5	1.5
	CONW036	6.0	0.0	0.0	4.0	0.0	1.0	1.0	0.0	2.8	0.0	0.3	0.3	0.0	1.8	0.0	0.0	0.1	0.0	1.1	0.0	0.0	0.0	0.0
	CONW037	33.0	2.0	0.0	15.0	1.0	7.0	6.0	6.0	9.3	1.0	4.3	2.5	4.8	4.0	1.0	2.0	1.1	2.8	1.4	0.6	0.8	0.4	1.5
	CONW038	38.0	2.0	0.0	14.0	1.0	8.0	7.0	10.0	9.3	1.0	6.0	3.5	8.8	4.4	0.5	3.8	0.8	6.0	1.6	0.3	1.8	0.4	2.3
	CONW039	44.0	0.0	0.0	15.0	1.0	9.0	12.0	7.0	10.3	0.3	6.5	7.0	4.3	5.5	0.0	2.5	2.9	2.1	2.9	0.0	1.1	0.3	1.0
	CONW040	21.0	0.0	0.0	11.0	0.0	5.0	4.0	1.0	6.0	0.0	2.8	1.5	0.3	1.9	0.0	0.8	0.4	0.0	0.3	0.0	0.4	0.1	0.0
	CONW041	43.0	4.0	0.0	13.0	1.0	9.0	12.0	12.0	10.5	1.0	4.5	6.5	8.0	5.9	0.6	2.0	2.6	3.8	2.9	0.3	0.9	1.1	2.9
	CONW042	37.0	2.0	2.0	12.0	1.0	6.0	10.0	12.0	10.0	1.0	4.8	5.8	9.3	5.9	0.9	3.1	2.8	5.0	3.5	0.6	2.1	1.3	2.5
	CONW043	53.0	2.0	0.0	12.0	0.0	11.0	17.0	15.0	8.3	0.0	7.0	12.5	10.5	4.8	0.0	4.0	7.3	7.0	2.4	0.0	2.1	3.5	4.9
	CONW044	60.0	1.0	0.0	16.0	1.0	14.0	16.0	14.0	11.8	0.3	9.3	12.0	12.8	6.1	0.0	4.3	5.4	9.6	3.3	0.0	1.5	2.5	5.9
	CONW045	44.0	0.0	0.0	12.0	3.0	8.0	9.0	12.0	7.0	2.0	6.3	3.5	8.5	3.5	1.4	4.8	2.3	4.5	1.8	1.0	1.6	1.0	2.5
	CONW046	39.0	2.0	0.0	15.0	1.0	8.0	9.0	8.0	10.0	1.0	4.5	3.8	5.8	4.0	0.9	2.3	1.5	3.5	1.8	0.4	1.3	0.4	2.3

¹ Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

² Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

³ Mean species richness at the nested 10 square meters (107.6 ft²) depth

⁴ Mean species richness at the nested 1 square meter (10.8 ft²) depth

Table 3 (continued). Vascular plant species richness across multiple spatial scales on Southeast Coast Network vegetation plots located within Congaree National Park. The data are summarized by total number of native versus non-native species/plot, and by vegetative growth forms (T: tree, S: shrub, V: vine, H: herbs/forbs, G: graminoids). Growth form information was obtained from the USDA Plants Database (USDA 2023).

Broadly Defined Habitat	Plot	Native ¹	Non-native ¹	Unknown ¹	T ¹	S ¹	V ¹	H ¹	G ¹	T ²	S ²	V ²	H ²	G ²	T ³	S ³	V ³	H ³	G ³	T ⁴	S ⁴	V ⁴	H ⁴	G ⁴
Coastal Plain Alluvial Wetlands	CONW047	39.0	2.0	0.0	15.0	1.0	7.0	9.0	9.0	9.8	1.0	4.8	4.3	6.0	3.9	0.4	2.1	2.3	3.1	1.8	0.1	0.9	1.3	1.5
	CONW048	43.0	0.0	0.0	15.0	0.0	9.0	14.0	5.0	9.0	0.0	6.0	7.5	3.3	3.1	0.0	2.6	3.0	1.3	1.0	0.0	1.3	1.0	0.8
	CONW049	31.0	0.0	0.0	14.0	1.0	6.0	7.0	3.0	8.5	0.3	3.5	2.8	2.0	4.3	0.0	1.3	0.8	0.8	2.0	0.0	0.5	0.1	0.6
	CONW050	13.0	0.0	1.0	7.0	0.0	1.0	4.0	2.0	3.8	0.0	0.3	1.0	0.5	1.4	0.0	0.1	0.5	0.3	0.3	0.0	0.0	0.0	0.0
	CONW051	46.0	3.0	0.0	15.0	1.0	7.0	14.0	12.0	11.3	0.5	6.0	8.3	8.8	5.6	0.1	2.3	2.9	5.1	1.5	0.0	0.8	1.3	3.3
	CONW052	40.0	3.0	0.0	14.0	1.0	13.0	5.0	10.0	9.0	1.0	8.5	4.3	8.3	3.5	0.8	4.8	1.5	5.0	1.6	0.5	2.5	0.5	3.4
	CONW053	38.0	1.0	0.0	16.0	2.0	11.0	4.0	6.0	8.3	1.3	6.8	1.5	3.3	3.1	0.6	2.9	0.3	1.8	1.4	0.3	0.9	0.1	0.5
	CONW054	30.0	1.0	0.0	11.0	0.0	6.0	8.0	6.0	7.5	0.0	4.3	5.0	3.8	3.6	0.0	1.6	2.5	2.3	1.8	0.0	0.5	1.1	1.4
	CONW055	42.0	1.0	0.0	17.0	1.0	8.0	9.0	8.0	10.3	1.0	5.0	5.0	5.0	4.4	1.0	2.5	2.6	2.6	1.8	0.6	0.8	1.1	2.0
	CONW056	25.0	0.0	0.0	9.0	1.0	7.0	5.0	3.0	5.8	0.8	2.5	3.5	2.3	3.8	0.0	0.9	1.1	1.1	2.9	0.0	0.4	0.1	0.5
	CONW057	33.0	2.0	0.0	17.0	1.0	7.0	5.0	5.0	9.5	1.0	3.5	1.3	3.3	4.0	0.8	2.0	0.4	1.9	2.1	0.1	0.8	0.3	1.1
	CONW058	34.0	3.0	0.0	11.0	1.0	7.0	7.0	11.0	7.8	0.8	4.8	5.0	7.3	3.6	0.6	2.8	1.8	4.1	1.5	0.4	1.9	0.5	2.5
	CONW059	29.0	3.0	0.0	12.0	0.0	9.0	6.0	5.0	9.0	0.0	6.3	3.8	4.0	4.5	0.0	2.5	2.5	1.9	2.1	0.0	1.4	1.6	0.6
	CONW063	15.0	0.0	0.0	7.0	1.0	2.0	5.0	0.0	4.5	0.8	0.8	1.8	0.0	2.3	0.3	0.1	0.5	0.0	1.4	0.1	0.0	0.0	0.0
	CONW068	33.0	2.0	0.0	13.0	1.0	8.0	6.0	7.0	9.0	1.0	4.8	2.8	5.0	4.4	0.9	1.8	0.8	3.3	2.1	0.8	0.6	0.4	1.9
	average	34.1	1.5	0.2	12.4	0.9	7.2	8.4	6.9	8.3	0.6	4.6	4.5	5.0	3.9	0.4	2.3	1.8	2.7	1.8	0.2	1.0	0.8	1.6
	standard deviation	12.2	1.3	0.5	3.0	0.6	2.9	5.0	4.0	2.1	0.5	2.0	3.0	3.3	1.3	0.4	1.2	1.5	2.1	0.9	0.3	0.7	0.8	1.4

¹ Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

² Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

³ Mean species richness at the nested 10 square meters (107.6 ft²) depth

⁴ Mean species richness at the nested 1 square meter (10.8 ft²) depth

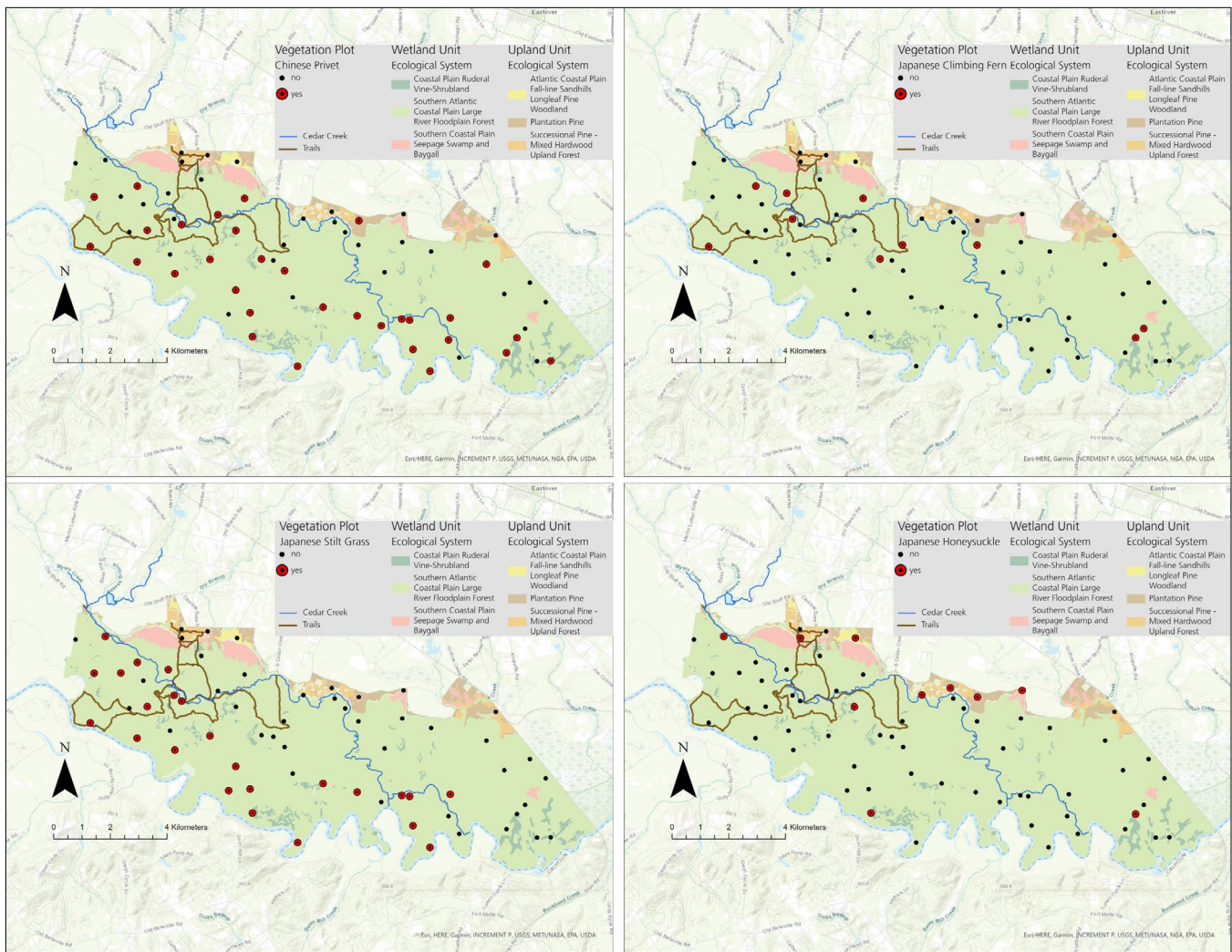


Figure 3. Plot-level occurrence of four invasive plants (Chinese privet, Japanese stilt grass, Japanese climbing fern, and Japanese honeysuckle) within Congaree National Park, May–August 2021.

Coastal Plain Alluvial Wetlands

Alluvial habitats of the southeastern Coastal Plain include forested and non-forested wetlands adjacent to rivers and streams that are often influenced by occasional or periodic flooding. In Georgia and the Carolinas, these rivers are often subdivided into “brownwater” and “blackwater” types. “Brownwater” rivers originate in the Piedmont or Mountains, experience higher flooding during the winter and early spring when evapotranspiration rates are low, and can deposit large loads of upstream sediment resulting in well-defined, complex floodplain features; conversely, “blackwater” rivers begin in the Coastal Plain, vary drastically in seasonality of flooding due to year-round storms and the water-holding capacity of depressional wetlands these rivers typically drain, and typically carry very little suspended material and have an inconspicuous floodplain (Christensen 2000; Edwards et al. 2013). Due to its large size and proximity to the “fall line” (the

geologic boundary that separates the metamorphosed terrain of the South Atlantic Piedmont from the relatively flat upper continental shelf of the Atlantic Coastal Plain), the Congaree River and its tributaries within Congaree National Park exhibit characteristics of both “brownwater” and “blackwater” rivers. Riparian vegetation types in the southeastern U.S. largely correspond with topography in relation to the river, and are often distributed across an anaerobic gradient—from wet sloughs often covered with water year-round (e.g., cypress-gum swamps) to alluvial flats inundated during the winter and spring (e.g. bottomland hardwood forests) to higher levees adjacent to the river and upper terraces scattered across the floodplain or adjacent to the uplands (Christensen 2000). The majority of the Congaree National Park occurs within the alluvial wetlands of the Congaree River floodplain (Figure 1, Figure 4).



Figure 4. Fifty-six plots were established in Coastal Plain Alluvial Wetlands of Congaree National Park during this monitoring effort (May–August 2021). These floodplain forests exhibited a wide range of diversity, and included inundated sloughs dominated by bald-cypress and swamp tupelo (left) and “drier” alluvial flats dominated by sweetgum and other hardwoods (right).

Several vegetation associations corresponding with alluvial vegetation types were sampled within the park during this monitoring effort, including (descriptions from NatureServe 2023):

- Atlantic Brownwater River Terrace and Ridge Laurel Oak Floodplain Forest (CEGL004678; 1 plot): Forests of stable floodplain terraces and ridges, but not levees, dominated by a mixture of bottomland oaks and other hardwood species; the elevated water table is high in pH, mineral sediment, and nutrients. (Global Status: G3—Vulnerable; State (SC) Status: No Status Rank)
- Overcup Oak – Laurel Oak – Bald-cypress Blackwater Bottomland Forest (CEGL004735; 2 plots): Forests of sloughs and backswamp edges that include a mixture of cypress-gum swamp and bottomland hardwood species. (Global Status: G4—Apparently Secure; State (SC) Status: No Status Rank)
- Atlantic Coastal Plain Sugarberry – Green Ash Levee Forest (CEGL004740; 17 plots): Forests of relatively fertile levees of brownwater rivers of the Atlantic Coastal Plain dominated by sugarberry, black walnut (*Juglans nigra*), boxelder (*Acer negundo* var. *negundo*), sweetgum, and American elm (*Ulmus americana* var. *americana*). (Global Status: G4—Apparently Secure; State (SC) Status: No Status Rank)
- Coastal Plain Planertree Floodplain Swamp Forest (CEGL007394; 1 plot): Floodplain forests occurring in depressions of bottomland hardwood forests that are dominated by a stunted canopy of planertree, occasionally with other species occurring in the emergent canopy stratum; diversity of ground cover is often low due to the extreme periods of inundation within these sites. (Global Status: G4—Apparently Secure; State (SC) Status: No Status Rank)
- Bald-cypress – Tupelo Brownwater Floodplain Forest (CEGL007431; 4 plots): Forests of semi-permanently flooded zones of brownwater floodplains dominated by tall individuals of bald-cypress and water tupelo; these forests can be found on a variety of sites (e.g., oxbow lakes, backwater sloughs, and various other isolated depressions within the floodplain) where they experience very frequent to near permanent flooding. (Global Status: G5—Secure; State (SC) Status: No Status Rank)
- Atlantic Coastal Plain Bald-cypress – Water Tupelo Blackwater Small Stream Swamp Forest (CEGL007432; 1 plot): One of several forests found along small blackwater streams of the Atlantic Coastal Plain and occasionally within isolated basins of brownwater floodplains; these forests are inundated for long periods and are dominated by a combination of bald-cypress, pond cypress (*Taxodium ascendens*), water tupelo, and swamp tupelo. (Global Status: G3—Vulnerable; State (SC) Status: No Status Rank)
- Coastal Plain Bald-cypress – Mixed Hardwood Floodplain Forest (CEGL007719; 7 plots): Forests that contain a mixture of bald-cypress and mixed hardwoods (not including water or swamp tupelo co-dominants) within sloughs and alluvial flats of Atlantic Coastal Plain floodplains; these forests occur on soils with some degree of silt; hardwood species that are found in these sites are indicative of less inundated conditions than typically found in sloughs and back swamps, and can include green ash, laurel oak, sweetgum, sugarberry, American elm, and many others. (Global Status: G3—Vulnerable; State (SC) Status: No Status Rank)

- American Sycamore – Sugarberry – Green Ash Floodplain Forest (CEGL007730; 1 plot): This riparian forest typically occurs on terraces of Atlantic Coast and Piedmont rivers and large creeks; soils tend to be more well-drained than adjacent alluvial flats. Canopy and subcanopy dominant species can include American sycamore, sugarberry, green ash, and boxelder. (Global Status: G4—Apparently Secure; State (SC) Status: No Status Rank)
- Sweetgum – Laurel Oak / Giant Cane Floodplain Forest (CEGL007732; 20 plots): Forests occurring on poorly to moderately well-drained silt loam soils of ridges within southern Atlantic Coastal Plain floodplains and with a water table well below the soil surface during the growing season of most years; the canopy is often co-dominated by sweetgum, laurel oak, and/or water oak (*Quercus nigra*), but can also contain other mixed hardwood species; an emergent canopy of large diameter loblolly pine is also present in a phase of this forest type within Congaree National Park. (Global Status: G3—Vulnerable; State (SC) Status: No Status Rank)
- Atlantic Coastal Plain Brownwater Floodplain Oak Seepage Forest (CEGL007737; 1 plot): Forests along edges of brownwater river floodplains in the Atlantic Coastal Plain that are rarely flooded by alluvial water; these forests are characterized as wetlands due to the regular seepage from adjacent upland slopes; the canopy is typically dominated by swamp chestnut oak (*Quercus michauxii*), sweetgum, and loblolly pine and the subcanopy is often dominated by American hornbeam (*Carpinus caroliniana* var. *caroliniana*). (Global Status: G2—Imperiled; State (SC) Status: No Status Rank)
- Southeastern Coastal Plain Green Ash – Elm Bottomland Forest (CEGL007806; 1 plot): Forests dominated by green ash, American elm, and sugarberry occurring on a variety of topographic positions of Atlantic and Gulf Coast floodplains; soils are clay or silt loams with alluvial deposition. (Global Status: G4—Apparently Secure; State (SC) Status: No Status Rank)

Species Diversity and Abundance

Native species richness was highly variable within alluvial floodplain forest plots of Congaree National Park and ranged from 6 to 65 (mean = 34.1) (Table 3). Richness was typically lowest in plots of lower sloughs and ponds that experience nearly year-round inundation and highest in the Sweetgum - Laurel Oak / Giant Cane Floodplain Forest association.

Species characterized as trees represented the most diverse growth form across all spatial scales within this habitat type, while herbaceous plants had the second highest diversity within the full plot scale and graminoids had the second highest diversity in all smaller spatial scales (Table 3). Non-native species occurrences were frequent, with at least one non-native species occurring in 70% of Coastal Plain Alluvial Wetland plots of the park (Table 3). All seven of the invasive plants categorized as either a Significant Threat or Severe Threat by the SCEPPC (2014) observed during this monitoring effort were found within at least one Coastal Plain Alluvial Wetland plot at Congaree National Park. Chinese privet was observed in 54% of these plots and Japanese stilt grass was observed in 43% of these plots. There were no federal or state protected plants observed in these plots. However, the state tracked heartleaf nettle (S2, imperiled) was located in a single plot. Another vegetation characteristic to note was the extremely high sedge (genus *Carex*) diversity featured in the park's alluvial wetlands; there were over 25 unique species of *Carex* observed among plots. Most native vascular plants observed in these plots are fairly common across alluvial floodplains of the Southeastern Coastal Plain. One hundred ninety-seven vascular plant species were found collectively within these 56 plots, and a complete species list, along with constancy and average cover per species, is listed in Appendix B, Table B-1. Species with high constancy in this habitat are listed below, by growth form (constancy values in parentheses):

Trees

- Green ash (95%)
- Red maple (*Acer rubrum*; 91%)
- Possumhaw (91%)
- Sweetgum (82%)
- Sugarberry (79%)

Vines

- Eastern poison ivy (*Toxicodendron radicans* var. *radicans*; 89%)
- Muscadine (*Muscadinia rotundifolia* var. *rotundifolia*; 86%)
- Roundleaf greenbrier (*Smilax rotundifolia*; 84%)

Shrubs

- Switchcane (64%)

Herbs/Forbs/Graminoids

- Smallspike false nettle (*Boehmeria cylindrica*; 86%)
- Eastern star sedge (*Carex radiata*; 68%)
- Violet (*Viola* sp.; 68%)
- Louisiana sedge (*Carex louisianica*; 66%)

Woody Stem Metrics

Total basal area (BA) of trees ranged from 15.8 to 124.5 m²/ha with an overall average of 47.0 m²/ha; density of canopy stems ranged from eight to 36 per plot, with an average of 18.4 (Table 4). Canopy height ranged from 25 to 47 meters (82 to 154 ft [average 35.6 meters {116.8 ft}], and canopy cover ranged from 60 to 91% (average=76.9%; Table 4). The most dominant canopy species included sweetgum (mean BA = 11.09 m²/

ha, mean density = 71/ha), water tupelo (mean BA = 6.36 m²/ha, mean density = 27/ha), green ash (mean BA = 5.79 m²/ha, mean density = 35/ha), and bald-cypress (mean BA = 4.43 m²/ha, mean density = 16/ha) (Appendix B, Table B-2). Sapling density at the 80-meter square scale ranged from one to 119 stems, with an average of 22.1, while seedling density at the 8-meter square scale ranged from two to 289 stems, with an average of 80.1 across all plots (Table 4). It should be noted that plots with low seedling and sapling densities were found in a majority of habitat types, and not confined to sites with high inundation rates (e.g., sloughs, lower depressions, ponds). Dominant sapling species included pawpaw (*Asimina triloba*), switchcane, and possumhaw; dominant seedlings included switchcane, red maple, crossvine, American elm, and eastern poison ivy (Appendix B, Table B-2).

Table 4. Woody stem abundance and canopy metrics on Southeast Coast Network vegetation plots located in Congaree National Park [m—meters; ha—hectares].

Broadly Defined Habitat	Plot	Tree Basal Area (m ² /ha)	Tree Density (400 m ²)	Sapling Basal Area (m ² /ha)	Sapling Density (80 m ²)	Seedling Density (8 m ²)	Mean Canopy Cover (%)	Mean Height (m)
Coastal Plain Upland Open Woodlands	CONU001	61.2	24.0	13.8	21.0	86.0	83.8	38.3
	CONU002	16.0	8.0	4.4	1.0	176.0	39.8	34.0
	CONU003	58.1	19.0	6.0	27.0	117.0	75.9	38.7
	CONU004	26.3	15.0	4.8	98.0	135.0	65.3	35.7
	CONU005	30.1	10.0	0.0	1.0	200.0	51.1	29.3
	CONU006	33.1	13.0	0.0	0.0	62.0	34.2	32.0
	CONU007	13.7	19.0	16.4	51.0	46.0	71.6	22.7
	CONU008	53.3	30.0	3.5	30.0	97.0	45.1	27.7
	average	36.5	17.3	6.1	28.6	114.9	58.3	32.3
	standard deviation	18.7	7.3	6.0	33.2	53.6	18.3	5.5
Coastal Plain Alluvial Wetlands	CONW001	108.1	26.0	5.5	3.0	3.0	66.6	37.0
	CONW002	17.6	11.0	26.8	119.0	195.0	76.2	36.7
	CONW003	54.7	14.0	17.5	11.0	20.0	84.1	40.3
	CONW004	19.3	17.0	45.3	18.0	107.0	80.9	26.3
	CONW005	62.2	25.0	1.3	2.0	75.0	78.3	36.7
	CONW006	20.0	9.0	20.4	24.0	67.0	83.6	33.7
	CONW007	78.9	16.0	14.4	4.0	3.0	71.6	40.7
	CONW008	25.0	32.0	13.6	43.0	84.0	75.7	30.0
	CONW009	54.2	23.0	8.4	18.0	62.0	91.3	34.0
	CONW010	52.5	19.0	13.1	21.0	78.0	78.9	38.3
	CONW011	15.9	22.0	8.7	10.0	42.0	73.0	33.0
	CONW012	39.6	18.0	49.8	19.0	208.0	66.6	29.0
	CONW013	41.3	14.0	5.5	6.0	93.0	87.6	38.3
	CONW015	20.7	11.0	37.3	25.0	67.0	75.3	35.7
	CONW017	31.9	27.0	22.6	13.0	103.0	87.8	25.0
	CONW018	47.6	8.0	32.1	38.0	68.0	70.3	47.0

Table 4 (continued). Woody stem abundance and canopy metrics on Southeast Coast Network vegetation plots located in Congaree National Park [m—meters; ha—hectares].

Broadly Defined Habitat	Plot	Tree Basal Area (m ² /ha)	Tree Density (400 m ²)	Sapling Basal Area (m ² /ha)	Sapling Density (80 m ²)	Seedling Density (8 m ²)	Mean Canopy Cover (%)	Mean Height (m)
Coastal Plain Alluvial Wetlands	CONW019	58.5	15.0	47.4	42.0	59.0	88.4	38.3
	CONW020	32.2	22.0	34.2	45.0	150.0	83.8	28.0
	CONW021	61.3	18.0	7.5	43.0	117.0	78.4	38.7
	CONW024	87.5	14.0	5.8	3.0	13.0	90.5	40.3
	CONW025	59.8	12.0	5.6	8.0	90.0	79.9	43.3
	CONW027	37.5	18.0	4.8	10.0	70.0	75.6	40.3
	CONW028	87.0	20.0	27.7	23.0	38.0	68.1	30.7
	CONW029	30.1	20.0	6.7	8.0	71.0	88.0	37.7
	CONW030	28.2	11.0	41.6	85.0	112.0	83.4	35.0
	CONW031	38.6	20.0	11.0	4.0	2.0	59.9	34.3
	CONW032	45.6	27.0	17.3	14.0	41.0	61.8	27.0
	CONW033	36.9	20.0	26.5	9.0	13.0	75.6	31.7
	CONW034	51.6	14.0	25.6	35.0	57.0	76.4	42.7
	CONW035	40.2	23.0	26.6	26.0	50.0	76.5	40.7
	CONW036	110.4	31.0	8.8	2.0	40.0	68.3	29.3
	CONW037	54.7	21.0	13.3	17.0	89.0	74.6	36.7
	CONW038	30.8	16.0	30.0	56.0	61.0	79.3	31.3
	CONW039	29.9	22.0	36.5	47.0	84.0	81.8	32.3
	CONW040	48.0	16.0	33.6	11.0	3.0	76.3	25.3
	CONW041	36.8	15.0	21.7	22.0	73.0	82.3	30.0
	CONW042	46.9	13.0	26.2	56.0	289.0	74.4	42.0
	CONW043	52.7	15.0	17.7	4.0	101.0	65.8	44.3
	CONW044	40.8	36.0	33.1	18.0	211.0	70.9	28.0
	CONW045	17.4	18.0	8.0	7.0	190.0	78.8	44.7
	CONW046	48.3	16.0	23.9	32.0	56.0	85.7	35.7
	CONW047	64.6	17.0	17.1	13.0	44.0	73.3	44.0
	CONW048	74.5	31.0	15.7	14.0	21.0	81.5	32.0
	CONW049	54.5	17.0	8.8	2.0	134.0	82.0	33.0
	CONW050	124.5	23.0	4.4	1.0	4.0	69.5	42.3
	CONW051	55.8	8.0	30.7	36.0	25.0	66.9	42.0
	CONW052	15.8	14.0	37.0	62.0	104.0	76.6	27.0
	CONW053	38.4	13.0	11.5	9.0	48.0	74.8	32.0
	CONW054	26.2	11.0	18.8	9.0	33.0	72.6	38.0
	CONW055	26.3	16.0	9.2	14.0	118.0	73.6	36.3
	CONW056	31.4	32.0	17.9	8.0	134.0	66.8	29.0
	CONW057	55.6	19.0	4.7	2.0	101.0	77.1	30.7
	CONW058	20.8	9.0	28.9	41.0	107.0	83.1	38.3
	CONW059	43.6	20.0	12.1	13.0	163.0	74.3	40.0
	CONW063	43.9	15.0	4.5	5.0	41.0	83.3	37.0
	CONW068	55.9	22.0	0.6	7.0	56.0	76.5	41.7
average		47.0	18.4	19.4	22.1	80.1	76.9	35.6
standard deviation		23.7	6.4	12.7	22.4	59.3	7.2	5.6

Based on stem count (density) alone, maples (boxelder + red) and sweetgum accounted for just over 30% of the relative abundance among species within the tree stratum, along with an even distribution of other species (e.g., oaks, elms, American holly, green ash, American hornbeam, and sugarberry; Figure 5). The sapling stratum was dominated by possumhaw (42% relative abundance), a native small tree of Coastal Plain floodplains; most species present in the tree stratum were also present in the sapling stratum (Figure 5). The most abundant group of species within the seedling size class were maples (boxelder + red) and American elm (Figure 6).

Most of the measured trees in these monitoring plots were living (95%) and the majority were categorized with healthy

vigor and minimal dieback (Figure 6). Of the 55 dead trees measured, most (N=13) were unidentifiable to species. The highest tally of dead trees from those that could still be identified to species were from green ash (N=7) and bald-cypress (N=7). Of living trees measured, only 6% were experiencing a severe decline or functionally dead. Most of these unhealthy living trees were either green ash or sweetgum. It should be noted that as of this writing, emerald ash borer (*Agrilus planipennis*) has not expanded its range to include the midlands of South Carolina (USDA 2023b). The emerald ash borer is a wood-boring pest of ash (*Fraxinus* sp.) native to Asia. Since its discovery in the U.S. in the early 2000's, the insect has been responsible for the death of tens of millions of ash trees in the eastern and midwestern parts of the country.

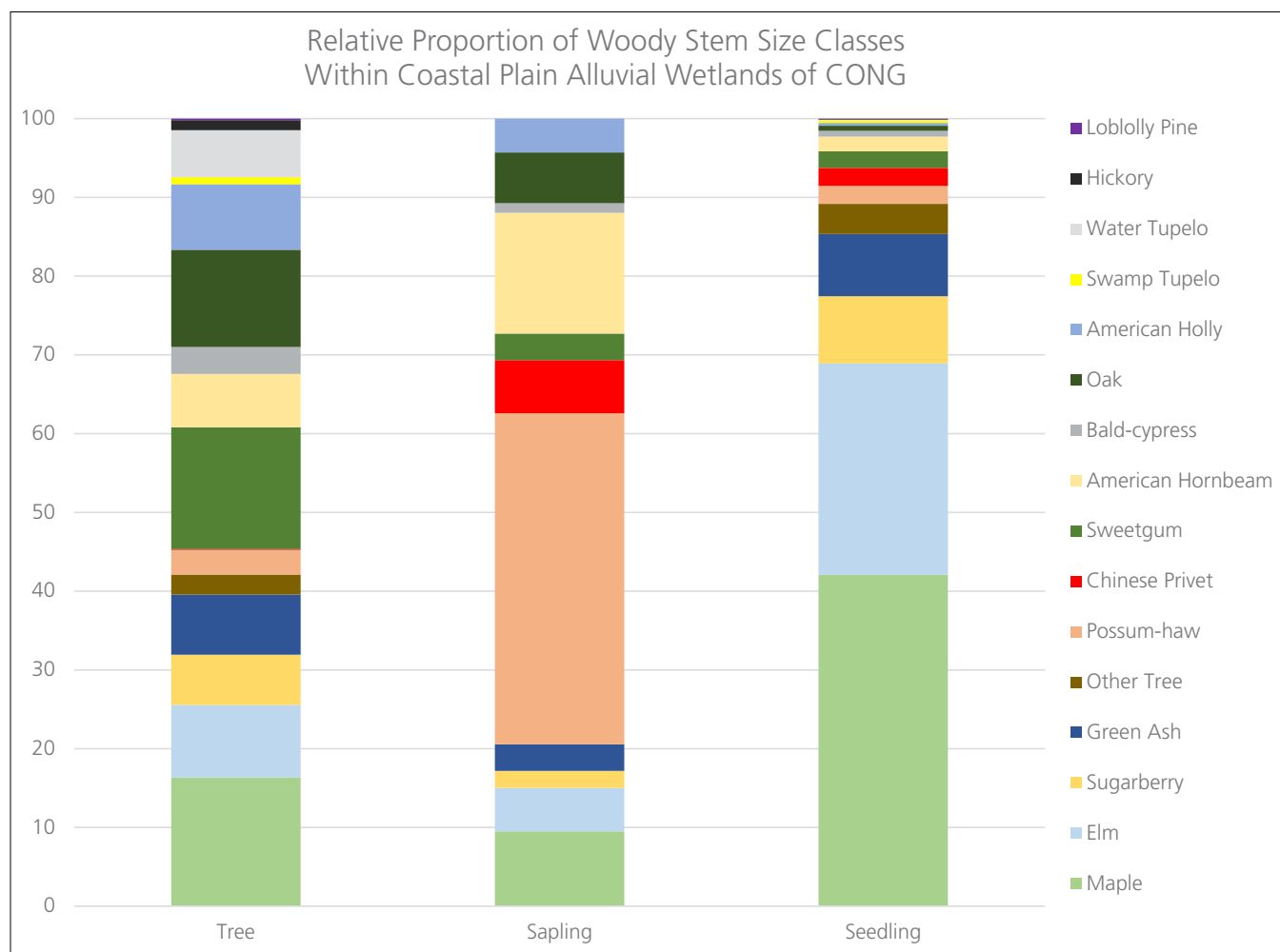


Figure 5. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings— within Coastal Plain Alluvial Wetland monitoring plots of Congaree National Park.

Health Condition of Trees Observed at Coastal Plain Alluvial Wetlands of CONG

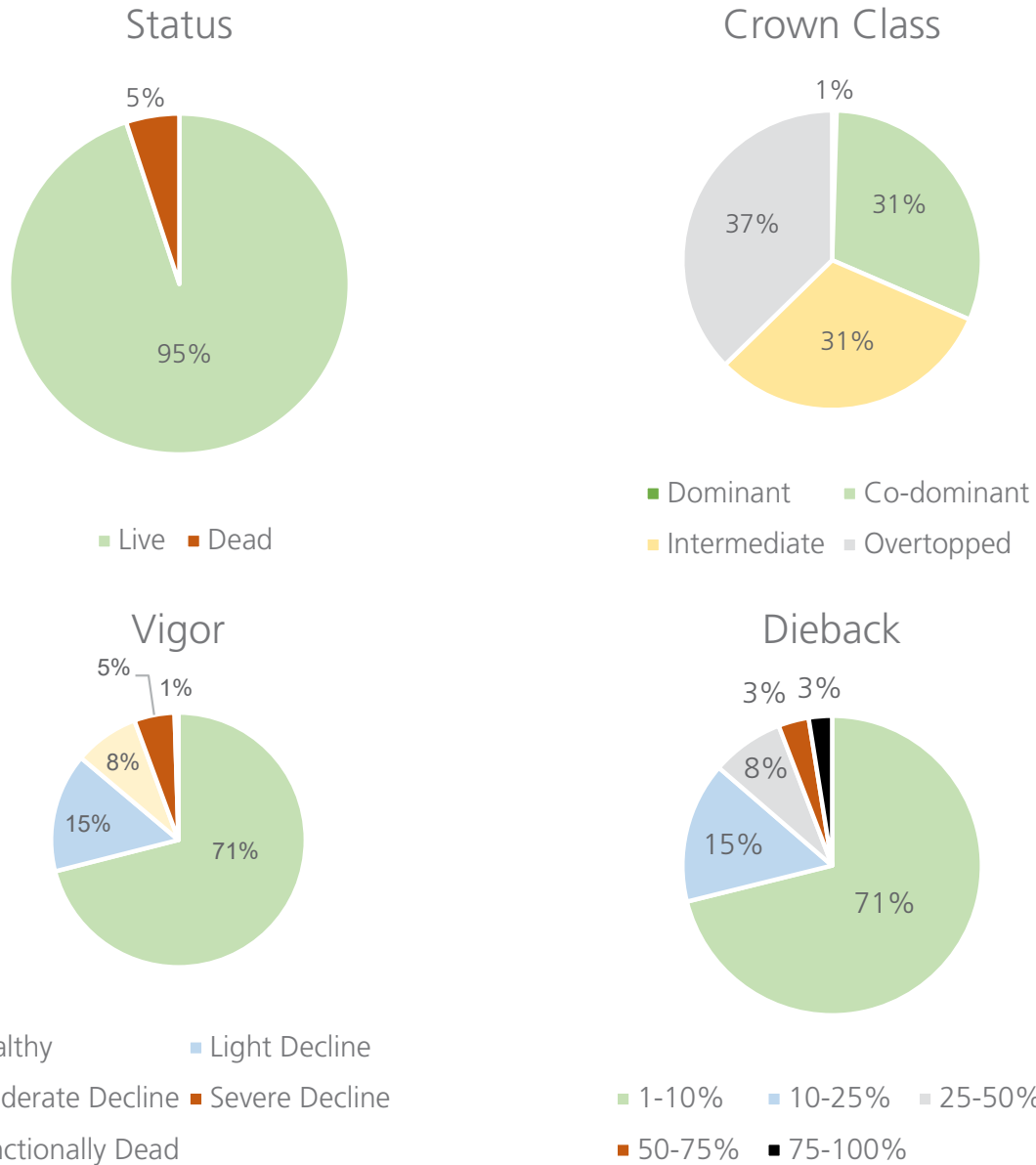


Figure 6. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH ('trees') measured on Coastal Plain Alluvial Wetland monitoring plots of Congaree National Park.

Disturbance and Threats

The most common observable disturbance to vegetation resources within Congaree National Park's Coastal Plain Alluvial Wetlands was related to the aggressive feral hog (*Sus scrofa*; Table 5). Although they have been present on the Congaree River floodplain for centuries, feral hogs are non-native to South Carolina. They are considered to be a mixture of feral animals originating from escaped and released domestic stock and European wild boar introduced to the area by hunt clubs and adjacent landowners (Mayer et al. 2002). Hogs negatively impact park resources by their destructive behavior of "rooting" the forest floor, "digging" mud wallows, and creating trail networks. Park resources impacted include

native vegetation (e.g., reduce tree regeneration, endanger populations of already rare plant species, and spread invasive plants), native wildlife (e.g., increase competition for resources, being eaten, and spread disease), soil (e.g., erosion), wetlands (e.g., increase bacteria waste into waterways), and archaeology sites. Of the 56 alluvial plots sampled during this monitoring effort, 41 had observable hog disturbance (73%); 11 of these plots had more than 60% of the ground disturbed by hog rooting or wallow creation (Figure 7). Hog disturbance was distributed fairly evenly across the park's floodplain, although less disturbance was observed in plots in the park's northeastern corner and adjacent to a private hunt club that actively controls feral hogs (Figure 7).

Table 5. Disturbance observations and abundance (%cover) measured on vegetation monitoring plots of Congaree National Park.

Broadly Defined Habitat	Plot	Recent Fire	Historic Fire	Heavy Windthrow	Heavy Erosion	Flood Scour	Feral Hog Damage	Historic Logging	Historic Plowing
Coastal Plain Upland Open Woodlands	CONU001	—	—	—	—	—	—	—	—
	CONU002	100	—	—	—	—	—	—	20
	CONU003	—	—	—	—	—	30	—	—
	CONU004	—	—	—	—	—	—	100	—
	CONU005	100	—	—	—	—	—	—	—
	CONU006	100	—	—	—	—	—	—	—
	CONU007	—	100	—	—	—	—	—	—
	CONU008	—	100	—	—	—	—	—	—
Coastal Plain Alluvial Wetlands	CONW001	—	—	—	—	—	—	—	—
	CONW002	—	—	40	—	—	20	—	—
	CONW003	—	—	—	—	—	100	—	—
	CONW004	—	—	—	—	—	—	—	—
	CONW005	—	—	—	—	—	—	—	—
	CONW006	—	—	—	—	—	10	—	—
	CONW007	—	—	—	—	—	70	—	—
	CONW008	—	—	—	—	—	10	—	—
	CONW009	—	—	—	—	—	20	—	—
	CONW010	—	—	—	—	—	30	—	—
	CONW011	—	—	—	—	—	80	100	—
	CONW012	—	—	—	—	—	40	—	—
	CONW013	—	—	—	—	—	20	—	—
	CONW015	—	—	—	—	—	10	—	—
	CONW017	—	—	—	—	—	—	100	—
	CONW018	—	—	—	—	—	60	—	—
	CONW019	—	—	—	—	—	30	—	—
	CONW020	—	—	—	—	—	—	—	—
	CONW021	—	—	40	—	—	—	—	—
	CONW024	—	—	—	—	—	20	—	—
	CONW025	—	—	—	—	—	20	—	—

Table 5 (continued). Disturbance observations and abundance (%cover) measured on vegetation monitoring plots of Congaree National Park.

Broadly Defined Habitat	Plot	Recent Fire	Historic Fire	Heavy Windthrow	Heavy Erosion	Flood Scour	Feral Hog Damage	Historic Logging	Historic Plowing
Coastal Plain Alluvial Wetlands	CONW027	—	—	—	—	—	40	—	—
	CONW028	—	—	—	—	—	80	—	—
	CONW029	—	—	—	—	—	30	—	—
	CONW030	—	—	—	—	—	10	—	—
	CONW031	—	—	—	—	100	—	—	—
	CONW032	—	—	—	—	100	10	—	—
	CONW033	—	—	—	—	—	60	—	—
	CONW034	—	—	10	—	—	40	—	—
	CONW035	—	—	—	—	—	10	—	—
	CONW036	—	—	—	—	—	90	—	—
	CONW037	—	—	—	—	—	10	—	—
	CONW038	—	—	20	—	—	10	—	—
	CONW039	—	—	—	—	—	40	—	—
	CONW040	—	—	—	—	—	80	—	—
	CONW041	—	—	20	—	—	—	—	—
	CONW042	—	—	40	—	—	20	—	—
	CONW043	—	—	—	—	—	10	100	—
	CONW044	—	—	—	—	—	10	100	20
	CONW045	—	—	5	—	40	25	—	—
	CONW046	—	—	—	—	—	20	—	—
	CONW047	—	—	—	—	—	30	—	—
	CONW048	—	—	—	—	—	—	—	—
	CONW049	—	—	—	—	—	—	—	—
	CONW050	—	—	—	—	—	—	—	—
	CONW051	—	—	60	—	—	—	—	—
	CONW052	—	—	10	—	—	10	—	—
	CONW053	—	—	—	40	—	—	—	—
	CONW054	—	—	—	—	—	40	—	—
	CONW055	—	—	—	—	—	10	—	—
	CONW056	—	—	—	—	—	30	10	—
	CONW057	—	—	—	—	—	—	—	—
	CONW058	—	—	—	—	—	—	—	—
	CONW059	—	—	—	—	—	80	—	—
	CONW063	—	—	—	—	—	80	—	—
	CONW068	—	—	—	—	—	80	—	—

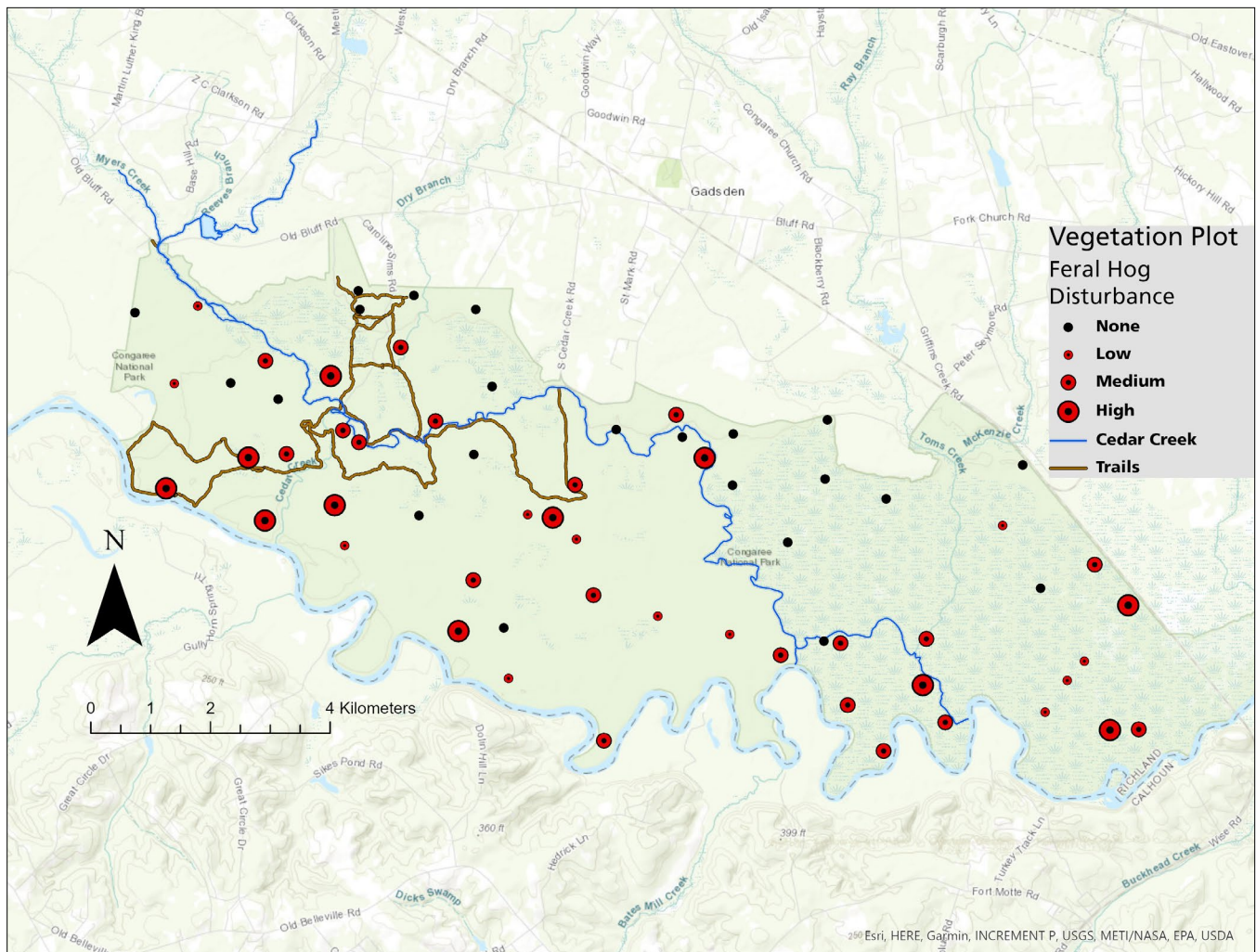


Figure 7. Observed impact of feral hogs (*Sus scrofa*) on soil disturbance and ground vegetation within SECN vegetation plots monitored in Congaree National Park during 2021. Disturbance categories (low, medium, high) are taken from cover percentages of rooting by hogs within a plot: high = > 60% ground impacted; medium = 20–60% ground impacted; low = 1–10% ground impacted.

Another broad-scale threat to vegetation resources on the park is related to the abundance of non-native invasive plants. The impacts of invasive species on native ecosystems and biodiversity are well-documented, and increased rates of habitat alteration and climate change are providing more opportunities for invasion (Vitousek et al. 1996; Chornesky and Randall 2003). Factors that facilitate pathways for invasion, such as increased density of roadways, land clearings, and urbanization (McNab and Loftis 2002; Christen and Matlack 2006) are a present and increasing reality for the landscape of Congaree National Park. The historical legacy from agriculture can also be a factor that leads to the establishment and spread of invasive plants (Kuhman et al. 2011). Management efforts

that target reduction of certain non-native species can lead to increased abundances of undesirable native species, other non-native species, or the targeted non-native species (see Royo and Carson 2006), which may have consequences on forest regeneration and ground cover diversity. It is difficult to predict how species will respond to both local-scale management efforts and landscape-scale changes (e.g., climate change). However, data from vegetation monitoring plots which track trends over time of non-native and native species abundance and forest regeneration patterns with regards to specific non-native control efforts can provide keen insight to park managers on the condition of their forest vegetation resources.

Geomorphology and Soil

Plots located within Coastal Plain Alluvial Wetlands of Congaree National Park occurred on relatively flat (0 degree) landforms with a wide range of topographic shapes (terrain shape indices > 0 [concave], < 0 [convex], or = 0 [flat]; Table 6). These sites occurred in temporary or permanent flood zones (Table 6). Because of their occurrence within the Congaree River floodplain, all sites have the potential to flood at multiple times of the year or following extreme rain events (Table 6). The dominant soils of the floodplain within Congaree National

Park are silty clay loams that are acidic, flood frequently, and erodible (Burkholder et al. 2018). Within soil samples taken from these vegetation plots, soil pH values ranged from strongly acidic to neutral, although most samples ranged from strongly to moderately acidic (Table 7). Alluvial floodplains of the Coastal Plain are typically fairly fertile, as these data suggest, owing to the periodic input of nutrients from flood events, which can lead to rapid tree growth (Edwards et al. 2013).

Table 6. Local landform and hydrologic condition from vegetation monitoring plots at Congaree National Park.

Broadly Defined Habitat	Plot	Slope (°)	Aspect (°)	TSI ¹ (°)	Landform Type	Water Source	Submerged (%)
Coastal Plain Upland Open Woodlands	CONU001	1.5	230	0.500	rolling upland	None	0
	CONU002	1.0	240	0.000	rolling upland	None	0
	CONU003	1.0	255	0.750	interfluv	None	0
	CONU004	0.0	0	-0.375	flat plain	None	0
	CONU005	1.0	15	0.875	rolling upland	None	0
	CONU006	2.0	72	-0.250	rolling upland	None	0
	CONU007	3.0	180	1.000	side slope	None	0
	CONU008	0.5	0	0.250	interfluv	None	0
Coastal Plain Alluvial Wetlands	CONW001	0.0	n/a	0.000	alluvial plain	Permanent water	60
	CONW002	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW003	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW004	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW005	0.0	0	-0.625	alluvial plain	Flood zones	0
	CONW006	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW007	1.0	135	0.375	seep/swale	Permanent water	50
	CONW008	0.0	n/a	0.000	flat plain	Flood zones	0
	CONW009	1.0	0	0.000	flat plain	Flood zones	0
	CONW010	0.0	n/a	0.000	levee	Flood zones	0
	CONW011	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW012	3.0	0	1.625	alluvial plain	Flood zones	0
	CONW013	n/a	n/a	n/a	alluvial plain	Flood zones	0
	CONW015	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW017	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW018	2.0	180	-0.125	alluvial plain	Flood zones	0
	CONW019	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW020	1.0	0	-0.625	levee	Flood zones	0
	CONW021	1.0	0	-1.500	alluvial plain	Flood zones	0
	CONW024	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW025	2.0	45	-0.125	alluvial plain	Flood zones	0
	CONW027	0.0	0	-0.875	alluvial plain	Flood zones	0
	CONW028	0.0	n/a	0.000	alluvial plain	Flood zones	0

¹ Terrain Shape Index: the larger the value, the higher degree of microsite concavity; the lower the value, the higher degree of microsite convexity; "0" values indicate a completely flat shape.

Table 6 (continued). Local landform and hydrologic condition from vegetation monitoring plots at Congaree National Park.

Broadly Defined Habitat	Plot	Slope (°)	Aspect (°)	TSI ¹ (°)	Landform Type	Water Source	Submerged (%)
Coastal Plain Alluvial Wetlands	CONW029	1.0	0	-1.000	levee	Flood zones	0
	CONW030	1.0	0	-1.000	alluvial plain	Flood zones	0
	CONW031	0.0	n/a	0.000	flat plain	Flood zones	0
	CONW032	1.0	0	0.875	flat plain	Flood zones	0
	CONW033	2.0	90	0.125	alluvial plain	Temporary Streams	0
	CONW034	1.0	0	0.375	alluvial plain	Flood zones	0
	CONW035	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW036	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW037	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW038	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW039	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW040	1.0	315	0.000	alluvial plain	Permanent water	10
	CONW041	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW042	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW043	1.0	0	-0.500	flat plain	Flood zones	0
	CONW044	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW045	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW046	1.5	225	-1.625	alluvial plain	Flood zones	0
	CONW047	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW048	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW049	2.0	0	-0.750	alluvial plain	Flood zones	0
	CONW050	0.0	0	-0.250	alluvial plain	Flood zones	0
	CONW051	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW052	0.0	n/a	0.000	flat plain	Flood zones	0
	CONW053	2.0	0	-3.375	alluvial plain	Temporary Streams	0
	CONW054	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW055	1.0	0	0.125	alluvial plain	Flood zones	0
	CONW056	0.0	n/a	0.000	alluvial plain	Permanent water	40
	CONW057	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW058	0.0	n/a	0.000	alluvial plain	Flood zones	0
	CONW059	0.0	n/a	0.125	alluvial plain	Flood zones	0
	CONW063	1.0	0	0.125	alluvial plain	Flood zones	0
	CONW068	0.0	n/a	0.000	alluvial plain	Flood zones	0

¹ Terrain Shape Index: the larger the value, the higher degree of microsite concavity; the lower the value, the higher degree of microsite convexity; "0" values indicate a completely flat shape.

Table 7. Soil nutrient status from vegetation monitoring plots at Congaree National Park. The Mehlich III method was used to obtain volume of exchangeable cations and extractable minor elements within soil samples. Methods to obtain other soil chemistry metrics (e.g., total exchange capacity [TEC], pH, and organic matter content [OM]) can be found at [Brookside Laboratories, Inc](#) (BL 2023).

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ¹	Ca ¹	Mg ¹	K ¹	Na ¹	B ¹	Fe ¹	Mn ¹	Cu ¹	Zn ¹	Al ¹
Coastal Plain Upland Open Woodlands	CONU001	1.94	6.40	3.22	15.00	247.00	38.00	28.00	11.00	0.72	378.00	4.00	0.24	0.50	532.00
	CONU002	5.27	4.70	2.45	36.00	313.00	55.00	36.00	10.00	0.10	172.00	67.00	0.24	1.19	485.00
	CONU003	8.26	5.00	4.94	17.00	574.00	109.00	42.00	11.00	0.37	161.00	399.00	1.06	1.03	838.00
	CONU004	5.27	4.00	9.78	32.00	147.00	47.00	56.00	18.00	0.30	425.00	7.00	0.61	0.84	1110.00
	CONU005	3.53	4.20	4.03	17.00	125.00	38.00	25.00	12.00	0.24	388.00	4.00	0.10	0.61	456.00
	CONU006	3.61	4.50	1.21	14.00	193.00	30.00	28.00	8.00	0.10	117.00	10.00	0.10	0.20	393.00
	CONU007	10.97	4.40	4.83	40.00	568.00	81.00	86.00	9.00	0.30	212.00	32.00	1.91	4.92	850.00
	CONU008	6.43	4.60	4.61	18.00	361.00	66.00	38.00	10.00	0.28	195.00	125.00	0.47	0.93	535.00
	average	5.66	4.73	4.38	23.63	316.00	58.00	42.38	11.13	0.30	256.00	81.00	0.59	1.28	649.88
	standard deviation	2.89	0.74	2.53	10.54	176.08	26.48	20.23	3.04	0.19	120.67	135.24	0.62	1.51	252.13
Coastal Plain Alluvial Wetlands	CONW001	11.04	4.70	15.75	46.00	638.00	117.00	102.00	23.00	0.42	660.00	44.00	2.96	3.31	1012.00
	CONW002	16.72	4.70	5.87	22.00	957.00	213.00	90.00	15.00	0.42	288.00	154.00	3.45	4.50	811.00
	CONW003	15.69	5.10	5.43	25.00	1247.00	180.00	64.00	16.00	0.36	445.00	206.00	3.48	5.73	638.00
	CONW004	15.35	4.50	6.79	18.00	750.00	195.00	53.00	25.00	0.23	170.00	190.00	4.50	2.92	978.00
	CONW005	7.38	6.00	7.88	10.00	804.00	197.00	45.00	23.00	0.29	140.00	287.00	1.90	2.56	812.00
	CONW006	19.25	4.80	7.50	20.00	1312.00	185.00	49.00	20.00	0.37	315.00	224.00	4.34	9.89	723.00
	CONW007	7.35	5.90	13.36	57.00	760.00	164.00	122.00	32.00	0.44	424.00	34.00	3.86	3.11	939.00
	CONW008	15.03	4.70	6.87	16.00	891.00	184.00	36.00	19.00	0.24	168.00	232.00	3.59	3.02	874.00
	CONW009	13.27	5.20	10.92	25.00	1056.00	196.00	56.00	25.00	0.28	174.00	275.00	2.65	3.75	664.00
	CONW010	18.81	4.80	5.90	23.00	1311.00	166.00	40.00	20.00	0.45	342.00	189.00	3.57	6.03	560.00
	CONW011	11.57	5.30	3.69	25.00	1058.00	140.00	37.00	15.00	0.33	362.00	173.00	2.25	4.00	461.00
	CONW012	13.15	5.00	6.59	11.00	874.00	203.00	45.00	19.00	0.27	161.00	187.00	2.31	2.06	876.00
	CONW013	9.37	5.30	5.60	11.00	697.00	182.00	115.00	14.00	0.33	147.00	140.00	2.08	1.26	972.00
	CONW015	19.93	5.20	7.39	18.00	1651.00	274.00	53.00	20.00	0.40	219.00	160.00	3.84	6.07	708.00
	CONW017	13.98	4.80	8.57	23.00	808.00	199.00	89.00	26.00	0.32	232.00	118.00	2.46	3.82	861.00
	CONW018	16.75	4.80	8.93	20.00	1059.00	205.00	52.00	23.00	0.33	186.00	263.00	2.98	6.25	807.00
	CONW019	11.94	4.90	3.26	21.00	835.00	129.00	39.00	16.00	0.29	344.00	162.00	1.98	6.32	495.00
	CONW020	17.83	4.50	7.28	17.00	952.00	188.00	46.00	19.00	0.26	214.00	191.00	2.99	3.50	985.00
	CONW021	21.04	4.10	7.59	18.00	834.00	168.00	77.00	19.00	0.34	175.00	207.00	1.98	1.98	981.00

¹Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

Table 7 (continued). Soil nutrient status from vegetation monitoring plots at Congaree National Park. The Mehlich III method was used to obtain volume of exchangeable cations and extractable minor elements within soil samples. Methods to obtain other soil chemistry metrics (e.g., total exchange capacity [TEC], pH, and organic matter content [OM]) can be found at [Brookside Laboratories, Inc](#) (BL 2023).

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ¹	Ca ¹	Mg ¹	K ¹	Na ¹	B ¹	Fe ¹	Mn ¹	Cu ¹	Zn ¹	Al ¹
Coastal Plain Alluvial Wetlands	CONW024	15.21	4.20	6.11	35.00	662.00	122.00	55.00	22.00	0.28	370.00	47.00	2.49	2.13	897.00
	CONW025	15.47	4.30	7.97	28.00	659.00	161.00	75.00	35.00	0.35	429.00	40.00	2.78	3.58	892.00
	CONW027	12.62	4.60	7.76	17.00	637.00	179.00	52.00	20.00	0.10	154.00	131.00	3.48	4.27	867.00
	CONW028	24.64	3.80	8.16	53.00	766.00	178.00	101.00	33.00	0.24	322.00	39.00	2.90	1.67	1037.00
	CONW029	14.80	4.50	7.99	14.00	721.00	188.00	60.00	21.00	0.23	159.00	265.00	2.58	4.36	854.00
	CONW030	12.36	6.20	7.25	17.00	1561.00	258.00	69.00	23.00	0.45	242.00	195.00	3.32	5.86	758.00
	CONW031	10.54	4.90	4.70	8.00	572.00	195.00	72.00	27.00	0.26	194.00	129.00	1.41	0.90	886.00
	CONW032	10.64	5.10	6.48	19.00	731.00	178.00	59.00	27.00	0.21	239.00	158.00	2.51	2.36	936.00
	CONW033	12.85	4.80	17.37	36.00	807.00	139.00	99.00	24.00	0.40	576.00	82.00	1.96	4.53	834.00
	CONW034	13.43	5.40	6.95	20.00	1245.00	198.00	57.00	21.00	0.26	242.00	190.00	3.25	4.09	766.00
	CONW035	11.98	5.20	5.13	21.00	974.00	171.00	41.00	16.00	0.40	254.00	100.00	3.12	2.89	816.00
	CONW036	8.62	5.60	9.35	77.00	787.00	161.00	148.00	24.00	0.40	425.00	50.00	5.34	4.85	1029.00
	CONW037	12.43	5.20	5.99	17.00	874.00	245.00	81.00	21.00	0.37	190.00	189.00	3.08	3.60	923.00
	CONW038	11.50	5.20	5.51	14.00	829.00	218.00	67.00	18.00	0.26	199.00	142.00	2.55	3.44	778.00
	CONW039	16.37	4.80	8.09	18.00	976.00	226.00	79.00	24.00	0.76	221.00	273.00	3.91	5.02	792.00
	CONW040	10.08	4.40	11.55	31.00	426.00	120.00	76.00	33.00	0.27	436.00	32.00	2.73	3.07	1078.00
	CONW041	15.70	5.80	8.49	15.00	1740.00	306.00	70.00	15.00	0.44	160.00	215.00	3.57	5.71	652.00
	CONW042	21.26	4.40	7.32	28.00	1070.00	206.00	62.00	20.00	0.35	274.00	263.00	4.71	5.12	880.00
	CONW043	8.90	4.50	6.06	27.00	371.00	136.00	70.00	21.00	0.21	157.00	149.00	1.47	1.33	956.00
	CONW044	9.94	4.50	5.11	20.00	443.00	141.00	69.00	16.00	0.25	173.00	144.00	1.69	2.13	748.00
	CONW045	8.59	4.80	6.51	13.00	433.00	153.00	76.00	17.00	0.35	177.00	153.00	1.22	1.93	806.00
	CONW046	17.82	5.30	9.83	29.00	1556.00	257.00	78.00	16.00	0.46	257.00	204.00	3.51	5.65	589.00
	CONW047	15.86	6.00	11.56	24.00	1959.00	294.00	116.00	19.00	0.65	191.00	273.00	2.37	6.70	503.00
	CONW048	10.84	5.20	6.46	13.00	823.00	171.00	89.00	20.00	0.31	159.00	183.00	1.38	2.59	675.00
	CONW049	14.05	4.30	10.76	44.00	588.00	151.00	83.00	26.00	0.26	337.00	55.00	2.17	3.78	952.00
	CONW050	8.11	5.70	16.19	48.00	833.00	139.00	96.00	25.00	0.48	568.00	97.00	3.14	5.97	835.00
	CONW051	11.78	5.30	5.39	12.00	1000.00	177.00	75.00	16.00	0.25	168.00	119.00	2.68	2.51	962.00
	CONW052	11.72	5.10	7.50	22.00	861.00	170.00	54.00	21.00	0.20	191.00	233.00	3.40	7.02	875.00
	CONW053	5.93	4.20	3.99	21.00	200.00	73.00	48.00	11.00	0.27	193.00	62.00	1.29	1.47	887.00

¹Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

Table 7 (continued). Soil nutrient status from vegetation monitoring plots at Congaree National Park. The Mehlich III method was used to obtain volume of exchangeable cations and extractable minor elements within soil samples. Methods to obtain other soil chemistry metrics (e.g., total exchange capacity [TEC], pH, and organic matter content [OM]) can be found at [Brookside Laboratories, Inc](#) (BL 2023).

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ¹	Ca ¹	Mg ¹	K ¹	Na ¹	B ¹	Fe ¹	Mn ¹	Cu ¹	Zn ¹	Al ¹
Coastal Plain Alluvial Wetlands	CONW054	14.33	5.20	7.38	30.00	1165.00	198.00	62.00	24.00	0.26	260.00	73.00	5.06	3.77	830.00
	CONW055	15.78	4.50	7.31	15.00	791.00	184.00	75.00	22.00	0.36	260.00	110.00	2.53	2.67	937.00
	CONW056	11.09	5.30	13.02	36.00	864.00	186.00	142.00	25.00	0.41	478.00	55.00	2.37	3.27	817.00
	CONW057	11.75	5.40	9.49	12.00	1009.00	210.00	76.00	25.00	0.41	168.00	190.00	2.30	1.78	829.00
	CONW058	14.21	4.90	5.81	16.00	963.00	172.00	49.00	18.00	0.30	231.00	139.00	2.87	3.77	713.00
	CONW059	12.62	6.00	8.14	23.00	1661.00	177.00	80.00	13.00	0.45	298.00	167.00	2.98	5.74	501.00
	CONW063	12.59	4.40	6.91	43.00	616.00	119.00	67.00	20.00	0.38	434.00	87.00	3.37	4.27	972.00
	CONW068	18.91	5.10	9.71	14.00	1385.00	290.00	66.00	22.00	0.37	174.00	189.00	4.78	5.18	786.00
	average	13.59	4.97	7.94	24.21	929.50	184.50	71.50	21.25	0.34	270.11	154.61	2.92	3.91	821.52
	standard deviation	3.84	0.53	2.94	13.14	357.25	45.70	24.87	5.03	0.11	122.54	72.05	0.95	1.77	146.39

¹Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

Coastal Plain Upland Open Woodlands

Coastal Plain Upland Open Woodlands of Congaree National Park are located on the park's northern low bluffs that were acquired during boundary expansion in 1988 (Burkholder et al. 2018). These uplands are dominated by a combination of loblolly and longleaf pine, as well as other pines and hardwoods (Landaal et al. 1998). Regionally, this broad category includes open-spaced forests and savannas occurring on low, flat topography and on dry (xeric) to mesic, and occasionally wet (hydric) soils. They are typically maintained by a combination of frequent fire and water availability—which can vary widely among sites depending on soil texture, microtopography, and seasonal precipitation. Soils are typically imperfectly to poorly drained and are usually acidic. Open pine-dominated woodlands in the southeastern United States were once widespread across the Coastal Plain mainland from Virginia to Mississippi, but close to 98% of their original

coverage has been eliminated due to land conversion to agriculture or urban environments, timber management, and fire suppression (Noss et al. 1985; Ware et al. 1993). Former land use history (e.g., timber management, agricultural practices, and fire suppression) on the park's approximately 590 hectares (1,460 acres) of uplands have resulted in extreme shifts in overall biodiversity and ecosystem function within this habitat type. The uplands of Congaree National Park are dominated by dense stands of loblolly pine and sweetgum, although isolated patches of natural longleaf woodlands are present (Figure 8). The park uses a combination of treatment approaches (e.g., fire, mechanical, and chemical) to reduce undesirable woody species (e.g., loblolly pine and sweetgum) and increase native open pine biodiversity, among other park objectives (NPS 2017). Vegetation associations sampled within the park that belong to this habitat type include (descriptions from NatureServe 2023):



Figure 8. Fire-suppressed stands of Coastal Plain Upland Open Woodlands. This habitat type is often dominated by a dense subcanopy of sweetgum (shown). Eight plots within this habitat type were sampled during this monitoring event. NPS photo / SECN staff.

- Southeastern Coastal Plain Ruderal Sweetgum – Oak – Loblolly Pine Forest (CEGL007726; 3 plots): Semi-natural forests that generally develop following the cessation of agriculture, or other land-clearing activities (e.g., clearcutting); the canopy is dominated by a mixture of upland and lowland species, such as sweetgum, loblolly pine, water oak, and willow oak (*Quercus phellos*). (Global Status: No Status Rank; State (SC) Status: No Status Rank)
- Atlantic Coastal Plain Mesic Longleaf Pine / Little Bluestem Woodland (CEGL007738; 1 plot): Woodlands of upland flats on sandy loam soils within the inner Atlantic Coastal Plain; the canopy ranges from open to mostly closed, and is dominated by longleaf pine, or loblolly pine in fire suppressed situations; the herbaceous stratum is typically dominated by little bluestem (*Schizachyrium scoparium*), but a host of other “savanna” species may be present. (Global Status: G1—Critically Imperiled; State (SC) Status: No Status Rank)
- Ruderal Loblolly Pine – Sweetgum Forest (CEGL008462; 4 plots): Semi-natural vegetation on sites recovering from past disturbance events (e.g., agriculture, timber management) strongly co-dominated by loblolly pine and sweetgum; this type is widespread throughout the Atlantic Coastal Plain (Global Status: No Status Rank; State (SC) Status: No Status Rank)

Species Diversity and Abundance

Native species richness ranged from 33 to 71 (mean = 51.0) within vegetation plots of this broadly defined habitat type (Table 3). The single plot with the highest diversity was described as a natural Atlantic Coastal Plain Mesic Longleaf Pine / Little Bluestem Woodland, while the other seven upland plots were described as successional, semi-natural associations. At least one non-native species was present in five of the eight upland plots (Table 3), and the invasive Japanese honeysuckle was present in all five of these plots (Figure 3). Herbaceous species exhibited the highest richness across all scales within this habitat type (Table 3). Native vascular plants observed in these plots are fairly common across the Southeastern Coastal Plain, and there were no state or federally

listed rare plants encountered. Two state-tracked species were observed in this habitat type: Cherokee sedge (*Carex cherokeensis*) and Santee azalea. One hundred seventy-eight vascular plant species were found collectively within these eight plots, and 99 of these were only found in this broadly defined habitat and not in Coastal Plain Alluvial Wetland plot; a complete species list, along with constancy and average cover per species, is located in Appendix B, Table B-1. Species with high constancy in this habitat are listed below by growth form and their frequency of occurrence (%) within Coastal Plain Upland Open Woodland plots are in parentheses.

Trees

- Loblolly pine (100%)
- Sweetgum (100%)
- Willow oak (100%)
- Common persimmon (*Diospyros virginiana*; 88%)

Shrubs

- American beautyberry (*Callicarpa americana*; 63%)
- Southern blueberry (*Vaccinium tenellum*; 63%)

Vines

- Muscadine (100%)
- Roundleaf greenbrier (100%)
- Carolina jessamine (*Gelsemium sempervirens*; 100%)
- Virginia creeper (*Parthenocissus quinquefolia*; 88%)
- Cat greenbrier (*Smilax glauca*; 88%)

Herbs/Forbs/Graminoids

- American burnweed (*Erechtites hieraciifolius*; 88%)
- Slender woodoats (*Chasmanthium laxum*; 75%)
- Variable panicgrass (*Dichanthelium commutatum*; 75%)
- Partridgeberry (*Mitchella repens*; 75%)

Woody Stem Metrics

Total basal area (BA) of trees ranged from 13.7 to 61.2 m²/ha with an overall average of 36.5 m²/ha; density of canopy stems ranged from eight to 30 per plot, with an average of 17.3 (Table 4). Canopy height ranged from 23 to 38 meters (average 32.3), and canopy cover ranged from 40 to 84% (average = 58.3%; Table 4). The most dominant canopy species was loblolly pine (mean BA = 28.48 m²/ha, mean density = 234/ha) (Appendix B, Table B-2). Sapling density at the 80-meter square scale ranged from 0 to 98 stems, with an average of 28.6, while seedling density at the 8-meter square scale ranged from 46 to 200 stems, with an average of 114.9 across all plots (Table 4). Dominant sapling species included American beautyberry, muscadine, and sweetgum; dominant seedlings included southern blueberry, muscadine, loblolly pine, sweetgum, and Carolina jessamine (Appendix B, Table B-2).

Based on stem count (density) alone, loblolly pine comprised over 50% of the relative abundance among species within the tree stratum; sweetgum, the next most dense species within the tree stratum, comprised 19% (Figure 9). The sapling stratum was heavily dominated by native woody vines (e.g., muscadine), American beautyberry, and sweetgum; the seedling stratum was dominated also by native woody vines and blueberries (*Vaccinium* sp.). It should be noted that there were no seedling or sapling sized stems of longleaf pine observed in any of these eight plots.

Most of the measured trees in these monitoring plots were living (90%) and the majority were categorized with healthy vigor and minimal dieback (Figure 10). Most of the dead stems and stems with poor vigor were either loblolly pine or sweetgum, which is not surprising owing to the elevated density of these species within this forest type.

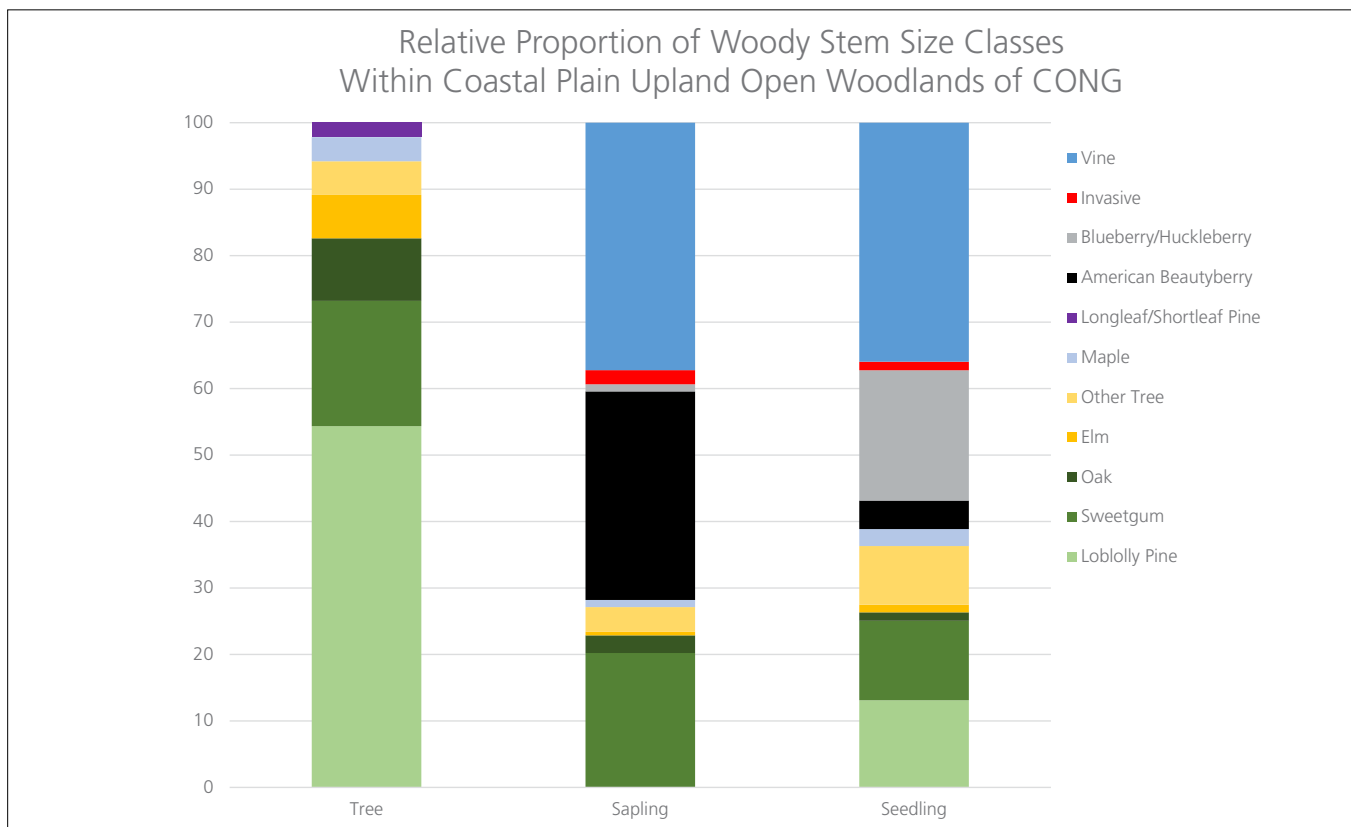


Figure 9. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings— within Coastal Plain Upland Open Woodland monitoring plots of Congaree National Park

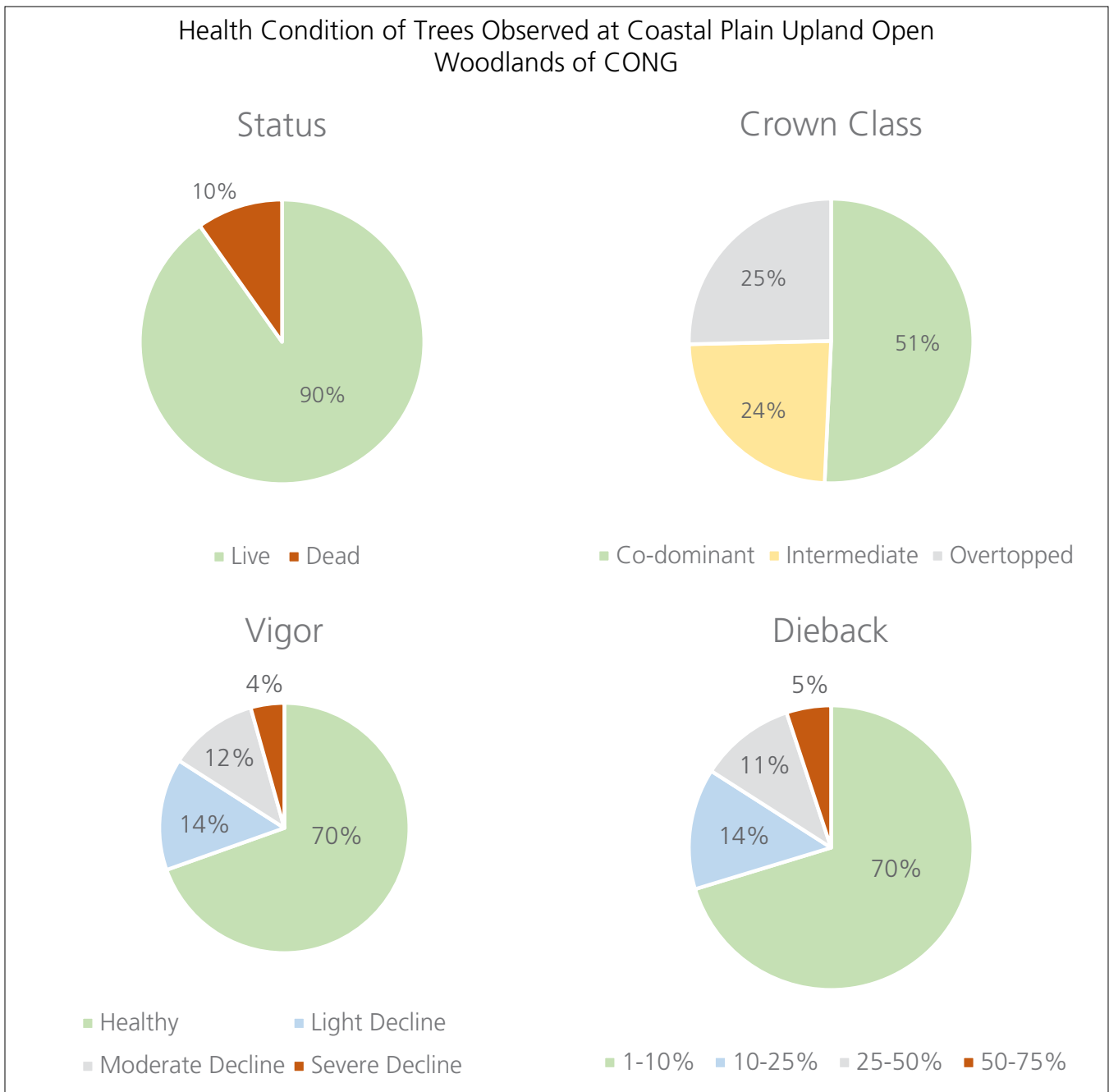


Figure 10. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH ('trees') measured on Coastal Plain Upland Open Woodland monitoring plots of Congaree National Park.

Disturbance and Threats

The most observable threat to this broadly defined habitat within the park is encroachment of mesophytic species of lower mesic slopes and alluvial floodplains (e.g., sweetgum) and increased canopy closure brought on by the high density of fast-growing loblolly pine. Fire exclusion over the past century across the southeastern Coastal Plain has resulted in the conversion of open pine-dominated woodlands that require frequent burning to forests dominated by fire-

intolerant hardwood species (Edwards et al. 2013). Either recent (within the past year) or historic (over a year) fire was observed on five of the eight upland monitoring plots of Congaree National Park (Table 5). As long as treatment intervals are short (< 4 years) and applied across most upland management units, the continued use of fire, and other fire surrogate treatments (e.g., mechanical, herbicide), will improve the overall vegetation condition of this habitat type on the park.

Geomorphology and Soil

Plots located within Coastal Plain Upland Open Woodlands of Congaree National Park occurred on relatively gentle slopes (typically < 3 degrees) and across an array of aspects and slope shapes (Table 6). Plot soils were typically acidic and ranged from 4.0 to 5.0 pH; however, the one upland plot adjacent to the park's Visitor Center (CONU001) did have elevated pH (pH = 6.4; Table 7). Compared to soils from the adjacent floodplain, upland woodland soils of Congaree National Park were lower in exchangeable cations, minor extractable nutrients, and organic matter content (Table 7).

Fuel Load Estimates

Fuel loads ranged from 4.3 to 24.7 (average=12.7) tons/acre in Coastal Plain Upland Open Woodlands of Congaree National Park (Figure 11). There was high variability between fuel loads among vegetation plots within the park's uplands. Variation in fuel loads among sites is typical and related to differences in live and dead vegetation structure, disturbance history, hydrology, and edaphic conditions. Plots that occurred in stands that had recent fire history (< one year) typically had less litter compared to plots with longer fire return intervals.

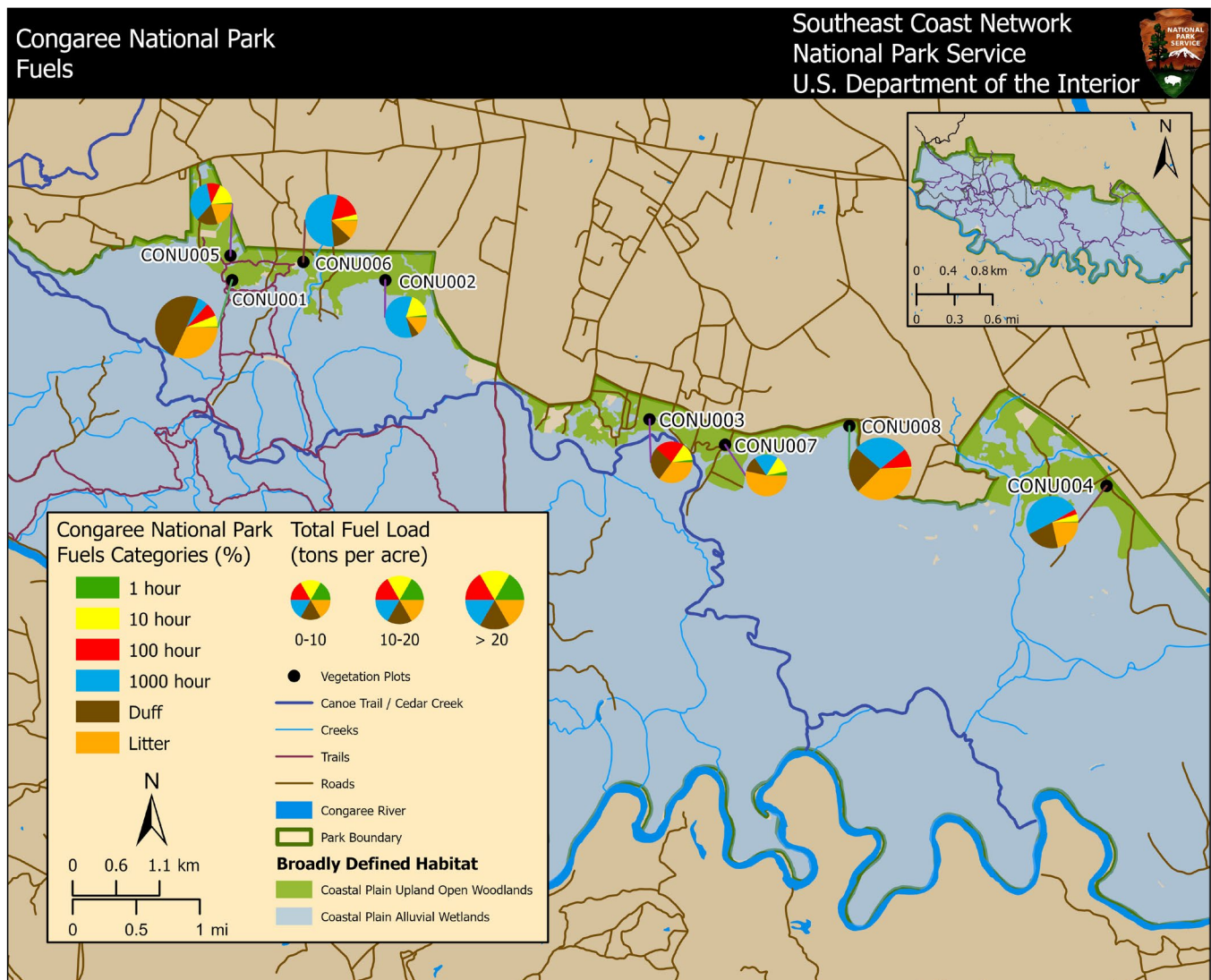


Figure 11. Fuel load estimates from vegetation monitoring plots located at Congaree National Park.

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Appendix A. Vascular Plants Observed During the 2021 Southeast Coast Network Terrestrial Vegetation Monitoring Effort at Congaree National Park

Table A-1. Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Euphorbiales	Euphorbiaceae	<i>Acalypha gracilens</i>	slender threeseed mercury	Native	Forb/herb	–	–
Euphorbiales	Euphorbiaceae	<i>Acalypha rhomboidea</i>	common threeseed mercury	Native	Forb/herb	–	–
Sapindales	Aceraceae	<i>Acer floridanum</i>	southern sugar maple	Native	Tree	–	–
Sapindales	Aceraceae	<i>Acer negundo</i> var. <i>negundo</i>	boxelder	Native	Tree	–	–
Sapindales	Aceraceae	<i>Acer rubrum</i>	red maple	Native	Tree	–	–
Sapindales	Aceraceae	<i>Acer saccharinum</i>	silver maple	Native	Tree	–	–
Asterales	Asteraceae	<i>Ambrosia artemisiifolia</i>	annual ragweed	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Amphicarpaea bracteata</i>	American hogpeanut	Native	Forb/herb, Vine	–	–
Primulales	Primulaceae	<i>Anagallis arvensis</i>	scarlet pimpernel	Non-native	Forb/herb	–	–
Polypodiales	Blechnaceae	<i>Anchistea virginica</i>	Virginia chainfern	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Andropogon gyrans</i>	Elliott's bluestem	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Andropogon virginicus</i>	broomsedge bluestem	Native	Graminoid	–	–
Apiales	Araliaceae	<i>Aralia spinosa</i>	devil's walkingstick	Native	Shrub, Tree	–	–
Arales	Araceae	<i>Arisaema dracontium</i>	green dragon	Native	Forb/herb	–	–
Arales	Araceae	<i>Arisaema triphyllum</i>	Jack in the pulpit	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Arnica acaulis</i>	common leopardbane	Native	Forb/herb	–	–
Rosales	Rosaceae	<i>Aronia arbutifolia</i>	red chokeberry	Native	Shrub,	–	–
Cyperales	Poaceae	<i>Arthraxon hispidus</i> var. <i>hispidus</i>	small carpetgrass	Non-native	Graminoid	–	–
Cyperales	Poaceae	<i>Arundinaria tecta</i>	switchcane	Native	Subshrub, Graminoid, Shrub	–	–
Gentianales	Asclepiadaceae	<i>Asclepias perennis</i>	aquatic milkweed	Native	Forb/herb	–	–
Magnoliales	Annonaceae	<i>Asimina parviflora</i>	smallflower pawpaw	Native	Shrub, Tree	–	–
Magnoliales	Annonaceae	<i>Asimina triloba</i>	pawpaw	Native	Shrub, Tree	–	–
Polypodiales	Aspleniaceae	<i>Asplenium platyneuron</i>	ebony spleenwort	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Asteraceae</i>	Composite Family	Unknown	Forb/herb	–	–
Polypodiales	Dryopteridaceae	<i>Athyrium asplenioides</i>	asplenium ladyfern	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Baccharis halimifolia</i>	eastern baccharis	Native	Tree, Shrub	–	–
Rhamnales	Rhamnaceae	<i>Berchemia scandens</i>	Alabama supplejack	Native	Vine	–	–
Asterales	Asteraceae	<i>Bidens discoidea</i>	small beggarticks	Native	Forb/herb	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Scrophulariales	Bignoniaceae	<i>Bignonia capreolata</i>	crossvine	Native	Vine	–	–
Urticales	Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle	Native	Forb/herb	–	–
Lamiales	Verbenaceae	<i>Callicarpa americana</i>	American beautyberry	Native	Shrub	–	–
Scrophulariales	Bignoniaceae	<i>Campsis radicans</i>	trumpet creeper	Native	Vine	–	–
Cyperales	Cyperaceae	<i>Carex</i>	sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex abscondita</i>	thicket sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex albicans</i>	whitetinge sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex amphibola</i>	eastern narrowleaf sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex annectens</i>	yellowfruit sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex blanda</i>	eastern woodland sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex bromoides</i> ssp. <i>bromoides</i>	brome-like sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex caroliniana</i>	Carolina sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex cherokeensis</i>	Cherokee sedge	Native	Graminoid	–	S3
Cyperales	Cyperaceae	<i>Carex complanata</i>	hirsute sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex corrugata</i>	prune-fruit sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex crebriflora</i>	coastal plain sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex crus-corvi</i>	ravenfoot sedge	Native	Graminoid	–	S3
Cyperales	Cyperaceae	<i>Carex debilis</i>	white edge sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex flaccosperma</i>	thinfuit sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex gigantea</i>	giant sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex grayi</i>	Gray's sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex intumescens</i> var. <i>intumescens</i>	greater bladder sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex leptalea</i> var. <i>harperi</i>	Harper's sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex lonchocarpa</i>	southern long sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex louisianica</i>	Louisiana sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex lurida</i>	shallow sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex radiata</i>	eastern star sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex rosea</i>	rosy sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex scoparia</i>	broom sedge	Native	Graminoid	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Cyperales	Cyperaceae	<i>Carex socialis</i>	low woodland sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex tribuloides</i>	blunt broom sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex typhina</i>	cattail sedge	Native	Graminoid	–	–
Fagales	Betulaceae	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	American hornbeam	Native	Tree, Shrub	–	–
Juglandales	Juglandaceae	<i>Carya aquatica</i>	water hickory	Native	Tree	–	–
Juglandales	Juglandaceae	<i>Carya cordiformis</i>	bitternut hickory	Native	Tree	–	–
Juglandales	Juglandaceae	<i>Carya glabra</i>	pignut hickory	Native	Tree	–	–
Juglandales	Juglandaceae	<i>Carya tomentosa</i>	mockernut hickory	Native	Tree	–	–
Urticales	Ulmaceae	<i>Celtis laevigata</i>	sugarberry	Native	Tree, Shrub	–	–
Fabales	Fabaceae	<i>Centrosema virginianum</i>	spurred butterfly pea	Native	Vine, Forb/herb	–	–
Rubiales	Rubiaceae	<i>Cephalanthus occidentalis</i>	common buttonbush	Native	Shrub, Tree	–	–
Fabales	Fabaceae	<i>Chamaecrista nictitans</i>	sensitive partridge pea	Native	Subshrub, Forb/herb	–	–
Cyperales	Poaceae	<i>Chasmanthium latifolium</i>	Indian woodoats	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Chasmanthium laxum</i>	slender woodoats	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Chasmanthium sessiliflorum</i> var. <i>sessiliflorum</i>	longleaf woodoats	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Chrysogonum virginianum</i> var. <i>brevistolon</i>	green and gold	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Cirsium nuttallii</i>	coastal tall thistle	Native	Forb/herb	–	–
Ranunculales	Ranunculaceae	<i>Clematis terniflora</i>	sweet autumn virginsbower	Non-native	Vine	Significant Threat	–
Cyperales	Poaceae	<i>Coleataenia anceps</i> ssp. <i>anceps</i>	beaked panicgrass	Native	Graminoid	–	–
Rosales	Rosaceae	<i>Crataegus</i>	hawthorn	Native	Tree	–	–
Rosales	Rosaceae	<i>Crataegus marshallii</i>	parsley hawthorn	Native	Tree, Shrub	–	–
Rosales	Rosaceae	<i>Crataegus viridis</i>	green hawthorn	Native	Shrub, Tree	–	–
Cyperales	Cyperaceae	<i>Cyperus</i>	flatsedge	Unknown	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus croceus</i>	Baldwin's flatsedge	Native	Graminoid	–	–
Ericales	Cyrillaceae	<i>Cyrilla racemiflora</i>	swamp titi	Native	Tree, Shrub	–	–
Cyperales	Poaceae	<i>Danthonia sericea</i>	downy danthonia	Native	Graminoid	–	–

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Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Fabales	Fabaceae	<i>Desmodium canescens</i>	hoary ticktrefoil	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Desmodium fernaldii</i>	Fernald's ticktrefoil	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Desmodium lineatum</i>	sand ticktrefoil	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Desmodium paniculatum</i>	panickedleaf ticktrefoil	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Desmodium rotundifolium</i>	prostrate ticktrefoil	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Desmodium tenuifolium</i>	slimleaf ticktrefoil	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Dichanthelium aciculare</i>	needleleaf rosette grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium acuminatum</i>	tapered rosette grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium angustifolium</i>	blood panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium commutatum</i>	variable panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium consanguineum</i>	Kunth's witchgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium dichotomum</i>	cypress panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium laxiflorum</i>	openflower rosette grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium sphaerocarpon</i>	roundseed panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium tenue</i>	cypress panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium villosissimum</i> var. <i>villosissimum</i>	whitehair rosette grass	Native	Graminoid	–	–
Solanales	Convolvulaceae	<i>Dichondra carolinensis</i>	Carolina ponysfoot	Native	Forb/herb	–	–
Scrophulariales	Acanthaceae	<i>Dicliptera brachiata</i>	branched foldwing	Native	Forb/herb	–	–
Liliales	Dioscoreaceae	<i>Dioscorea villosa</i>	wild yam	Native	Forb/herb, Vine	–	–
Ebenales	Ebenaceae	<i>Diospyros virginiana</i>	common persimmon	Native	Tree	–	–
Lamiales	Boraginaceae	<i>Echium vulgare</i>	common viper's bugloss	Non-native	Forb/herb	–	–
Asterales	Asteraceae	<i>Elephantopus carolinianus</i>	Carolina elephantsfoot	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Elephantopus nudatus</i>	smooth elephantsfoot	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Elephantopus tomentosus</i>	devil's grandmother	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Elymus glabriflorus</i> var. <i>glabriflorus</i>	southeastern wildrye	Native	Graminoid	–	–
Aristolochiales	Aristolochiaceae	<i>Endodeca serpentaria</i>	Virginia snakeroot	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Erechtites hieraciifolius</i>	American burnweed	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Erianthus alopecuroides</i>	silver plumegrass	Native	Graminoid	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Cyperales	Poaceae	<i>Erianthus giganteus</i>	sugarcane plumegrass	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Erigeron canadensis</i>	Canadian horseweed	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Erigeron strigosus</i> var. <i>strigosus</i>	prairie fleabane	Native	Forb/herb	–	–
Celastrales	Celastraceae	<i>Euonymus americanus</i>	bursting-heart	Native	Forb/herb, Subshrub	–	–
Asterales	Asteraceae	<i>Eupatorium capillifolium</i>	dogfennel	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium compositifolium</i>	yankeeweed	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium hyssopifolium</i>	hyssopleaf thoroughwort	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium rotundifolium</i>	roundleaf thoroughwort	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium serotinum</i>	lateflowering thoroughwort	Native	Forb/herb	–	–
Scrophulariales	Oleaceae	<i>Fraxinus pennsylvanica</i>	green ash	Native	Tree	–	–
Fabales	Fabaceae	<i>Galactia volubilis</i>	downy milkpea	Native	Vine, Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium aparine</i>	stickywilly	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium circaeans</i>	licorice bedstraw	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium obtusum</i>	bluntleaf bedstraw	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium pilosum</i>	hairy bedstraw	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium tinctorium</i> var. <i>floridanum</i>	stiff marsh bedstraw	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium triflorum</i>	fragrant bedstraw	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Gamochaeta purpurea</i>	spoonleaf purple everlasting	Native	Forb/herb	–	–
Ericales	Ericaceae	<i>Gaylussacia dumosa</i>	dwarf huckleberry	Native	Shrub, Subshrub	–	–
Gentianales	Loganiaceae	<i>Gelsemium sempervirens</i>	evening trumpetflower	Native	Vine, Shrub	–	–
Gentianales	Gentianaceae	<i>Gentiana villosa</i>	striped gentian	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Glyceria striata</i> var. <i>striata</i>	fowl mannagrass	Native	Graminoid	–	–
Gentianales	Asclepiadaceae	<i>Gonolobus suberosus</i> var. <i>suberosus</i>	angularfruit milkvine	Native	Forb/herb, Vine	–	–
Scrophulariales	Scrophulariaceae	<i>Gratiola virginiana</i>	roundfruit hedgehyssop	Native	Forb/herb	–	–
Apiales	Apiaceae	<i>Hydrocotyle verticillata</i>	whorled marshpennywort	Native	Forb/herb	–	–
Theales	Clusiaceae	<i>Hypericum crux-andreae</i>	St. Peterswort	Native	Subshrub, Shrub	–	–
Theales	Clusiaceae	<i>Hypericum hypericoides</i>	St. Andrew's cross	Native	Subshrub, Shrub	–	–
Theales	Clusiaceae	<i>Hypericum mutilum</i>	dwarf St. Johnswort	Native	Forb/herb	–	–
Theales	Clusiaceae	<i>Hypericum punctatum</i>	spotted St. Johnswort	Native	Forb/herb	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Theales	Clusiaceae	<i>Hypericum setosum</i>	hairy St. Johnswort	Native	Forb/herb	–	–
Theales	Clusiaceae	<i>Hypericum stragulum</i>	St. Andrew's cross	Native	Shrub, Subshrub	–	–
Liliales	Liliaceae	<i>Hypoxis hirsuta</i>	common goldstar	Native	Forb/herb	–	–
Celastrales	Aquifoliaceae	<i>Ilex ambigua</i>	Carolina holly	Native	Shrub, Tree	–	–
Celastrales	Aquifoliaceae	<i>Ilex decidua</i>	possumhaw	Native	Tree, Shrub	–	–
Celastrales	Aquifoliaceae	<i>Ilex opaca</i>	American holly	Native	Tree, Shrub	–	–
Geraniales	Balsaminaceae	<i>Impatiens capensis</i>	jewelweed	Native	Forb/herb	–	–
Solanales	Convolvulaceae	<i>Ipomoea lacunosa</i>	whitestar	Native	Forb/herb, Vine	–	–
Solanales	Convolvulaceae	<i>Ipomoea pandurata</i>	man of the earth	Native	Forb/herb, Vine	–	–
Rosales	Grossulariaceae	<i>Itea virginica</i>	Virginia sweetspire	Native	Shrub	–	–
Juncales	Juncaceae	<i>Juncus bufonius</i>	toad rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus coriaceus</i>	leathery rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus dichotomus</i>	forked rush	Native	Graminoid	–	–
Scrophulariales	Acanthaceae	<i>Justicia ovata</i>	looseflower water-willow	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Krigia virginica</i>	Virginia dwarfdandelion	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Lactuca graminifolia</i> var. <i>graminifolia</i>	grassleaf lettuce	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Leersia virginica</i>	whitegrass	Native	Graminoid	–	–
Fabales	Fabaceae	<i>Lespedeza capitata</i>	roundhead lespedeza	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Lespedeza hirta</i> var. <i>curtissii</i>	Curtiss' lespedeza	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Lespedeza violacea</i>	violet lespedeza	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Lespedeza virginica</i>	slender lespedeza	Native	Forb/herb	–	–
Scrophulariales	Oleaceae	<i>Ligustrum sinense</i>	Chinese privet	Non-native	Tree, Shrub	Severe Threat	–
Laurales	Lauraceae	<i>Lindera benzoin</i>	northern spicebush	Native	Tree, Shrub	–	–
Hamamelidales	Hamamelidaceae	<i>Liquidambar styraciflua</i>	sweetgum	Native	Tree	–	–
Campanulales	Campanulaceae	<i>Lobelia cardinalis</i>	cardinalflower	Native	Forb/herb	–	–
Campanulales	Campanulaceae	<i>Lobelia elongata</i>	longleaf lobelia	Native	Forb/herb	–	–
Dipsacales	Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle	Non-native	Vine	Severe Threat	–
Myrtales	Onagraceae	<i>Ludwigia alternifolia</i>	seedbox	Native	Forb/herb	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Lamiales	Lamiaceae	<i>Lycopus rubellus</i>	taperleaf water horehound	Native	Forb/herb	–	–
Polypodiales	Lygodiaceae	<i>Lygodium japonicum</i>	Japanese climbing fern	Non-native	Forb/herb, Vine	Severe Threat	–
Magnoliales	Magnoliaceae	<i>Magnolia virginiana</i>	sweetbay	Native	Tree, Shrub	–	–
Rosales	Rosaceae	<i>Malus angustifolia</i>	southern crab apple	Native	Tree, Shrub	–	–
Cyperales	Poaceae	<i>Melica mutica</i>	twoflower melicgrass	Native	Graminoid	–	–
Ranunculales	Menispermaceae	<i>Menispermum canadense</i>	common moonseed	Native	Vine	–	S3?
Cyperales	Poaceae	<i>Microstegium vimineum</i>	Nepalese browntop	Non-native	Graminoid	Severe Threat	–
Asterales	Asteraceae	<i>Mikania scandens</i>	climbing hempvine	Native	Vine, Forb/herb	–	–
Fabales	Fabaceae	<i>Mimosa microphylla</i>	littleleaf sensitive-briar	Native	Vine, Forb/herb	–	–
Scrophulariales	Scrophulariaceae	<i>Mimulus alatus</i>	sharpwing monkeyflower	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Mitchella repens</i>	partridgeberry	Native	Subshrub, Forb/herb	–	–
Gentianales	Loganiaceae	<i>Mitreola petiolata</i>	lax hornpod	Native	Forb/herb	–	–
Myricales	Myricaceae	<i>Morella cerifera</i>	wax myrtle	Native	Tree, Subshrub, Shrub	–	–
Urticales	Moraceae	<i>Morus rubra</i>	red mulberry	Native	Tree	–	–
Commelinales	Commelinaceae	<i>Murdannia keisak</i>	wartremoving herb	Non-native	Forb/herb	Severe Threat	–
Rhamnales	Vitaceae	<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	muscadine	Native	Vine	–	–
Rhamnales	Vitaceae	<i>Nekemias arborea</i>	peppervine	Native	Shrub, Vine	–	–
Cornales	Cornaceae	<i>Nyssa aquatica</i>	water tupelo	Native	Tree	–	–
Cornales	Cornaceae	<i>Nyssa biflora</i>	swamp tupelo	Native	Tree	–	–
Cornales	Cornaceae	<i>Nyssa sylvatica</i>	blackgum	Native	Tree	–	–
Polypodiales	Dryopteridaceae	<i>Onoclea sensibilis</i>	sensitive fern	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Oplismenus setarius</i>	basketgrass	Native	Graminoid	–	–
Polypodiales	Osmundaceae	<i>Osmunda spectabilis</i>	royal fern	Native	Forb/herb	–	–
Polypodiales	Osmundaceae	<i>Osmundastrum cinnamomeum</i>	cinnamon fern	Native	Forb/herb	–	–
Geraniales	Oxalidaceae	<i>Oxalis stricta</i>	common yellow oxalis	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Packera glabella</i>	butterweed	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Panicum virgatum</i>	switchgrass	Native	Graminoid	–	–
Rhamnales	Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper	Native	Vine	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Polygonales	Polygonaceae	<i>Persicaria hydropiperoides</i>	swamp smartweed	Native	Forb/herb	–	–
Urticales	Urticaceae	<i>Pilea pumila</i>	Canadian clearweed	Native	Forb/herb	–	–
Pinales	Pinaceae	<i>Pinus echinata</i>	shortleaf pine	Native	Tree	–	–
Pinales	Pinaceae	<i>Pinus palustris</i>	longleaf pine	Native	Tree	–	–
Pinales	Pinaceae	<i>Pinus taeda</i>	loblolly pine	Native	Tree	–	–
Cyperales	Poaceae	<i>Piptochaetium avenaceum</i>	blackseed speargrass	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Pityopsis graminifolia</i>	narrowleaf silkgrass	Native	Forb/herb	–	–
Urticales	Ulmaceae	<i>Planera aquatica</i>	planertree	Native	Tree	–	–
Orchidales	Orchidaceae	<i>Platanthera</i>	fringed orchid	Native	Forb/herb	–	–
Hamamelidales	Platanaceae	<i>Platanus occidentalis</i>	American sycamore	Native	Tree	–	–
Polypodiales	Polypodiaceae	<i>Pleopeltis michauxiana</i>	resurrection fern	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Pluchea camphorata</i>	camphor pluchea	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Poa autumnalis</i>	autumn bluegrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Poaceae</i>	Grass Family	Unknown	Graminoid	–	–
Caryophyllales	Caryophyllaceae	<i>Polycarpon tetraphyllum</i> ssp. <i>tetraphyllum</i>	fourleaf manyseed	Non-native	Forb/herb	–	–
Salicales	Salicaceae	<i>Populus deltoides</i> ssp. <i>deltoides</i>	eastern cottonwood	Native	Tree	–	–
Rosales	Rosaceae	<i>Potentilla indica</i>	Indian strawberry	Non-native	Forb/herb	–	–
Rosales	Rosaceae	<i>Prunus caroliniana</i>	Carolina laurelcherry	Native	Tree, Shrub	–	–
Rosales	Rosaceae	<i>Prunus serotina</i> var. <i>serotina</i>	black cherry	Native	Shrub, Tree	–	–
Apiales	Apiaceae	<i>Ptilimnium capillaceum</i>	herbwilliam	Native	Forb/herb	–	–
Fagales	Fagaceae	<i>Quercus alba</i>	white oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus laurifolia</i>	laurel oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus lyrata</i>	overcup oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus michauxii</i>	swamp chestnut oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus nigra</i>	water oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus pagoda</i>	cherrybark oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus phellos</i>	willow oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus stellata</i>	post oak	Native	Tree	–	–

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Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Fagales	Fagaceae	<i>Quercus velutina</i>	black oak	Native	Tree	–	–
Ranunculales	Ranunculaceae	<i>Ranunculus recurvatus</i> var. <i>recurvatus</i>	blisterwort	Native	Forb/herb	–	–
Ericales	Ericaceae	<i>Rhododendron canescens</i>	mountain azalea	Native	Shrub	–	–
Ericales	Ericaceae	<i>Rhododendron eastmanii</i>	Santee azalea	Native	Shrub	–	S2
Sapindales	Anacardiaceae	<i>Rhus copallinum</i> var. <i>copallinum</i>	winged sumac	Native	Shrub, Tree	–	–
Fabales	Fabaceae	<i>Rhynchosia difformis</i>	doubleform snoutbean	Native	Forb/herb, Vine	–	–
Cyperales	Cyperaceae	<i>Rhynchospora globularis</i>	globe beaksedge	Native	Graminoid	–	–
Rosales	Rosaceae	<i>Rubus pensilvanicus</i>	sawtooth blackberry	Native	Subshrub	–	–
Rosales	Rosaceae	<i>Rubus trivialis</i>	southern dewberry	Native	Subshrub, Vine	–	–
Scrophulariales	Acanthaceae	<i>Ruellia caroliniensis</i>	Carolina wild petunia	Native	Forb/herb	–	–
Arecales	Arecaceae	<i>Sabal minor</i>	dwarf palmetto	Native	Shrub, Tree	–	–
Gentianales	Gentianaceae	<i>Sabatia calycina</i>	coastal rose gentian	Native	Forb/herb	–	–
Primulales	Primulaceae	<i>Samolus parviflorus</i>	seaside brookweed	Native	Forb/herb	–	–
Apiales	Apiaceae	<i>Sanicula canadensis</i>	Canadian blacksnakeroot	Native	Forb/herb	–	–
Piperales	Saururaceae	<i>Saururus cernuus</i>	lizard's tail	Native	Forb/herb	–	–
Ophioglossales	Ophioglossaceae	<i>Sceptridium bitermum</i>	sparselobe grapefern	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	little bluestem	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Scleria</i>	nutrush	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Scleria ciliata</i>	fringed nutrush	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Scleria minor</i>	slender nutrush	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Scleria oligantha</i>	littlehead nutrush	Native	Graminoid	–	–
Lamiales	Lamiaceae	<i>Scutellaria integrifolia</i>	helmet flower	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Sericocarpus asteroides</i>	toothed whitetop aster	Native	Forb/herb	–	–
Ebenales	Sapotaceae	<i>Sideroxylon lycioides</i>	buckthorn bully	Native	Tree, Shrub	–	–
Liliales	Iridaceae	<i>Sisyrinchium angustifolium</i>	narrowleaf blue-eyed grass	Native	Forb/herb	–	–
Liliales	Smilacaceae	<i>Smilax bona-nox</i> var. <i>bona-nox</i>	saw greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax glauca</i>	cat greenbrier	Native	Shrub, Vine	–	–

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Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Liliales	Smilacaceae	<i>Smilax hispida</i>	bristly greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax hugeri</i>	Huger's carrionflower	Native	Forb/herb, Vine	–	–
Liliales	Smilacaceae	<i>Smilax laurifolia</i>	laurel greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax rotundifolia</i>	roundleaf greenbrier	Native	Vine, Shrub	–	–
Liliales	Smilacaceae	<i>Smilax walteri</i>	coral greenbrier	Native	Shrub, Vine	–	–
Solanales	Solanaceae	<i>Solanum carolinense</i> var. <i>carolinense</i>	Carolina horsenettle	Native	Forb/herb, Subshrub	–	–
Solanales	Solanaceae	<i>Solanum emulans</i>	West Indian nightshade	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago</i>	goldenrod	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago leavenworthii</i>	Leavenworth's goldenrod	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago rugosa</i> var. <i>aspera</i>	wrinkleleaf goldenrod	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago tortifolia</i>	twistleaf goldenrod	Native	Forb/herb	–	–
Orchidales	Orchidaceae	<i>Spiranthes odorata</i>	marsh lady's tresses	Native	Forb/herb	–	–
Primulales	Primulaceae	<i>Steironema lanceolatum</i>	lanceleaf loosestrife	Native	Forb/herb	–	–
Caryophyllales	Caryophyllaceae	<i>Stellaria media</i>	common chickweed	Non-native	Forb/herb	–	–
Ebenales	Styracaceae	<i>Styrax americanus</i> var. <i>pulverulentus</i>	American snowbell	Native	Shrub, Tree	–	–
Cornales	Cornaceae	<i>Swida foemina</i>	stiff dogwood	Native	Tree, Shrub	–	–
Asterales	Asteraceae	<i>Symphyotrichum lanceolatum</i> var. <i>latifolium</i>	white panicle aster	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Symphyotrichum pilosum</i> var. <i>pilosum</i>	hairy white oldfield aster	Native	Forb/herb	–	–
Pinales	Cupressaceae	<i>Taxodium distichum</i>	bald cypress	Native	Tree	–	–
Polypodiales	Thelypteridaceae	<i>Thelypteris palustris</i> var. <i>pubescens</i>	eastern marsh fern	Native	Forb/herb	–	–
Gentianales	Apocynaceae	<i>Thyrsanthella difformis</i>	climbing dogbane	Native	Vine	–	–
Malvales	Tiliaceae	<i>Tilia americana</i> var. <i>heterophylla</i>	American basswood	Native	Tree	–	–
Bromeliales	Bromeliaceae	<i>Tillandsia usneoides</i>	Spanish moss	Native	Vine, Forb/herb	–	–
Sapindales	Anacardiaceae	<i>Toxicodendron radicans</i> var. <i>radicans</i>	eastern poison ivy	Native	Forb/herb, Shrub, Subshrub, Vine	–	–
Theales	Clusiaceae	<i>Triadenum virginicum</i>	Virginia marsh St. Johnswort	Native	Forb/herb	–	–
Urticales	Ulmaceae	<i>Ulmus alata</i>	winged elm	Native	Tree	–	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Table A-1 (continued). Vascular plant species present in 64 vegetation monitoring plots within Congaree National Park, May–August 2021.

Order ¹	Family ¹	Scientific Name	Common Name ¹	Native Status ¹	Growth Form ¹	State Invasive Status ²	South Carolina Rare-Protected Status ³
Urticales	Ulmaceae	<i>Ulmus americana</i> var. <i>americana</i>	American elm	Native	Tree	–	–
Urticales	Ulmaceae	<i>Ulmus rubra</i>	Slippery elm	Native	Tree	–	–
Urticales	Urticaceae	<i>Urtica chamaedryoides</i>	heartleaf nettle	Native	Forb/herb	–	S2
Ericales	Ericaceae	<i>Vaccinium arboreum</i>	farkleberry	Native	Tree, Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium elliotii</i>	Elliott's blueberry	Native	Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium formosum</i>	southern blueberry	Native	Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium fuscatum</i>	black highbush blueberry	Native	Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium stamineum</i>	deerberry	Native	Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium tenellum</i>	small black blueberry	Native	Subshrub, Shrub	–	–
Asterales	Asteraceae	<i>Vernonia acaulis</i>	stemless ironweed	Native	Forb/herb	–	–
Dipsacales	Caprifoliaceae	<i>Viburnum nudum</i>	possumhaw	Native	Shrub, Tree	–	–
Dipsacales	Caprifoliaceae	<i>Viburnum obovatum</i>	small-leaf arrowwood	Native	Shrub, Tree	–	–
Violales	Violaceae	<i>Viola</i>	violet	Native	Forb/herb	–	–
Violales	Violaceae	<i>Viola palmata</i>	three-lobed violet	Native	Forb/herb	–	–
Rhamnales	Vitaceae	<i>Vitis aestivalis</i> var. <i>aestivalis</i>	summer grape	Native	Vine	–	–
Rhamnales	Vitaceae	<i>Vitis baileyana</i>	graybark grape	Native	Vine	–	–
Rhamnales	Vitaceae	<i>Vitis labrusca</i>	fox grape	Native	Vine	–	–
Fabales	Fabaceae	<i>Wisteria sinensis</i>	Chinese wisteria	Non-native	Vine	Severe Threat	–

¹ Information obtained from the PLANTS database (USDA 2023a)² Information obtained from the South Carolina Exotic Pest Plant Council (SCEPPC 2014)³ Information obtained from the South Carolina Natural Heritage Program (SCNHP 2023)

Appendix B. Species Diversity, Abundance, and Woody Stem Metrics Summarized by Broadly Defined Habitats at Congaree National Park

Table B-1. Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Acalypha gracilens</i>	2	2	0	–
<i>Acalypha rhomboidea</i>	4	2	38	2
<i>Acer floridanum</i>	2	4	0	–
<i>Acer negundo</i> var. <i>negundo</i>	54	6	0	–
<i>Acer rubrum</i>	91	6	75	5
<i>Acer saccharinum</i>	4	2	0	–
<i>Ambrosia artemisiifolia</i>	2	2	0	–
<i>Amphicarpaea bracteata</i>	2	3	13	1
<i>Anagallis arvensis</i>	2	1	0	–
<i>Anchistea virginica</i>	9	1	0	–
<i>Andropogon gyrans</i>	0	–	13	1
<i>Andropogon virginicus</i>	0	–	38	2
<i>Aralia spinosa</i>	0	–	25	4
<i>Arisaema dracontium</i>	7	2	0	–
<i>Arisaema triphyllum</i>	2	1	0	–
<i>Arnica acaulis</i>	0	–	13	1
<i>Aronia arbutifolia</i>	0	–	13	2
<i>Arthraxon hispidus</i> var. <i>hispidus</i>	4	1	0	–
<i>Arundinaria tecta</i>	64	5	13	2
<i>Asclepias perennis</i>	5	2	0	–
<i>Asimina parviflora</i>	0	–	13	2
<i>Asimina triloba</i>	73	6	0	–
<i>Asplenium platyneuron</i>	2	1	13	2
Asteraceae	14	2	25	1
<i>Athyrium asplenoides</i>	9	2	0	–
<i>Baccharis halimifolia</i>	2	1	0	–
<i>Berchemia scandens</i>	11	2	0	–
<i>Bidens discoidea</i>	2	1	0	–
<i>Bignonia capreolata</i>	79	2	13	2
<i>Boehmeria cylindrica</i>	86	2	13	1
<i>Callicarpa americana</i>	0	–	63	6
<i>Campsis radicans</i>	64	3	25	2
<i>Carex</i>	2	2	0	–
<i>Carex abscondita</i>	34	3	13	4
<i>Carex albicans</i>	0	–	13	2
<i>Carex amphibola</i>	32	2	13	2
<i>Carex annectens</i>	0	–	13	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Carex blanda</i>	5	2	0	–
<i>Carex bromoides</i> ssp. <i>bromoides</i>	7	4	0	–
<i>Carex caroliniana</i>	2	1	0	–
<i>Carex cherokeensis</i>	2	1	13	2
<i>Carex complanata</i>	0	–	50	2
<i>Carex corrugata</i>	46	3	0	–
<i>Carex crebriflora</i>	14	2	0	–
<i>Carex crus-corvi</i>	14	2	0	–
<i>Carex debilis</i>	11	2	13	2
<i>Carex flaccosperma</i>	4	2	0	–
<i>Carex gigantea</i>	2	2	0	–
<i>Carex grayi</i>	39	3	0	–
<i>Carex intumescens</i> var. <i>intumescens</i>	13	3	13	1
<i>Carex leptalea</i> var. <i>harperi</i>	2	2	0	–
<i>Carex lonchocarpa</i>	2	2	0	–
<i>Carex louisianica</i>	66	4	13	2
<i>Carex lurida</i>	2	1	0	–
<i>Carex radiata</i>	68	4	0	–
<i>Carex rosea</i>	9	2	13	2
<i>Carex scoparia</i>	4	3	13	1
<i>Carex socialis</i>	2	1	0	–
<i>Carex tribuloides</i>	39	2	0	–
<i>Carex typhina</i>	9	2	0	–
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	66	6	38	4
<i>Carya aquatica</i>	20	4	0	–
<i>Carya cordiformis</i>	5	5	0	–
<i>Carya glabra</i>	7	5	0	–
<i>Carya tomentosa</i>	2	6	0	–
<i>Celtis laevigata</i>	79	6	13	2
<i>Centrosema virginianum</i>	0	–	25	2
<i>Cephalanthus occidentalis</i>	5	2	0	–
<i>Chamaecrista nictitans</i>	0	–	25	2
<i>Chasmanthium latifolium</i>	16	3	0	–
<i>Chasmanthium laxum</i>	11	2	75	5
<i>Chasmanthium sessiliflorum</i> var. <i>sessiliflorum</i>	0	–	63	5
<i>Chrysogonum virginianum</i> var. <i>brevistolon</i>	0	–	13	2
<i>Cirsium nuttallii</i>	4	1	0	–
<i>Clematis terniflora</i>	2	1	0	–
<i>Coleataenia anceps</i> ssp. <i>anceps</i>	4	2	25	2
<i>Crataegus</i>	38	3	0	–
<i>Crataegus marshallii</i>	0	–	25	5

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Crataegus viridis</i>	2	3	0	–
<i>Cyperus</i>	0	–	13	1
<i>Cyperus croceus</i>	0	–	13	1
<i>Cyrilla racemiflora</i>	2	2	13	1
<i>Danthonia sericea</i>	0	–	13	1
<i>Desmodium canescens</i>	0	–	13	2
<i>Desmodium fernaldii</i>	0	–	13	2
<i>Desmodium lineatum</i>	0	–	13	2
<i>Desmodium paniculatum</i>	0	–	38	2
<i>Desmodium rotundifolium</i>	0	–	50	2
<i>Desmodium tenuifolium</i>	0	–	50	2
<i>Dichanthelium aciculare</i>	0	–	13	2
<i>Dichanthelium acuminatum</i>	0	–	13	2
<i>Dichanthelium angustifolium</i>	0	–	25	2
<i>Dichanthelium commutatum</i>	34	2	75	2
<i>Dichanthelium consanguineum</i>	0	–	13	2
<i>Dichanthelium dichotomum</i>	5	2	38	2
<i>Dichanthelium laxiflorum</i>	2	2	63	3
<i>Dichanthelium sphaerocarpon</i>	0	–	25	4
<i>Dichanthelium tenue</i>	2	2	0	–
<i>Dichanthelium villosissimum</i> var. <i>villosissimum</i>	0	–	13	1
<i>Dichondra carolinensis</i>	0	–	13	2
<i>Dicliptera brachiata</i>	2	1	0	–
<i>Dioscorea villosa</i>	2	2	0	–
<i>Diospyros virginiana</i>	13	2	88	2
<i>Echium vulgare</i>	2	2	0	–
<i>Elephantopus carolinianus</i>	4	2	0	–
<i>Elephantopus nudatus</i>	0	–	13	2
<i>Elephantopus tomentosus</i>	0	–	38	2
<i>Elymus glaberrimus</i> var. <i>glaberrimus</i>	9	2	0	–
<i>Endodeca serpentaria</i>	5	2	0	–
<i>Erechtites hieracifolius</i>	21	2	88	2
<i>Erianthus alopecuroides</i>	0	–	13	2
<i>Erianthus giganteus</i>	0	–	13	2
<i>Erigeron canadensis</i>	0	–	13	1
<i>Erigeron strigosus</i> var. <i>strigosus</i>	14	2	0	–
<i>Euonymus americanus</i>	7	2	13	1
<i>Eupatorium capillifolium</i>	5	1	38	1
<i>Eupatorium compositifolium</i>	0	–	25	1
<i>Eupatorium hyssopifolium</i>	0	–	13	1
<i>Eupatorium rotundifolium</i>	0	–	50	2
<i>Eupatorium serotinum</i>	2	2	13	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Fraxinus pennsylvanica</i>	95	6	0	–
<i>Galactia volubilis</i>	0	–	13	1
<i>Galium aparine</i>	5	2	0	–
<i>Galium circaeans</i>	0	–	13	2
<i>Galium obtusum</i>	0	–	25	1
<i>Galium pilosum</i>	0	–	13	1
<i>Galium tinctorium</i> var. <i>floridanum</i>	2	2	0	–
<i>Galium triflorum</i>	7	2	0	–
<i>Gamochaeta purpurea</i>	2	1	0	–
<i>Gaylussacia dumosa</i>	0	–	13	6
<i>Gelsemium sempervirens</i>	2	2	100	3
<i>Gentiana villosa</i>	0	–	13	1
<i>Glyceria striata</i> var. <i>striata</i>	2	2	0	–
<i>Gonolobus suberosus</i> var. <i>suberosus</i>	29	2	13	1
<i>Gratiola virginiana</i>	7	1	0	–
<i>Hydrocotyle verticillata</i>	2	2	0	–
<i>Hypericum crux-andreae</i>	0	–	13	2
<i>Hypericum hypericoides</i>	0	–	63	2
<i>Hypericum mutilum</i>	5	2	0	–
<i>Hypericum punctatum</i>	4	2	0	–
<i>Hypericum setosum</i>	0	–	13	2
<i>Hypericum stragulum</i>	0	–	13	1
<i>Hypoxis hirsuta</i>	7	3	38	2
<i>Ilex ambigua</i>	0	–	25	2
<i>Ilex decidua</i>	91	5	25	2
<i>Ilex opaca</i>	43	6	75	3
<i>Impatiens capensis</i>	11	1	0	–
<i>Ipomoea lacunosa</i>	5	1	0	–
<i>Ipomoea pandurata</i>	0	–	38	2
<i>Itea virginica</i>	5	2	0	–
<i>Juncus bufonius</i>	2	2	13	2
<i>Juncus coriaceus</i>	0	–	13	1
<i>Juncus dichotomus</i>	0	–	25	2
<i>Justicia ovata</i>	30	2	0	–
<i>Krigia virginica</i>	0	–	25	1
<i>Lactuca graminifolia</i> var. <i>graminifolia</i>	0	–	50	1
<i>Leersia virginica</i>	64	3	38	2
<i>Lespedeza capitata</i>	0	–	13	2
<i>Lespedeza hirta</i> var. <i>curtissii</i>	0	–	38	2
<i>Lespedeza violacea</i>	0	–	38	2
<i>Lespedeza virginica</i>	0	–	38	2
<i>Ligustrum sinense</i>	54	3	13	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Lindera benzoin</i>	13	2	0	–
<i>Liquidambar styraciflua</i>	82	6	100	6
<i>Lobelia cardinalis</i>	14	2	0	–
<i>Lobelia elongata</i>	0	–	13	1
<i>Lonicera japonica</i>	9	2	63	2
<i>Ludwigia alternifolia</i>	0	–	13	2
<i>Lycopus rubellus</i>	5	2	0	–
<i>Lygodium japonicum</i>	18	2	0	–
<i>Magnolia virginiana</i>	0	–	13	1
<i>Malus angustifolia</i>	0	–	13	2
<i>Melica mutica</i>	2	2	0	–
<i>Menispermum canadense</i>	13	2	0	–
<i>Microstegium vimineum</i>	43	5	0	–
<i>Mikania scandens</i>	11	2	25	2
<i>Mimosa microphylla</i>	0	–	25	2
<i>Mimulus alatus</i>	2	1	0	–
<i>Mitchella repens</i>	18	2	75	2
<i>Mitreola petiolata</i>	4	1	0	–
<i>Morella cerifera</i>	0	–	25	2
<i>Morus rubra</i>	9	4	13	1
<i>Murdannia keisak</i>	4	1	0	–
<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	86	4	100	6
<i>Nekemias arborea</i>	21	2	50	2
<i>Nyssa aquatica</i>	18	7	0	–
<i>Nyssa biflora</i>	30	4	0	–
<i>Nyssa sylvatica</i>	0	–	63	4
<i>Onoclea sensibilis</i>	14	2	0	–
<i>Oplismenus setarius</i>	0	–	25	2
<i>Osmunda spectabilis</i>	0	–	13	2
<i>Osmundastrum cinnamomeum</i>	7	2	13	2
<i>Oxalis stricta</i>	16	2	50	2
<i>Packera glabella</i>	63	2	0	–
<i>Panicum virgatum</i>	4	2	13	1
<i>Parthenocissus quinquefolia</i>	75	2	88	2
<i>Persicaria hydropiperoides</i>	52	2	0	–
<i>Pilea pumila</i>	5	1	0	–
<i>Pinus echinata</i>	0	–	13	3
<i>Pinus palustris</i>	0	–	25	2
<i>Pinus taeda</i>	9	6	100	7
<i>Piptochaetium avenaceum</i>	0	–	13	2
<i>Pityopsis graminifolia</i>	0	–	13	3
<i>Planera aquatica</i>	13	6	0	–

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Platanthera</i>	2	2	0	–
<i>Platanus occidentalis</i>	25	5	0	–
<i>Pleopeltis michauxiana</i>	23	2	25	1
<i>Pluchea camphorata</i>	32	2	0	–
<i>Poa autumnalis</i>	45	3	25	3
<i>Poaceae</i>	7	1	13	1
<i>Polycarpon tetraphyllum</i> ssp. <i>tetraphyllum</i>	2	1	0	–
<i>Populus deltoides</i> ssp. <i>deltoides</i>	11	5	0	–
<i>Potentilla indica</i>	9	2	13	2
<i>Prunus caroliniana</i>	2	1	38	2
<i>Prunus serotina</i> var. <i>serotina</i>	0	–	13	1
<i>Ptilimnium capillaceum</i>	4	1	0	–
<i>Quercus alba</i>	0	–	13	3
<i>Quercus laurifolia</i>	66	6	13	5
<i>Quercus lyrata</i>	34	6	0	–
<i>Quercus michauxii</i>	16	6	13	2
<i>Quercus nigra</i>	13	6	75	3
<i>Quercus pagoda</i>	9	4	0	–
<i>Quercus phellos</i>	4	6	100	5
<i>Quercus stellata</i>	0	–	25	2
<i>Quercus velutina</i>	0	–	75	5
<i>Ranunculus recurvatus</i> var. <i>recurvatus</i>	2	2	0	–
<i>Rhododendron canescens</i>	2	2	0	–
<i>Rhododendron eastmanii</i>	0	–	13	2
<i>Rhus copallinum</i> var. <i>copallinum</i>	0	–	63	3
<i>Rhynchosia difformis</i>	0	–	13	2
<i>Rhynchospora globularis</i>	0	–	13	1
<i>Rubus pensilvanicus</i>	20	2	25	6
<i>Rubus trivialis</i>	0	–	63	2
<i>Ruellia caroliniensis</i>	7	2	13	3
<i>Sabal minor</i>	7	2	13	1
<i>Sabatia calycina</i>	5	2	0	–
<i>Samolus parviflorus</i>	18	2	0	–
<i>Sanicula canadensis</i>	14	2	25	2
<i>Saururus cernuus</i>	30	2	0	–
<i>Sceptridium bitematum</i>	7	2	0	–
<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	0	–	50	2
<i>Scleria</i>	2	2	0	–
<i>Scleria ciliata</i>	0	–	38	2
<i>Scleria minor</i>	2	1	0	–
<i>Scleria oligantha</i>	2	1	0	–
<i>Scutellaria integrifolia</i>	5	2	13	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Sericocarpus asteroides</i>	0	–	38	1
<i>Sideroxylon lycioides</i>	2	5	0	–
<i>Sisyrinchium angustifolium</i>	2	2	0	–
<i>Smilax bona-nox</i> var. <i>bona-nox</i>	21	2	75	2
<i>Smilax glauca</i>	5	1	88	2
<i>Smilax hispida</i>	13	2	0	–
<i>Smilax hugeri</i>	2	2	0	–
<i>Smilax laurifolia</i>	0	–	25	1
<i>Smilax rotundifolia</i>	84	2	100	4
<i>Smilax walteri</i>	7	2	0	–
<i>Solanum carolinense</i> var. <i>carolinense</i>	0	–	25	1
<i>Solanum emulans</i>	13	2	13	1
<i>Solidago</i>	29	2	13	2
<i>Solidago leavenworthii</i>	2	2	0	–
<i>Solidago rugosa</i> var. <i>aspera</i>	2	1	25	3
<i>Solidago tortifolia</i>	0	–	13	2
<i>Spiranthes odorata</i>	4	1	0	–
<i>Steironema lanceolatum</i>	2	1	0	–
<i>Stellaria media</i>	0	–	13	1
<i>Styrax americanus</i> var. <i>pulverulentus</i>	0	–	13	2
<i>Swida foemina</i>	2	2	0	–
<i>Symphytotrichum lanceolatum</i> var. <i>latifolium</i>	2	2	0	–
<i>Symphytotrichum pilosum</i> var. <i>pilosum</i>	0	–	13	1
<i>Taxodium distichum</i>	52	6	0	–
<i>Thelypteris palustris</i> var. <i>pubescens</i>	2	1	0	–
<i>Thysanthera difformis</i>	11	2	25	3
<i>Tilia americana</i> var. <i>heterophylla</i>	2	6	0	–
<i>Tillandsia usneoides</i>	38	2	13	1
<i>Toxicodendron radicans</i> var. <i>radicans</i>	89	4	75	2
<i>Triadenum virginicum</i>	2	2	0	–
<i>Ulmus alata</i>	16	5	63	4
<i>Ulmus americana</i> var. <i>americana</i>	66	5	0	–
<i>Ulmus rubra</i>	48	5	13	4
Unknown	0	–	25	2
<i>Urtica chamaedryoides</i>	2	2	0	–
<i>Vaccinium arboreum</i>	0	–	13	2
<i>Vaccinium elliotii</i>	4	2	25	2
<i>Vaccinium formosum</i>	0	–	38	3
<i>Vaccinium fuscum</i>	0	–	13	1
<i>Vaccinium stamineum</i>	0	–	50	2
<i>Vaccinium tenellum</i>	0	–	63	4
<i>Vernonia acaulis</i>	0	–	13	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (eight plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPAW Constancy	CPAW Cover	CPUOW Constancy	CPUOW Cover
<i>Viburnum nudum</i>	9	2	0	–
<i>Viburnum obovatum</i>	0	–	13	2
<i>Viola</i>	68	2	25	2
<i>Viola palmata</i>	0	–	13	1
<i>Vitis aestivalis</i> var. <i>aestivalis</i>	54	3	25	2
<i>Vitis baileyana</i>	4	2	0	–
<i>Vitis labrusca</i>	2	2	0	–
<i>Wisteria sinensis</i>	2	2	25	3

Table B-2. Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (8 plots).

Species	CPAW Tree BA	CPAW Tree DEN	CPAW Sapling BA	CPAW Sapling Den	CPAW Seedling Den	CPUOW Tree BA	CPUOW Tree DEN	CPUOW Sapling BA	CPUOW Sapling Den	CPUOW Seedling Den
<i>Acer floridanum</i>	0.01	0	–	–	22	–	–	–	–	–
<i>Acer negundo</i> var. <i>negundo</i>	1.27	33	0.55	125	1250	–	–	–	–	–
<i>Acer rubrum</i>	2.83	41	1.18	429	19085	0.63	16	0.69	250	3438
<i>Acer saccharinum</i>	–	–	–	–	223	–	–	–	–	–
<i>Aralia spinosa</i>	–	–	–	–	–	–	–	–	–	4375
<i>Arundinaria tecta</i>	–	–	0.12	4714	20960	–	–	0.02	875	1719
<i>Asimina triloba</i>	0.02	2	4.02	5196	1049	–	–	–	–	–
<i>Berchemia scandens</i>	–	–	0.00	18	67	–	–	–	–	–
<i>Bignonia capreolata</i>	–	–	0.10	1429	13147	–	–	–	–	156
<i>Callicarpa americana</i>	–	–	–	–	–	–	–	0.84	7375	5781
<i>Campsis radicans</i>	0.01	1	0.54	321	960	–	–	–	–	625
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	0.66	31	2.12	893	915	0.04	3	–	–	156
<i>Carya aquatica</i>	0.23	2	–	–	22	–	–	–	–	–
<i>Carya cordiformis</i>	0.01	0	–	–	22	–	–	–	–	–
<i>Carya glabra</i>	0.15	2	–	–	–	–	–	–	–	–
<i>Carya tomentosa</i>	0.15	1	–	–	–	–	–	–	–	–
<i>Celtis laevigata</i>	2.24	29	0.49	125	4174	–	–	–	–	625
<i>Cephalanthus occidentalis</i>	–	–	0.00	18	–	–	–	–	–	–
<i>Crataegus</i>	0.01	1	–	–	45	–	–	–	–	–
<i>Crataegus marshallii</i>	–	–	–	–	–	0.08	6	0.55	125	–
<i>Crataegus viridis</i>	0.01	0	–	–	–	–	–	–	–	–
<i>Cyrilla racemiflora</i>	–	–	0.04	36	–	–	–	–	–	–
<i>Diospyros virginiana</i>	0.02	0	–	–	–	–	–	0.06	375	313
<i>Endodeca serpentaria</i>	–	–	–	–	22	–	–	–	–	–
<i>Fraxinus pennsylvanica</i>	5.79	35	0.37	196	3862	–	–	–	–	–
<i>Gaylussacia dumosa</i>	–	–	–	–	–	–	–	–	–	469
<i>Gelsemium sempervirens</i>	–	–	–	–	45	–	–	0.05	1125	12344
<i>Ilex decidua</i>	0.16	14	3.98	2446	1116	–	–	–	–	156
<i>Ilex opaca</i>	1.47	38	0.87	250	179	–	–	0.17	250	313
<i>Ligustrum sinense</i>	0.00	0	0.44	393	1116	–	–	–	–	156
<i>Lindera benzoin</i>	–	–	0.03	71	89	–	–	–	–	–

Table B-2 (continued). Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (8 plots).

Species	CPAW Tree BA	CPAW Tree DEN	CPAW Sapling BA	CPAW Sapling Den	CPAW Seedling Den	CPUOW Tree BA	CPUOW Tree DEN	CPUOW Sapling BA	CPUOW Sapling Den	CPUOW Seedling Den
<i>Liquidambar styraciflua</i>	11.09	71	0.19	196	1027	2.80	81	2.04	4750	16094
<i>Lonicera japonica</i>	–	–	–	–	67	–	–	0.01	375	781
<i>Morus rubra</i>	0.10	1	–	–	–	–	–	–	–	–
<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	0.01	1	1.20	1464	1362	–	–	0.16	6875	22969
<i>Nekemias arborea</i>	–	–	–	–	45	–	–	–	–	313
<i>Nyssa aquatica</i>	6.36	27	–	–	45	–	–	–	–	–
<i>Nyssa biflora</i>	0.24	4	–	–	156	–	–	–	–	–
<i>Nyssa sylvatica</i>	–	–	–	–	–	0.15	13	–	–	156
<i>Parthenocissus quinquefolia</i>	–	–	0.04	1036	2188	–	–	0.01	750	8906
<i>Pinus echinata</i>	–	–	–	–	–	0.54	3	–	–	–
<i>Pinus palustris</i>	–	–	–	–	–	1.09	6	–	–	–
<i>Pinus taeda</i>	0.93	1	–	–	22	28.48	234	–	–	17656
<i>Planera aquatica</i>	0.27	9	0.16	36	938	–	–	–	–	–
<i>Platanus occidentalis</i>	0.36	6	–	–	1808	–	–	–	–	–
<i>Populus deltoides</i> ssp. <i>deltoides</i>	0.28	2	–	–	–	–	–	–	–	–
<i>Prunus caroliniana</i>	–	–	–	–	22	–	–	–	–	–
<i>Prunus serotina</i> var. <i>serotina</i>	–	–	–	–	–	–	–	–	–	156
<i>Quercus laurifolia</i>	2.83	38	1.01	339	246	–	–	–	–	–
<i>Quercus lyrata</i>	1.95	8	–	–	22	–	–	–	–	–
<i>Quercus michauxii</i>	1.32	7	–	–	22	–	–	0.03	250	–
<i>Quercus nigra</i>	0.41	3	0.08	36	22	0.07	6	0.00	125	–
<i>Quercus phellos</i>	0.08	0	–	–	–	1.14	25	0.55	125	938
<i>Quercus velutina</i>	–	–	–	–	–	0.83	9	0.14	125	781
<i>Rhododendron canescens</i>	–	–	–	–	22	–	–	–	–	–
<i>Rhus copallinum</i> var. <i>copallinum</i>	–	–	–	–	–	–	–	0.00	125	5625
<i>Smilax bona-nox</i> var. <i>bona-nox</i>	–	–	–	–	–	–	–	0.00	125	1094
<i>Smilax glauca</i>	–	–	–	–	22	–	–	0.00	125	2656
<i>Smilax hispida</i>	–	–	–	–	580	–	–	–	–	–
<i>Smilax rotundifolia</i>	–	–	0.00	125	1451	–	–	0.08	4000	3438
<i>Smilax walteri</i>	–	–	–	–	156	–	–	–	–	–

Table B-2 (continued). Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 64 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPAW = Coastal Plain Alluvial Wetlands (56 plots) and CPUOW = Coastal Plain Upland Open Woodlands (8 plots).

Species	CPAW Tree BA	CPAW Tree DEN	CPAW Sapling BA	CPAW Sapling Den	CPAW Seedling Den	CPUOW Tree BA	CPUOW Tree DEN	CPUOW Sapling BA	CPUOW Sapling Den	CPUOW Seedling Den
<i>Swida foemina</i>	–	–	0.02	18	–	–	–	–	–	–
<i>Taxodium distichum</i>	4.43	16	0.01	71	357	–	–	–	–	–
<i>Tilia americana</i> var. <i>heterophylla</i>	0.05	1	–	–	–	–	–	–	–	–
<i>Toxicodendron radicans</i> var. <i>radicans</i>	–	–	0.48	1571	8884	–	–	–	–	3125
<i>Ulmus alata</i>	0.14	5	0.20	71	1429	0.35	22	0.55	125	1563
<i>Ulmus americana</i> var. <i>americana</i>	0.62	15	0.18	125	9554	–	–	–	–	–
<i>Ulmus rubra</i>	0.50	13	0.28	89	1205	0.28	6	–	–	–
<i>Vaccinium elliotii</i>	–	–	–	–	45	–	–	0.00	125	313
<i>Vaccinium formosum</i>	–	–	–	–	–	–	–	0.00	125	1094
<i>Vaccinium stamineum</i>	–	–	–	–	–	–	–	–	–	313
<i>Vaccinium tenellum</i>	–	–	–	–	–	–	–	–	–	24219
<i>Vitis aestivalis</i> var. <i>aestivalis</i>	0.01	0	0.67	232	112	–	–	–	–	–
<i>Vitis labrusca</i>	–	–	0.00	18	–	–	–	–	–	–
<i>Wisteria sinensis</i>	–	–	–	–	–	–	–	0.14	125	781

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