

14590

Atlantic Coastal Plain Clay-Based Carolina Bay Wetland

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Chris Szell	cszell@tnc.org	Milo Pyne	Milo_pyne@natureserve.org
None	None	Cecil Frost	cecil.frost@earthlink.net
None	None	Mike Schafale	Michael.schfale@ncmail.net

Reviewer: Tim Christiansen, timothy.a.christiansen.nfg@mail.mil

Vegetation Type

Woody Wetland

Map Zone

58

Geographic Range

This system is found in the Inner to Middle Coastal Plain, from southern North Carolina through South Carolina and into adjacent Georgia. It is most numerous and extensive in South Carolina (NatureServe 2006a).

Occurs only in highly acid, seasonally flooded depressions in North Carolina and South Carolina where it is restricted to the region of clay-based Carolina bays on the southern part of the Inner Coastal Plain (Schafale and Weakley 1990; NatureServe 2006b).

Biophysical Site Description

This system consists of wetlands associated with ovoid, shallow depressions with nearly flat bottoms in parts of the Atlantic Coastal Plain. The depressions have mineral soils with clay hardpans -- generally McColl (Typic Fragi aquult) and Rains (Typic Paleaquult) (Schafale and Weakley 1990) -- that trap and retain water from a combination of rainfall and exposure of a high regional water table. Some are essentially permanently flooded. Others contain water well into the growing season in most years, but water levels vary substantially from year to year and over longer climatic cycles. Fire is an important natural influence in dry times (NatureServe 2006a).

While most Carolina bays in the Outer Coastal Plain occur in sandy sediments and are filled with peat, most Carolina bays of the Inner Coastal Plain occur in loamy sediments and have mineral soils with clay hardpans (NatureServe 2006a).

Vegetation Description

Vegetation includes a series of primarily herbaceous and woodland associations -- *Taxodium ascendens/Cyrilla racemiflora* -- *Zenobia pulverulenta* Woodland (Coastal Plain Small Depression Swamp, CEGl003734, G2); *Taxodium ascendens/Panicum hemitomon* -- *Polygala cymosa* Woodland (Atlantic Coastal Plain Pond-cypress Savanna, CEGl003733, G2G3); and *Taxodium ascendens/Woodwardia virginica* Woodland (Pond Cypress Savanna, CEGl004441, G2?) (NatureServe 2006a).

The wettest sites have open water and floating-leaved aquatic vegetation or marsh vegetation of tall graminoids. Drier sites often have an open canopy of *Taxodium ascendens*, with a dense, often fairly species-rich herbaceous layer beneath. Many annual species are present. Some sites have similar herbaceous vegetation without trees. A few occurrences are shrubby, but none contain the dense shrub layers of characteristic pocosin species that occur in the bays with organic soils. Vegetational composition often varies substantially from year to year, in response to differences in water levels and drawdown times. Seed banking plays an important role in component communities (NatureServe 2006a).

If we base this model on Schafale and Weakley (1990) third approximation Cypress Savanna, which is the most common community type in Clay-based Bay, the canopy is an open-structured savanna or woodland that encompasses very acid, species-poor communities in which *Taxodium ascendens* dominates the canopy. The subcanopy stratum is usually poorly developed. *Nyssa biflora*, *Pinus taeda*, *Pinus serotina*, *Liquidambar styraciflua*, and other wetland trees or shrubs may or may not be present. The shrub stratum is usually poorly developed as well, though scattered to moderately dense shrubs sometimes occur. Shrubs include *Ilex amelanchier*, *Leucothoe racemosa*, *Cyrilla racemiflora*, and *Lyonia lucida*. The herb stratum is dominated by *Woodwardia virginica* (NatureServe 2006b).

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
TAAS	<i>Taxodium ascendens</i>	Pond cypress
NYBI	<i>Nyssa biflora</i>	Swamp tupelo
PITA	<i>Pinus taeda</i>	Loblolly pine
ILAM2	<i>Ilex amelanchier</i>	Sarvis holly
LER4	<i>Leucothoe racemosa</i>	Swamp doghobble
CYRA	<i>Cyrilla racemiflora</i>	Swamp titi
LYLU3	<i>Lyonia lucida</i>	Fetterbush lyonia
WOVI	<i>Woodwardia virginica</i>	Virginia chainfern

Species names are from the NRCS PLANTS database. Check species codes at <http://plants.usda.gov>.

Disturbance Description

These communities are apparently dependent on a combination of flooding and fire to maintain their open savanna structure (Schafale and Weakley 1990; NatureServe 2006b). After several years without flooding due to drought, young pine and hardwoods began to invade many sites. It remains to be seen if subsequent flooding in wetter years will eliminate them. These savannas undoubtedly burned periodically under natural conditions, and this would have helped restrict establishment of woody species. The frequency of natural burning is not known. Because the natural fire season was primarily in the summer when bays are often dry, Cypress Savannas may have burned fairly frequently. Peroni (1988) found that physiognomy of Cypress Savannas had remained relatively constant for the past 50yrs despite grazing and lack of fire (Schafale and Weakley 1990; NatureServe 2006b).

Variation in hydroperiod is the most important dynamic, causing rapid major changes in the herbaceous vegetation. Unlike the steeper-sided solution depressions, where many different hydroperiods are present within a short distance and vegetation zones simply shift, the flat-bottomed Carolina bays experience drastic yearly changes in hydroperiod over most of their

extent. Many plants persist in seed banks for periods of years when conditions are not suitable (NatureServe 2006a).

Fire is also an important process, spreading into the bays from adjacent uplands when conditions are dry. Unfortunately, the frequency of natural burning is not known (NatureServe 2006b). Fire prevents invasion by less water-tolerant trees during dry periods and interacts with flooding to affect vegetational composition. Where fire is removed, *Pinus taeda* and other hardwoods often invade the bays. Fire may also be important in preventing buildup of organic matter on the soil surface (NatureServe 2006a).

Fire Frequency Results

Severity	Min FI	Max FI
Replacement		
Moderate (Mixed)		
Low (Surface)		
All Fires		

Scale Description

Considered a small-patch system, most clay-based Carolina bays are one-half mile or less long. Some are isolated, while in places several bays may be close enough together to be considered part of the same occurrence (NatureServe 2006a).

Adjacency or Identification Concerns

Most occurrences were naturally associated with or embedded within Atlantic Coastal Plain Northern Wet Longleaf Pine Savanna and Flatwoods (CES203.265) and Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281). Most are now surrounded by heavily altered systems.

The distinction between the central concepts of this system and Atlantic Coastal Plain Southern Depression Pondshore (CES203.262) is well marked, with basin morphology, geographic range, and prevailing communities differing. However, there is a common set of plant species, including some rare ones, that occurs in both systems. Thus, there may be difficulty in defining the local boundary, and some atypical depressions may have to be placed in one system or the other based on the preponderance of evidence. This system is related to Atlantic Coastal Plain Northern Pondshore (CES203.518), which occurs farther north in the Coastal Plain, and to some of the flat-bottomed basin wetlands of Florida, which occur outside the range of this system to the south. Another similar ecological system includes the Southeastern Coastal Plain Natural Lakeshore (CES203.044) (NatureServe 2006a).

Issues or Problems

An increase of precipitation due to climate change may be detrimental because the bays will not have as much fire through them. This will cause an increase in shrubs and pines into the Carolina Bays. Fire intervals will be extended due to the increase of standing water in the Bays.

Many of the clay-based Carolina bays have been ditched and drained for agricultural use, while others have been timbered off. Remaining bays are nearly all degraded hydrologically and occur in highly fragmented landscapes (NatureServe 2006b).

Native Uncharacteristic Conditions

Comments

Succession Classes

Mapping Rules

Upper Layer Lifeform	Height (m)	Canopy Cover (%)									
		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Herb	0-0.5	A	A	A	A	A	A	A	A	A	A
Herb	0.5-1.0	A	A	A	A	A	A	A	A	A	A
Herb	>1.0	A	A	A	A	A	A	A	A	A	A
Shrub	0-0.5	A	A	A	A	A	A	A	A	A	A
Shrub	0.5-1.0	A	A	A	A	A	A	A	A	A	A
Shrub	1.0-3.0	A	A	A	A	A	A	A	A	A	A
Shrub	>3.0	A	A	A	A	A	A	A	A	A	A
Tree	0-5	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix
Tree	0-5	B con	B con	B con	B con	B con	B con	B con	B con	B con	B con
Tree	0-5	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf
Tree	5-10	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf
Tree	5-10	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix
Tree	5-10	B con	B con	B con	B con	B con	B con	B con	B con	B con	B con
Tree	10-25	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf
Tree	10-25	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix
Tree	10-25	B con	B con	B con	B con	B con	B con	B con	B con	B con	B con
Tree	25-50	B con	B con	B con	B con	B con	B con	B con	B con	B con	B con
Tree	25-50	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf
Tree	25-50	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix
Tree	>50	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf	C brdlf
Tree	>50	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix	C mix
Tree	>50	B con	B con	B con	B con	B con	B con	B con	B con	B con	B con

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

Description

Class A	27	Early Development 1 - All Structures
----------------	-----------	---

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
WOVI	Woodwardia virginica	Virginia chainfern	Lower
ANVI2	Andropogon virginicus	Broomsedge bluestem	Lower
PAHE2	Panicum hemitomon	Maidencane	Lower
PAVE2	Panicum verrucosum	Warty panicgrass	Lower

Description

Class A is a treeless state represented by relatively small canopy gaps within cypress savannas. Some clay-based bays (depression meadows) are completely treeless for long periods of time, but it is not clear how that relates to this model.

Option 1 refers to unfavorable hydrology and failure for cypress to generate.

Other indicator species include *Dichanthelium* spp., *Saccharum alopecuroidum*, *Carex striata*, *Rhynchospora inundata*, *R. tracyi*, *R. corniculata*, and *Scleria muehlenbergii*.

Maximum Tree Size Class

None

Class B	71	Mid Development 1 - Open
----------------	-----------	---------------------------------

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
TAAS	Taxodium ascendens	Pond cypress	Upper
WOVI	Woodwardia virginica	Virginia chainfern	Lower
ANVI2	Andropogon virginicus	Broomsedge bluestem	Lower
PAHE2	Panicum hemitomon	Maidencane	Lower

Description

Class B is characterized as a diverse savanna whose composition varies with flooding cycles. Characterized by a cypress savanna with cypress trees as the upper-layer lifeform over a grass/herbaceous layer. The herb composition will follow the hydrological cycle. Plants bank seeds when hydrology is favorable.

This stage alternatively succeeds to a closed state after a long period without fire.

Maximum Tree Size Class

Medium 9-21" DBH

Class C	2	Late Development 2 - Closed
----------------	----------	------------------------------------

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
TAAS	Taxodium ascendens	Pond cypress	Upper
PITA	Pinus taeda	Loblolly pine	Upper
ACRU	Acer rubrum	Red maple	Mid-Upper
NYBI	Nyssa biflora	Swamp tupelo	Mid-Upper

Description

Class C is characterized by a pond cypress savanna where a lack of fire has led to hardwood encroachment in the understory and a decline in the herbaceous graminoid groundcover. This class will look like dense trees or dense shrubs.

This is a woody-invaded state that develops with the long absence of both fire and flooding but is naturally very rare.

Other indicator species may include shrubs like *Ilex amelanchier*, *Leucothoe racemosa*, *Cyrilla racemiflora*, and *Lyonia lucida*.

Maximum Tree Size Class

Medium 9-21"DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	10
Mid1:OPN	11	Mid1:OPN	999
Late2:CLS	11	Late2:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start Age After Disturbance?	Years Since Last Disturbance
Mixed Fire	Early1:ALL	Early1:ALL	0.01	100	No	0
Replacement Fire	Early1:ALL	Early1:ALL	0.06	17	Yes	0
Optional 1	Early1:ALL	Early1:ALL	0.2	5	Yes	0
Alternative Succession	Mid1:OPN	Late2:CLS	1	1	Yes	50
Replacement Fire	Mid1:OPN	Early1:ALL	0.005	200	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.1	10	No	0
Replacement Fire	Late2:CLS	Early1:ALL	0.0025	400	Yes	0
Mixed Fire	Late2:CLS	Mid1:OPN	0.02	50	Yes	0
Surface Fire	Late2:CLS	Late2:CLS	0.04	25	No	0

Optional Disturbances

Optional 1: unfavorable hydrology

References

Bennett, S.H. and J.B. Nelson. 1990. Distribution and status of Carolina Bays in South Carolina. Draft manuscript, South Carolina Natural Heritage Program.

Bryant, J.P. 1964. Soils of the Carolina bays and interbay areas in Scotland County, N.C. Ph.D. Dissertation, N.C. State Univ.

Carter, J.H., III. 1978. Reconnaissance surveys of Carolina bays. Report to N.C. Natural Heritage Program.

Harrison, E.C. 1983. Protection planning for clay-based bays. Report to NC Nature Conservancy.

NatureServe. 2006a. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 18 July 2006.

NatureServe. 2006b. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed: January 10, 2007).

Nifong, T.D. 1982. The clay subsoil bays of North Carolina. Report to NC Natural Heritage Program and NC Nature Conservancy.

Peroni, P.A. 1988. A vegetation history of the North Carolina Nature Conservancy clay-based Carolina Bay Preserve with recommendations for Future Research. Report to NC Nature Conservancy.

Schafale, M. P. and A. S. Weakley. 1990. Classification of the Natural Communities of North Carolina, Third Approximation. North Carolina Department of Environment, Health and Natural Resources, Raleigh, NC, USA.

Sharitz, Rebecca R. 2003. Carolina Bay Wetlands: Unique habitats of the southeastern United States. *Wetlands* 23(3): 550-562.