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The Vegetation of the Congaree Swamp National Monument

by

L.L. GADDY and G.A. SMATHERS

Contents

1. Introduction to the area

Congaree "Swamp" is the name applied to the wide floodplain (it ranges up to four miles wide) of the Congaree River just below Columbia, South Carolina. The floodplain lies on the edge of the Atlantic Coastal Plain only a few miles southeast of the fall line, the boundary between the Piedmont of the ancient Appalachian system and the Atlantic Coastal Plain (see Fig. 1). Although it is a much smaller river, the Congaree, with its wide meander belts and well-developed oxbow lakes, may be compared to the Mississippi. Rivers like the Congaree (and the Mississippi) with a high alluvium content are referred to as "red" rivers in the Southeast, due to the color of their silt and clay-laden waters. These rivers have a much higher nutrient content than the sandy, "black" rivers of the Southeastern Coastal Plain. The trees found on the red or alluvial river floodplains, therefore, tend to be much larger

than those of the black river floodplains.

The flora of the Congaree floodplain is similar to that of most other alluvial floodplains in the Southeast. Arboreal vegetation completely dominates the floodplain with over forty-five tree species found there. Sweet gum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), cherrybark oak (*Quercus falcata* var. *pagodaefilia*), overcup oak (*Quercus lyrata*), laurel oak (*Quercus laurifolia*), loblolly pine (*Pinus taeda*), bald cypress (*Taxodium distichum*), and water tupelo (*Nyssa aquatica*) are the most common canopy species of the floodplain; American hornbeam (*Carpinus caroliniana*), possum haw (*Ilex decidua*), and American holly (*Ilex opaca*) dominate the forest understory. When present, the shrub layer is dominated by either pawpaw (*Asimina triloba*), spicebush (*Lindera benzoin*), cane (*Arundinaria gigantea*), or combinations of these trees. The herbaceous layer is poorly-developed in most communities with sedges (*Carex* spp.), vines, and members of the nettle family (*Urticaceae*) such as false nettle (*Boehmeria cylindrica*) and clearweed (*Pilea pumila*) usually dominating.

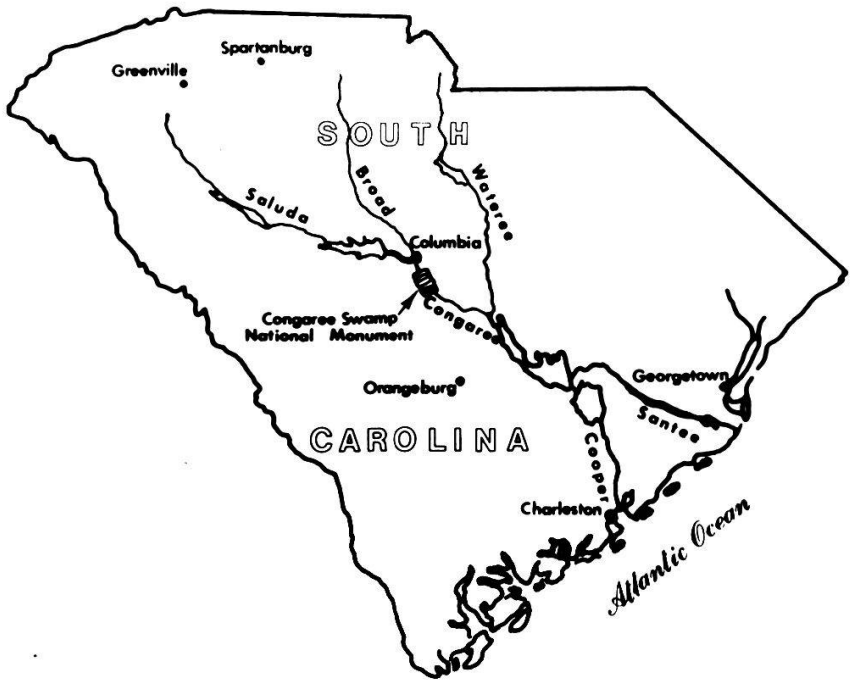

Figure 1. Location of Congaree Swamp in South Carolina.

Although most of the trees and shrubs found in the Congaree floodplain have a Southeastern (U.S.) distribution, a considerable number of species found there have a more widespread distribution. Red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), box elder (*Acer negundo*), American elm (*Ulmus americana*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), American beech (*Fagus grandiflora*), tulip tree (*Liriodendron tulipifera*), American holly (*Ilex opaca*), American hornbeam (*Carpinus caroliniana*), spicebush (*Lindera benzoin*), and pawpaw (*Asimina triloba*) are Congaree trees and shrubs that are common throughout eastern North America.

To some, a swamp or floodplain forest conjures ideas of an impenetrable thicket of briars, cane, and shrubs. In alluvial or red river floodplains such as the Congaree, impassable thickets are only found in recently clearcut areas and in light gaps of older stands where trees have been blown down. The structure of the floodplain forests of the Congaree, although varying slightly from community to community, usually consists of a 100 % canopy coverage of old and middle-aged trees, a sparse understory of shade-tolerant tree species, and a fairly open,shrub layer. Because most species of floodplain trees are tolerant of shade, a cathedral-like effect is produced by the combination of a tall, dense canopy and a sparse or completely absent understory.

The floodplain forest reaches its structural perfection about twelve miles southeast of Columbia. Here, a 15,000-acre area of undisturbed forest called the "Beidler" Tract is found. This tract has been described as "one of the largest concentrations of big trees in eastern North America" (GADDY 1978). The state record tree for almost every species found in South Carolina floodplains is located here, along with national records for several species (see Table 1). The trees of the Beidler tract exemplify what happens when a forest is allowed to grow undisturbed on optimum soil conditions. The number and size of the large trees in the tract are astounding. More than one hundred individuals of sweet gum (*Liquidambar styraciflua*) larger than twelve feet in circumference have been located; over twenty bald cypresses(*Taxodium distichum*) greater than twenty feet in circumference have been measured; and more than ten loblolly pines (*Pinus taeda*) larger than thirteen feet in circumference are growing in the Beidler Tract.

The tremendous girths are not the only impressive features about the trees along Beidler Tract. Intense competition for light has produced a canopy

Table 1. Record trees of the Congaree floodplain (from GADDY 1978)

Species	Circumference at 1.3 meters (4'6")		Height		Spread	
	Meters	(Feet)	Meters	(Feet)	Meters	(Feet)
State record						
+**Quercus phellos* (willow oak)	5.4	(17'8")	48.2	(158')	22.3	(73')
+**Ilex opaca* (American holly(	2.5	(8'2")	30.2	(99')	12.2	(40')
**Quercus shumardii* (Shumard oak)	4.7	(15'4")	45.4	(149')	19.5	(64')
**Platanus occidentalis* (sycamore)	4.4	(14'4")	50.6	(166')	23.2	(76')
**Ulmus americana* (American elm)	5.0	(16'6")	43.9	(144')	21.4	(72')
**Nyssa aquatica* (water tupelo)	6.4	(20'11")	37.8	(124')	18.9	(62')
**Gleditsia triacanthos* (honeylocust)	2.5	(8'3")	37.2	(122')	10.4	(36')
**Carpinus caroliniana* (American hornbeam)	1.4	(4'7")	18.3	(60')	14.3	(49')
**Fraxinus pennsylvanica* (green ash)	4.6	(15'2")	36.0	(118')	22.6	(74')
***Populus heterophylla* (swamp cottonwood)	5.2	(17'0")	39.6	(130')	36.6	(120')
***Acer rubrum* (red maple)	4.0	(13'2")	38.4	(126')	25.9	(85')
***A. saccharum* (sugar maple)	2.5	(8'3")	30.5	(100')	19.8	(65')
***A. negundo* (box elder)	2.0	(6'8")	19.8	(65')	16.8	(55')
***Betula nigra* (river birch)	2.9	(9'5")	36.6	(120')	24.4	(80')
***Diospyros virginiana* (persimmon)	1.7	(5'5")	33.5	(110')	7.6	(25')
***Salix nigra* (black willow)	1.6	(5'2")	21.3	(70')	16.8	(55')
National record						
**Ilex decidua* (possumhaw)	0.5	(1'8")	9.1	(30')	10.1	(33')
**Quercus laurifolia* (laurel oak)	6.3	(20'9")	45.1	(148')	23.2	(76')
**Nyssa sylvatica* var.*biflora* (swamp tupelo)	4.0	(13'1")	34.1	(112')	15.9	(52')
+**Quercus lyrata* (overcup oak)	6.7	(22'0")	37.5	(123')	14.6	(48')
***Forestiera acuminata* (swamp privet)	0.8	(2'7")	12.8	(42')	7.6	(25')
***Liquidambar styraciflua* (sweet gum)	6.0	(19'8")	38.1	(125')	30.5	(100')

* Found in Beidler Tract
** Found on adjacent tracts
\+ Co-champion

that ranges from 30-50 m (110-160 feet) in height, with pines up to 60 m (170 feet). Some trees here may be only 60 cm (2 feet) in diameter but 45 m (140 feet) tall. Among the outstanding trees are a sycamore (*Platanus occidentalis*) that is 55 m (166 feet) tall, a 53 m (158 foot) willow oak (*Quercus phellos*), an American holly (*Ilex opaca*) 33 m (99 feet) tall, and several pines that range over 55 m (165 feet) in height.

The National Park Service has recently studied the Beidler Tract and concluded that it is of national significance. Plans are being made to make the area a National "Monument" to be used for education, recreation, and research. Congaree Swamp National Monument will be the only floodplain under the protection of the National Park System and will add many new habitats to the diversity of the park system.

2. Vegetation mapping efforts

Since summer of 1975, sixteen exploratory transects (one kilometer apart) were run across the floodplain. Along each transect, information was gathered from a 10 meter wide belt or strip (5 meters on each side of the transect). This information was used for initial delineation and description of the plant communities. Eleven different plant communities were recognized and described.

Representative stands were sampled in each community type. Density, frequency, basal area, and importance value data were determined for each stand (gathered from 50 m x 50 m quadrats). A stem diameter distribution study was carried out to determine the successional equilibrium of selected communities (see SCHMELZ and LINDSEY 1965 for methodology). Tree-ring counts were made in several areas where cutting was going on (the initiation of widespread logging on the Beidler Tract was one of the main reasons the study had been started).

Stand analysis data revealed communities of massive basal areas. The stem diamater study illustrated in some communities equilibria similar to known virgin forests. Tree-ring counts indicated that the floodplain trees were fast-growing and significantly mature (up to three hundred years old). In summary, it was evident that the Beidler Tract was of national significance.

The next phase of the vegetation analysis of the Beidler Tract used false color infrared aerial photographs. These provided the necessary information to produce a vegetation/type map (Fig. 2*) .Twenty-nine plant communities were recognized and delineated on a manual map; whereas, the eleven community types described in GADDY et al. (1975) were mapped by computer. The descriptions of each plant community and its associated habitat are given below. The number in parantheses corresponds to the mapped unit shown in Figure 2. The description follows in general SMATHERS and GADDY (1977).

Agriculturual Crops (2). This type includes land planted to soybeans, corn, etc. as well as pastures or fallow fields.

Bottomland Hardwoods (2). This type consists of those species that find their optimal distribution between subhydric and mesic sites of the floodplain. No single species dominates the forest canopy. It appears to be a combination of Sweetgum/mixed Hardwood (21) and Laurel Oak/Sweetgum (10).

Bluff Hardwoods (3). This type closely resembles the Upland Hardwoods (22) in both structure and species composition. It may well represent more mesic sites of Upland Hardwoods, because of its generally north and east-facing aspect. The more submesic species with wide ecological amplitudes, such as tulip poplar, pignut hickory, Shumard oak, beech, white ash, and red maple, tend to dominate the canopy cover.

Cottonwood (4). This type, *Populus deltoides* Marshall, occurs in pratically pure stands, and may grade into Willow (27) where the two occur together along the river banks.

Cypress (5). The pure stands of *Taxodium distichum* (L.) Richard suggest a transitional stage to the Water Tupelo/Cypress (26) type. The Cypress type occurs as small stands in the sloughs and large depressions in the northern portion of the floodplain.

Cypress/Bottomland Hardwoods (6). This type is a variation of Bottomland Hardwoods (2) where subhydric to hydric soil conditions prevail, which favors the subdominancy of baldcypress (*Taxodium distichum* (L.) Richard).

Green Ash (7). These near-pure stands of *Fraxinus* sp. appear to be early seral stages to Green Ash/Red Maple (8). The Green Ash type is rare, being found in the northeastern section of the floodplain.

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* in the pouched back-cover

Green Ash/Red Maple (8). This higly variable community is found in wet flats, and usually grades into Water Tupelo/Cypress (26). Various ashes (*Fraxinus* spp.), red maple, American elm, sycamore, cypress, and sweetgum are found in this type.

Laurel Oak (9). A few stands of *Quercus laurifolia* Michaux occur on the floodplain near the river. They appear to be seral to Sweetgum/Mixed Hardwoods (21) and Laurel Oak/Sweetgum (10).

Laurel Oak/Sweetgum (10). This type is very similar in species composition to Sweetgum (20), but laurel oak dominates instead of sweetgum. This type may be a successional variation of Sweetgum; generally, however, it is found on slightly wetter soils. American elm (*Ulmus americana* L.), green ash, and water hickory (*Carya aquatica* (Michaux f.) Nuttall) are all common in this type along with sweetgum. Dwarf palmetto (*Sabal minor* (Jacquin) Persoon), possum haw (*Ilex decidua* Walter), and ironwood dominate the understory.

Loblolly Pine (11). This unit consists of pure stands of loblolly pine (*Pinus taeda* L.) that are primarily located along the mid-region of low bluffs of the northern edge of the floodplain.

Loblolly Pine/Bottomland Hardwoods (12). This type occurs on "ridges" in the floodplain and is dominated by large loblolly pines (*Pinus taeda* L.), and mixed oaks and hickories. Pawpaw (*Asimina triloba* (L.) Dunal) is the most common plant in the shrub layer.

Loblolly Pine/Swamp Tupelo (13). This type is found on acid organic soils adjacent to and grading into Swamp Tupelo (18). Loblolly pine and swamp tupelo (*Nyssa sylvatica* var. *biflora* (Walter) Sargent) are the dominants. Sweetgum, swamp chestnut oak, and red maple (*Acer rubrum* L.) are also present in sizable proportions. *Leucothoe axillaris* var. *axillaris* (Lam.) D. Don and sweet pepperbush (*Clethra alnifolia* var. *alnifolia* L.) dominate the shrub layer with an abundance of ferns and mosses in the herbaceous layer.

Overcup Oak (14). In wet flats that periodically are flooded and hold water slightly longer than the rest of the floodplain, overcup oak (*Quercus lyrata* Walter) dominates. Baldcypress, *Taxodium distichum* (L.) Richard, water hickory, and American elm are associates. Understory is dominated by saplings of the above species.

Overcup Oak/Mixed Hardwoods (15). This type is similar in structure to

Overcup Oak (14), but is found in drier sites. While *Quercus lyrata* Walter dominates the cover, other associated such as American elm (*Ulmus americana* L.) are conspicuously present.

Pine Plantations (16). This vegetation type is characterized by even stands of pines, mostly of pole size, that have been planted or have invaded cleared land sites. Most of this type is restricted to the north bluffs of the floodplain, and unless man-maintained it will, through climax, tend to be invaded by hardwood species.

Riverbank Hardwoods (17). This type is found on natural levees and on newer alluvium along the river and bordering Cedar Creek. These areas are higher than the surrounding floodplain and have a better drained soil. Dominants are sugarberry (*Celtis laevigata* Willd.), sycamore (*Platanus occidentalis* L.) and cherrybark oak (*Quercus falcata* var. *pagodaegolia* Ell.). Box elder (*Acer negundo* L.) almost completely dominates the understory, and spicebush (*Lindera benzoin* (L.) Blume) and pawpaw are the most common shrubs.

Swamp Tupelo (18). Swamp tupelo (*Nyssa sylvatica* var. *biflora* (Walter) Sargent) is found in almost pure stands in bogs or depressions along the edge of the floodplain. These bogs have pure organic soil and are fed by underground springs surfacing from the bluffs of the floodplain. Sweetgum, American holly, and red maple are also found in the canopy. The understory is thick and is dominated by sweet bay (*Magnolia virginiana* L.). As in Loblolly Pine/Swamp Tupelo (13), *Leucothoe axillaris* var. *axillaris* (Lam.) D. Don and *Clethra alnifolia* var. *alnifolia* L. are the most abundant shrubs along with various acid-tolerant plants (*Ilex* sp.).

Swamp Tupelo/Others (19). This type is considered to be seral to Swamp Tupelo (18). It occurs near the north bluffs of the floodplain, and while consisting primarily of *Nyssa sylvatica* var. *biflora* (Walter) Sargent, the total canopy cover is shared with associates of red maple (*Acer rubrum* L.), water hickory (*Carya aquatica* Michaux f.), American elm (*Ulmus americana* L.), Carolina ash (*Fraxinus coroliniana* Miller), and baldcypress (*Taxodium distichum* (L.) Richard).

Sweetgum (20). The practically pure stands of *Liquidambar styraciflua* may characterize this vegetation type as an early community stage to Sweetgum/Mixed Hardwoods (21). It is found primarily within the floodplain, but may occur along the river bank and the contiguous edge of the floodplain.

Sweetgum/Mixed Hardwoods (21). This is the most common community type encountered in the Beidler Tract. It occurs in all areas of the floodplain. Sweetgum dominates along with swamp chestnut oak, laurel oak (*Quercus laurifolia* Michaux) and green ash (*Fraxinus pennsylvanica* Marshall). Ironwood (*Carpinus caroliniana* Walter) dominates the understory.

Upland Hardwoods (22). This type consists of a mixture of hardwood species that are more common to well-drained soil sites such as floodplain ridges and bluffs. It consists of a mixture of oak and hickories in which no one species possesses canopy dominance. Major species composition consists of sweetgum (*Liquidambar styraciflua* L.), beech (*Fagus grandifolia* Erhard), and pignut hickory (*Carya glabra* (Miller) Sweet).

Upland Loblolly Pine (23). This type, comprising small acreage, is located on bluffs outside the floodplain. Before recent removal of canopy pines, it was dominated by loblolly pine and several longleaf pines (*Pinus palustris* Miller). Trees of value to the rare red-cockaded woodpecker (*Dendrocopus borealis*) were not removed. It is closely associated by structure and composition to the Loblolly Pine (11) type.

Upland Loblolly Pine/Mixed Hardwoods (24). This type occurs on ridges in the floodplain and along both the north and south bluff areas. It is dominated by old loblolly pines (*Pinus taeda* L.) and mixed oaks and hickories. Pawpaw (*Asimina triloba* (L.) Dunal) is the most common plant in the shrub layer.

Water Tupelo (25). This type occurs in large depressions, bogs, and sloughs in the floodplain. It consists primarily of pure stands of water tupelo (*Nyssa aquatica*). This community type regenerates after a severe cut of cypress.

Water Tupelo/Cypress (26). In sloughs and large depressions, baldcypress and water tupelo (*Nyssa aquatica* L.) are the dominants. Carolina ash (*Fraxinus caroliniana* Miller), red maple, and planer tree (water elm) (*Planera aquatica* Walter ex. J.F. Gmelin) dominate the understory of this community.

Willow (27). This type occurs in pure to mixed stands with swamp cottonwood (*Populus deltoides* Marshall) on sandy beaches along the Congaree River. It is the major pioneer woody colonizer of sandy substrates.

Selective and Clear Cut Lands (28 and 29). These are areas, primarily in the floodplain that were formerly dominated by one of the above community types. Due to recent cutting, the present community cannot be determined from aerial

photographs. Field checks show that a large proportion of these areas were formerly types 10 and 21.

3. Future phytogeographical and ecological studies

Extensive research remains to be done on the vegetation of the Congaree Swamp National Monument. Details concerning the intricate relationship between floodplain hydrology and plant communities need to be discovered; valuable research on succession and regeneration in mature forests may be carried out here; research pertaining to soil nutrients and primary productivity in floodplain systems could easily be conducted in the national monument; and many other phytosociological studies may be carried out in the 15,000 acre national monument.

Recently, two graduate students completed master's thesis work on the Congaree floodplain. RUNYAN (1978) studied corticolous liverworts, and CREWZ (1976) analyzed the successional pattern in clearcut areas. These studies complement earlier general vegetation work, such as SWAILS et al. (1957), DENNIS (1967), STALTER and BATSON (1969), FITZPATRICK et al. (1977), and GADDY et al. (1975), and provide a good basis for more specific studies. GADDY (1977) listed several rare and disjunct plants found in the area, and he (GADDY 1978) documented the record trees of the area (see Table 1). Presently, he is locating superlative trees and stands (state and national records), and doing research on the endangered and threatened plants of the national monument. All in all, the future seems to be very exciting for studying and preserving the outstanding vegetation of the Congaree Swamp National Monument.

Summary

Congaree "Swamp" is a large floodplain forest located along the Congaree River in the Southeastern Atlantic Coastal Plain of the United States. The proposed Congaree Swamp National Monument will protect a 15,000 acre (600 ha) area of the floodplain forest in which one of the largest concentrations of big trees in eastern North America is found. The size of the trees in the Congaree floodplain is exemplary of what happens when a forest is allowed to

grow undisturbed under optimum soil conditions. Here, the canopy ranges from 110 to 160 feet (34-49 m) in height, and trees with circumferences greater than 12 feet (3.7 m) are common. Tree-ring counts revealed many of these trees may be over 300 years old, and quantitative studies revealed stands with massive basal areas. Twenty-nine plant communities have been mapped from false color infrared aerial photographs of the proposed National Monument area. If, as planned, a portion of Congaree Swamp does indeed become a protected National Monument, the floodplain forest will be used for educational, recreational, and research purpose.

Zusammenfassung

Der Congaree-"Sumpf" ist ein grosser Auenwald längs des Congaree-Flusses in der südöstlichen atlantischen Küstenebene der Vereinigten Staaten. Der als nationales Denkmal vorgesehene "Congaree Swamp" umfasst etwa 600 ha Auenwald, in welchem sich die grösste Anhäufung von hohen Bäumen im östlichen Nordamerika befindet. Die Höhe der Bäume im Congaree-Auenwald ist bezeichnend für die ungestörte Entwicklung eines Waldes, der unter optimalen Bodenbedingungen wachsen kann. Die Baumschicht erreicht 34-49 m Höhe, und die Bäume mit mehr als 3,7 m Stammumfang sind häufig. Stammringzählungen ergaben für viele Bäume ein Alter von mehr als 300 Jahren, und die Ausmessungen weisen auf sehr hohe Stammflächenbedeckung hin. Mit Hilfe von Infrarot-Falschfarb-Flugbildaufnahmen wurden im untersuchten Gebiet 29 Pflanzengesellschaften kartiert. Wenn ein Teil des Congaree Swamp unter Schutz gestellt wird, kann der Auenwald für Lehre, Forschung und Erholung dienen.

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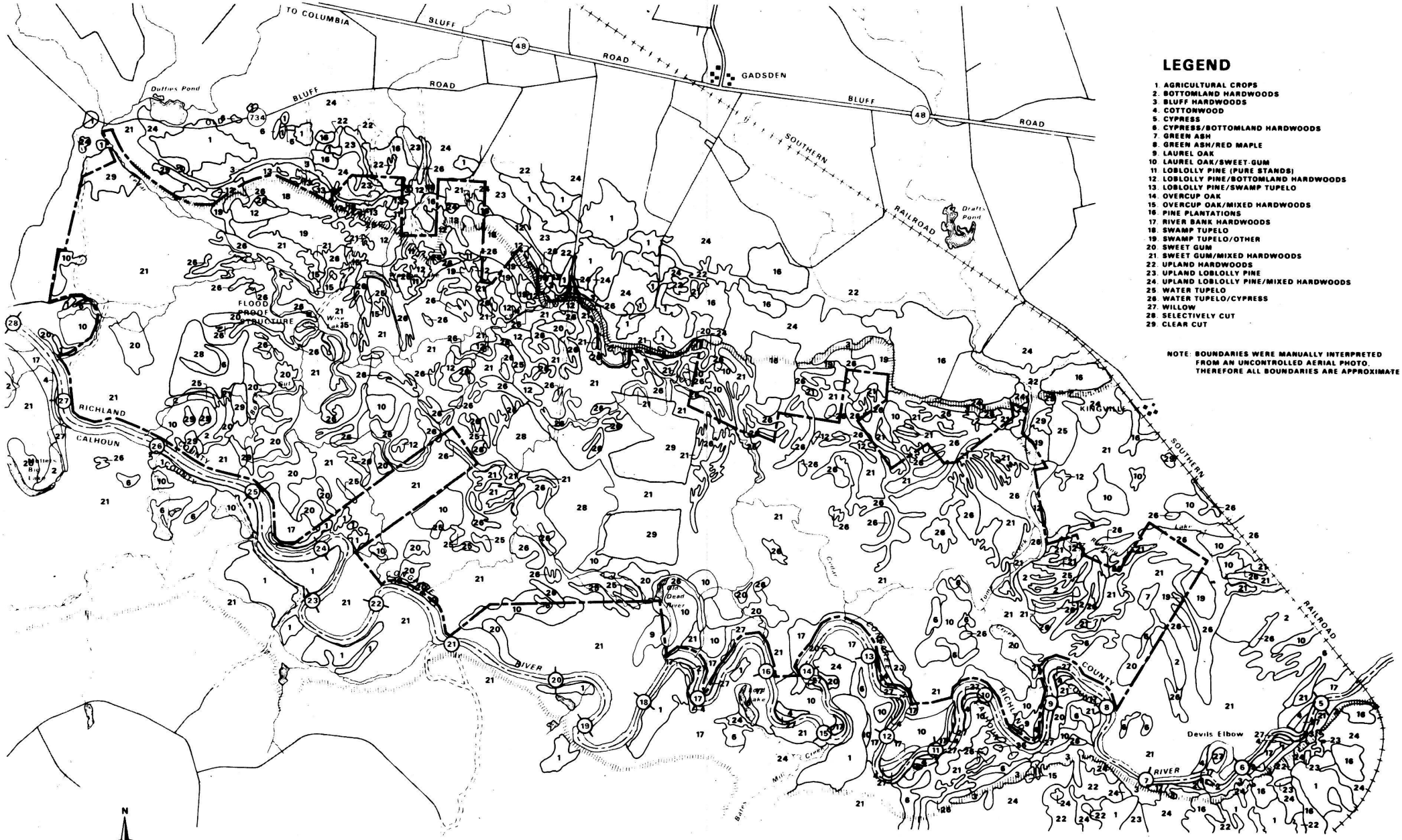
Figure 2. Vegetation, Congaree Swamp National Monument, South Carolina.



VEGETATION

CONGAREE SWAMP NATIONAL MONUMENT

SOUTH CAROLINA

UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE