

# COASTAL PLAIN DEPRESSION COMMUNITIES

## Contents

COASTAL PLAIN DEPRESSION COMMUNITIES .....	1
COASTAL PLAIN DEPRESSION COMMUNITIES THEME .....	2
KEY TO COASTAL PLAIN DEPRESSION COMMUNITIES .....	9
SMALL DEPRESSION POCOSIN (TYPIC SUBTYPE).....	12
SMALL DEPRESSION POCOSIN (BLUEBERRY SUBTYPE) .....	16
SMALL DEPRESSION SHRUB BORDER .....	18
COASTAL PLAIN DEPRESSION SWAMP (MIXED SUBTYPE).....	21
COASTAL PLAIN DEPRESSION SWAMP (POCOSIN SUBTYPE).....	24
COASTAL PLAIN DEPRESSION SWAMP (CYPRESS DOME SUBTYPE).....	26
VERNAL POOL.....	28
CYPRESS SAVANNA (TYPIC SUBTYPE).....	31
CYPRESS SAVANNA (ACIDIC SUBTYPE) .....	36
SMALL DEPRESSION DRAWDOWN MEADOW (TYPIC SUBTYPE).....	39
SMALL DEPRESSION DRAWDOWN MEADOW (BOGGY POOL SUBTYPE).....	43
SMALL DEPRESSION POND (TYPIC MARSH SUBTYPE).....	46
SMALL DEPRESSION POND (CUTGRASS PRAIRIE SUBTYPE .....	49
SMALL DEPRESSION POND (OPEN LILY POND SUBTYPE).....	52
FLOATING BOG .....	55

## COASTAL PLAIN DEPRESSION COMMUNITIES THEME

**Concept:** Coastal Plain Depression Communities are wetlands of relatively small, closed basins in the Coastal Plain, which pond water at least intermittently, and which lack the characteristics of Peatland Pocosins, Natural Lake Communities, and Maritime Wetlands. They occur in Carolina bays, limesink depressions, and a variety of other depressions on geologically young surfaces. Their vegetation is extremely varied, ranging from open water and herbaceous vegetation to shrubland and forest.

**Distinguishing Features:** Coastal Plain Depression Communities may be distinguished from most other Coastal Plain communities by their occurrence in small, closed basins that hold standing water at least at times. Most basins are distinctive, but the subtle topography of the outer Coastal Plain and the presence of seasonally high water tables and slow runoff from high rainfall events in many flat areas can make some basins difficult to recognize. In addition, excessive soil drainage in sandy areas allows some closed basins to never hold water and not to be wetlands at all. Therefore, the distinctive vegetation of the specific communities often is crucial for recognizing Coastal Plain Depression Communities.

If permanent standing water is present, Coastal Plain Depression Communities are distinguished from Natural Lake Communities by occurring in much smaller basins and having water bodies that are much smaller, lack wave action, and generally are more vegetated. Open water is not more than a couple of acres in size, consistent with the Cowardin et al.'s (1979) definition of palustrine rather than lacustrine wetlands as being less than 20 acres/8 hectares. Maritime Wetlands, which often occur in closed basins, are distinguished by locations on barrier islands, with the concomitant influence of salt spray, geologically younger surfaces, and the dynamic coastal environment. Coastal Plain Depression Communities do not include communities that fit the characteristics of Peatland Pocosins. Where Peatland Pocosins occur in depressions, the depressions are filled with moderate-to-deep organic matter accumulations and the vegetation is indistinguishable from other peatlands. However, the distinction can be subtle in transitional communities such as Small Depression Pocosins and some Coastal Plain Depression Swamps. Coastal Plain Depression Communities are distinguished from various closed basins of active floodplains, such as Oxbow Lakes and some Cypress–Gum Swamps, by the lack of river flooding. Piedmont and Mountain Upland Pools and Depressions are similar basin communities of the inland geologic regions, sometimes sharing species with Coastal Plain Depression Communities but also having distinctive vegetation.

Within the Coastal Plain Depressions theme, the communities are distinguished by the combinations of hydrology and vegetation. Small Depression Pocosins have dense shrubby vegetation, sometimes with an open tree canopy, resembling that of Peatland Pocosins and Streamhead Pocosins, though with some additional species. Coastal Plain Depression Swamps have a substantial tree canopy, generally of *Taxodium ascendens* or *Nyssa biflora*. The Pocosin Subtype may also have a substantial shrub layer, but the Cypress Dome Subtype has deep water and little shrub layer. Cypress Savannas occur in flat basins with substantial differences in water presence from year to year. They generally have an open canopy dominated by *Taxodium ascendens*. In the few treeless examples, floristic differences distinguish them. Wetter depressions

have herbaceous vegetation, but often have a ring of dense shrub and tree vegetation around their edge. This woody edge zone is recognized as the Small Depression Shrub Border community.

Herbaceous Depressions are divided into broad categories by wetness and the vegetation it promotes. Vernal Pools dry early and have facultative wetland plants, sometimes even upland species. Small Depression Drawdown Meadows have longer flooding but still a substantial dry period. They may fill a basin or occur as a broad band in zoned basins. Small Depression Ponds can hold water for much or all of the growing season. The Typic Marsh and Cutgrass Prairie subtypes are shallow enough that they are dominated by emergent large herbs, while the Open Lily Pond Subtype is dominated by floating or submersed herbs. The distinctive Floating Bog community encompasses the rare situations where a thick vegetation mat floating on water creates rooting sites for bog-like vegetation.

**Sites:** The most abundant sites for Coastal Plain Depression Communities are Carolina bays without peat (clay-based bays) and limesinks. Limesinks are collapse basins in sandy or loamy sediments believed to result from solution in buried limestone. Other depressions that support these communities include swales in relict inland sand dune systems and relict fluvial features on high river terraces that no longer flood. Limesink depressions often occur in clusters, with basins that vary in depth, steepness, and size occurring close together. Other depressions may also occur in clusters or may be isolated. A given basin may hold one community or may have two or three in an irregular or concentrically zoned complex.

**Soils:** Most depressions are small and are treated as unnamed inclusions in soil map units. Larger depressions, such as Carolina bays, may be mapped as a variety of wet Ultisols. McColl (Typic Fragiaquult) is often mapped for clay-based Carolina bays. Soils may be an important driver of differences among depression communities or may reflect them. Kirkman, et al. (2000), working in limesink clusters in southwest Georgia, found that what they called cypress savannas were correlated with clay while their marshes were correlated with sand. Denser cypress-gum swamps were correlated with more organic matter in the soil as well as longer hydroperiod.

**Hydrology:** Coastal Plain Depression Communities are distinguished by at least periods of standing water which cannot run off. Rain falling directly into the basin is a major source of water. Most basins have little or no surface watershed. Many basins are water table windows, with water levels rising and falling with the shallow ground water of adjacent uplands. However, many may also have perched water, with an impermeable layer preventing downward drainage when the surrounding water table falls. Some basins have outlet channels that allow drainage of excess water while retaining water of a certain depth. Water may be removed by infiltration in some cases but solely by evapotranspiration in others.

The hydroperiod – typical duration of flooding – is a crucial characteristic of depressions and is a major driver of the occurrence of the different communities. The centers of the deepest basins may remain flooded except in the most severe droughts. Most basins, however, have both flooded and drawdown periods, holding water in the winter but lacking it at least by late summer.

The variation in hydroperiod is also common and important in these communities. Water levels are sensitive to climatic cycles and to variation in weather from year to year. Some depressions

may be flooded throughout some years and dry throughout others. The steepness of the slope in the depression affects the community through its effect on the hydroperiod. Flat-bottomed basins have similar water levels over large areas, and the environment can be strikingly different from year to year. More sloping basins can have greater absolute variation in water level but retain a range of environments, allowing animals and even plants to shift in response.

**Vegetation:** Vegetation within this theme spans a very wide range of structure and composition, reflecting the range of wetness. In communities with trees, *Taxodium ascendens* or *Nyssa biflora* usually dominate, but *Acer rubrum* var. *trilobum*, *Magnolia virginiana*, *Persea palustris*, or *Pinus serotina* may occur in Small Depression Pocosin and Small Depression Shrub Border communities. Shrub layers may be similar to pocosins, with *Cyrilla racemiflora*, *Lyonia lucida*, and *Ilex coriacea* prominent, or may contain *Vaccinium fuscatum*, *Vaccinium corymbosum*, or, in the case of Small Depression Shrub Border, *Litsea aestivalis*.

Herbaceous composition is even more variable. Vernal Pools often are dominated by species that may be shared with uplands, particularly *Panicum virgatum* and *Andropogon* spp. Small Depression Ponds are most often dominated by *Nymphaea odorata* in the Open Lily Pond Subtype, or by *Hymenachne (Panicum) hemitomom* or *Leersia hexandra* in the other subtypes, but a variety of other large graminoids may be abundant. Between Vernal Pool and Small Depression Pond in wetness, Small Depression Drawdown Meadows may share species with both and may contain a high diversity of rare plants and of showy herbs such as *Polygala cymosa* and *Lachnanthes caroliniana*. Cypress Savannas too can support a highly diverse herb layer with many rare species. However, more acidic subtypes of several communities have a small set of characteristic herbs shared with pocosins, such as *Anchistea virginica*, *Lorinseria areolata*, and *Sphagnum* spp.

**Dynamics:** Coastal Plain Depression Communities tend to have a distinctive dynamic character driven by flooding and drawdown and their variations. Intensive study of depressional wetlands at Savanna River Plant and Ichauway Plantation in South Carolina (Mulhouse, et al. 2005, DeSteven and Toner 2004, Kirkman, et al. 2000, Kirkman 1995, Kirkman and Sharitz 1994, Kirkman and Sharitz 1993) has not been repeated in North Carolina but seems to be similar in broad outlines. However, those studies were focused on dominant species and addressed only a few of the species that can be dominant in North Carolina's communities.

Water levels fluctuate over the course of a year, generally being high in the winter and spring and drawing down with the higher temperatures and evapotranspiration in summer. The hydroperiod, the typical duration of flooding, affects the nature of the soil and is the most important driver of community types. Differences in typical water depth also are important and are at least somewhat independent of flooding duration. Some basins have relatively stable water levels while others may go from deep water to dry in many years.

There can be substantial variation from the normal hydroperiod, in response to weather. Stahle's (1988) dendrochronology work showed periods of persistent drought or high rainfall on a time scale of around 30 years. These changes for periods of several years perhaps have more effect on Coastal Plain Depression Communities than on any others. The South Carolina and Georgia studies documented some of the major changes in vegetation that are possible between wet and dry periods. During extended droughts, upland ruderal species such as *Andropogon virginicus*,

*Eupatorium capillifolium*, and *Pinus taeda* can establish. Species they characterize as fugitive species, such as *Iva microcephala*, *Croton elliotii*, *Kelloggchloa (Panicum) verrucosa*, and *Dichanthelium wrightianum*, appear. In North Carolina, *Cyperus* spp. sometimes are prominent in dried basins. The dominant species of wetter times may remain present at reduced cover or may disappear. Species of open water, such as *Nymphaea odorata* and *Utricularia* spp., may be absent or invisible during drought, while marsh dominants such as *Hymenachne hemitomom* persist but are joined by different species. The characteristic trees species, *Taxodium ascendens* and *Nyssa biflora*, likely only establish during dry periods, presumably resulting in natural populations with several distinct cohorts. These longer-term irregular or cyclic changes are sometimes referred to as disturbances in the literature but they are quite different from other kinds of natural or human disturbances that may occur.

During dry periods, fire appears to be an important part of ecological dynamics. Different Coastal Plain Depression Communities vary, but those dominated by dense herbaceous cover, such as Vernal Pool, Small Depression Drawdown Meadow, and the marsh subtypes of Small Depression Pond can readily carry fire when dry. Even the wetter Open Lily Pond Subtype may burn if its bed becomes occupied by new grass and sedge cover during prolonged drought. The natural surrounding landscape, almost always some kind of longleaf pine community, burned frequently and would have provided ample opportunity for ignition. Thus, the loss of natural fire regimes has potentially altered the depression communities as well as the uplands. Prescribed fires conducted in the winter or confined to wetter growing seasons, when depressions are flooded, do not replace the natural fire regime. The characteristic tree species are at least somewhat tolerant of fire; nevertheless, burning must be an important mediator of their seedling establishment during dry periods.

Many published studies mention *Pinus taeda* establishing during drought, and *Liquidambar styraciflua* and *Acer rubrum* can also be observed invading depressions in North Carolina. Older trees of these species are not found in the less altered, more natural examples of these communities. It is widely believed that these trees should be eliminated when higher water levels return. This has been observed in some limesinks with the return of wetter conditions in 2017 and 2018 after a dry period. However, it appears that fire may be important in preventing the development of dense tree stands during drought. Some other sites have developed dense cover of trees that have become large enough that they may not be easily eliminated. It is often suggested that, once established, increased evapotranspiration by the trees may reduce the hydroperiod even when wet conditions return, and thus they may persist. The long time span of weather fluctuations makes the ultimate outcome unclear. Other alterations besides lack of fire may also be important. The invading tree species have greatly increased in the surrounding landscape with human disturbance, and their seed rain is vastly larger than under more natural conditions. The effects of drainage and ground water pumping in the wider landscape are also unclear but potentially important.

The changes in vegetation over time are driven both by the ecology of individual species and by interactions among them and with other factors. Mulhouse, et al. (2005) found that vegetation changed less in dense marsh vegetation such as *Hymenachne hemitomom* than in the more open *Leersia hexandra* and *Nymphaea odorata* ponds, and they suggested this was because of competitive effects of the vegetation. However, they noted that these vegetation types were associated with different hydroperiods, with more extreme fluctuation in the more open ponds,

making it impossible to disentangle the effects. The ability of *Hymenachne hemitomom*, *Leersia hexandra*, and *Coelorachis rugosa* to persist is aided by their ability for stem elongation with rising water (Kirkman and Sharitz 1993). *Leersia* elongates the most, but it was found to have less stomatal control and so to be less tolerant of drought. *Hymenache* was found to be dependent on standing dead stems to withstand flooding; it was harmed when stands burned shortly before flooding.

Seed banking is particularly important in these depression communities. It is a particularly beneficial strategy in an environment with such drastic changes. Kirkman and Sharitz (1994) found 72,600 seeds per square meter, with a total of 108 species and 17-19 species per plot. This was double the diversity of standing vegetation in 5x5 meter plots. Most species emerged in standard greenhouse conditions but several species, including rare ones such as *Helanthis tenellum* (*Echinodorus parvulus*) and *Sagittaria isoetiformis* emerged only with flooding. Perennial species that reproduce in their first year were particularly important. Despite the size of the seed bank for some species, most species had low frequency, and important dominants such as *Leersia hexandra* and *Hymenachne hemitomom* were not important. These species rely primarily on vegetative reproduction and on persistence of individuals through varying conditions. The longevity of seed banks is not well known. The rediscovery of *Lobelia boykinii*, a rare species of North Carolina depressions, in a Delaware pond after an absence of 100 years, is probably extreme but points at the possibilities.

The longer term dynamics of depressions are necessarily less well known. The few pocosin-dominated, peat-filled Carolina bays that have been studied appear to have once had open vegetation that may have been akin to Coastal Plain Depression Communities. However, given the time spans involved, it is more likely that changes in climate drove the change rather than successional time. Kirkman (1995) notes that some authors have interpreted concentric zonation as representing hydrarch succession, as it is often interpreted in glacial kettle hole lakes. They note that some take the different communities in different depressions to represent successional stages, such as a progression from mineral to organic soils and from herbaceous to woody vegetation. This is possible, but it seems more likely that they represent stable patterns in relative equilibrium with typical hydroperiods and fire regimes. However, it is possible that there are stable states that are rarely created but, once created, persist indefinitely by altering flammability or preventing reproduction of other species.

Carolina bays appear to be stable landforms at present and are probably all around the same age, but limesink depressions in a cluster may form at different times and may change as the underground solution continues. A new pond was formed in the Patsy Pond limesink complex in Croatan National Forest in 2003 and offers a chance to observe the changes first hand. Directional changes that can be expected in limesink depressions include erosion of the sides to create gentler slopes, filling of the bottom by eroded material to make them shallower, accumulation of organic matter or wind-blown clay, and development of a spodic soil horizon. The latter two process would gradually create an impermeable layer that would perch water. Thus ponds might become more independent of water tables over time and hydroperiods shift. The pace of such changes is not known but must be slow. The 2003 new limesink can be seen to have somewhat softened edges but remains nearly vertical-sided and with only sparse vegetation. The variation in ponds within a

cluster may be related to such slow successional processes but is also related to the initial steepness, size, and depth of basins and how they interact with water tables.

**Comments:** Coastal Plain Depression Communities are some of the most difficult to classify for the purposes of the 4<sup>th</sup> Approximation, where enduring characteristics are emphasized. The extreme temporal variability in their environmental conditions and vegetation makes it difficult to tell what characteristics are enduring. Observation may be close to impossible in wet years and yet give false impressions if done during drought. All observations need to be interpreted in light of the relationship of current conditions to the long term variation.

Classification also is difficult because of uncertainty about the best spatial scale to use. While some depressions have homogeneous vegetation, in many the vegetation is strongly zoned. Zones may be recognized at a broad range of scales, down to just a couple meters wide. A classification of 1 meter square plots would potentially look very different from a classification of 1/10 hectare plots in the same places. At the same place, a whole-site species list might include many species that would never actually occur close to each other. The 3<sup>rd</sup> Approximation subsumed the zones, classifying a whole depression as one community based on the wettest or the most predominant portion. The 4<sup>th</sup> Approximation uses a middle ground approach, distinguishing a small number of communities that can represent broad zones within a single basin. The rationale for this change in approach is that the communities at this scale often are separated. Though a single depression could contain 3 or 4 zonal communities, most do not have that many well developed examples. The best developed, most extensive examples often are in different depressions. Conservation of their diversity is best served if they are tracked separately.

For limesink depressions and other outer Coastal Plain members of this theme, observations and synthesis by Richard LeBlond, contained in Natural Heritage Program reports and personal communications, has been a major contribution to this classification. His work is based on whole-site species lists and specific descriptions of zones and of the role of basin configuration. For Carolina bay depressions, Nifong's (1998) plot-based quantitative study contributes heavily to this classification. His analysis units are 10 meter square plots, but many are extracted from 1/10 hectare Carolina Vegetation Survey (CVS) plots. The sampling spanned a period of many years; the resulting mix of spatial and temporal variation is partially confounded; this is recognized in some places but perhaps not throughout. For these reasons, interpretation for the purpose of the Fourth Approximation is difficult and remains somewhat uncertain. More experience is needed in applying it, and further refinement of the units in this theme is likely. There is a need both for extensive study that compares depressions over a short period of time and for long-term study of the range of variation in single sites.

Coastal Plain Depression communities are better represented in the published literature in South Carolina and Georgia. Though it is difficult to match published names to our classification, much of our understanding of dynamics comes from this area.

#### **References:**

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Service. FWS/OBS-79-31.

- De Steven, D., and M.M. Toner. 2004. Vegetation of Upper Coastal Plain wetlands: environmental templates and wetland dynamics within a landscape framework. *Wetlands* 24: 23–42.
- Kirkman L.K. 1995. Impacts of fire and hydrological regimes on vegetation of depression wetlands of the southeastern USA. Pages 10-20 In S.I. Cerulean and R.T. Engstrom (Eds). *Fire in wetlands: a management perspective*. Proceedings of the Tall Timbers Fire Ecology Conference No. 19. Tall Timbers Research Station, Tallahassee, FL.
- Kirkman, L.K., R.C. Goebel, L. West, M.B. Drew, and B.J. Palik. 2000. Depressional wetland vegetation types: A question of community development. *Wetlands* 20: 373-385.
- Kirkman, L.K. and R.R. Sharitz. 1993. Growth in controlled water regimes of three grasses common in freshwater wetlands of the southeastern USA. *Aquatic Botany* 44: 345-359.
- Kirkman, L.K., and R.R. Sharitz. 1994. Vegetation disturbance and maintenance of diversity in intermittently flooded Carolina bays in South Carolina. *Ecological Applications* 41: 177-188.
- Mulhouse, J.M., D. De Steven, R.F. Lide, and R.R. Sharitz. 2005. Effects of dominant species on vegetation change in Carolina bay wetlands following a multi-year drought. *Journal of the Torrey Botanical Society* 132: 411-420.
- Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.
- Stahle, D. W., M. K. Cleaveland, and J. G. Hehr. 1988. North Carolina climate changes reconstructed from tree rings: A.D. 372-1985. *Science* 240:1517-1519.



## KEY TO COASTAL PLAIN DEPRESSION COMMUNITIES

1. Community dominated by woody vegetation, with a substantial (though often open) tree canopy or shrub layer.
  2. Community a narrow band around the edge of a nonwoody depression community, adjacent to the upland on one side; vegetation dense shrubs and often an open tree canopy; dominant species usually shrubs shared with pocosins (*Lyonia lucida*, *Cyrilla racemiflora*, *Ilex glabra*, *Ilex coriacea*, but potentially also *Vaccinium* spp., *Litsea aestivalis*, *Ilex myrtifolia*, and others).....  
..... **Small Depression Shrub Border**
  2. Community filling the basin or a substantial part if it, not a narrow band on the edge; vegetation various, with or without dense shrubs shared with pocosins.
  3. Community in natural condition with a dense herb layer that often varies year to year with changing water levels; with an open tree canopy of *Taxodium ascendens*; occurring in a broad, flat basin, usually clay-based Carolina bays but occasionally other flat outer Coastal Plain depressions.
    4. Community with a diverse herb layer that varies substantially with water levels, often containing *Dichanthelium wrightianum*, *Rhexia aristosa*, *Scleria reticularis*, *Scleria muhlenbergii*, *Rhynchospora inundata*, *Rhynchospora filifolia*, *Eupatorium leucolepis*, *Eupatorium paludicola*, *Kellogglochia (Panicum) verrucosa*, *Pluchea baccharis (rosea)*, *Boltonia asteroides*, and *Eleocharis tricostata*, as well as some more widespread species such as *Hymenachne (Panicum) hemitomon* and *Kellogglochia (Panicum) verrucosa*. ..... **Cypress Savanna (Typic Subtype)**
    4. Community with a less diverse herb layer dominated by species of the most extremely acid-tolerant plants, such as *Sphagnum* spp., *Anchistea virginica*, *Carex striata*, *Carex glaucescens*, *Lachnanthes caroliniana*, *Hymenachne (Panicum) hemitomon*, *Kellogglochia (Panicum) verrucosa*, and *Centella erecta*. ..... **Cypress Savanna (Acidic Subtype)**
  3. Community in natural condition with a sparse herb layer; with a dense shrub layer or, if shrubs less dense, with a dense or only slightly open tree canopy of *Nyssa biflora*, *Taxodium ascendens*, or *Pinus serotina*; in various kinds of basins, including clay-based Carolina bays, limesinks, and deep swales.
    5. Canopy dominated by *Pinus serotina*, or canopy absent and shrub layer dense and pocosin-like.
    6. Community with a dense shrub layer dominated by varying combinations of *Lyonia lucida*, *Cyrilla racemiflora*, *Ilex glabra*, *Ilex coriacea*, *Zenobia pulverulenta*, *Vaccinium* spp., or *Ilex laevigata*; *Smilax laurifolia* often abundant. .... **Small Depression Pocosin (Typic Subtype)**
    6. Community with a dense shrub layer dominated by *Vaccinium fuscatum* or *Vaccinium formosum*, sometimes with some *Eubotrys racemosa* or *Viburnum nudum* .....  
..... **Small Depression Pocosin (Blueberry Subtype)**
  5. Canopy dominated by *Nyssa biflora* or *Taxodium ascendens*; *Pinus serotina* absent.
    7. Community with little shrub layer except on the edges; predominantly shrub *Ilex myrtifolia*; canopy usually dominated by *Taxodium ascendens*; sometimes with floating-leaf aquatic plants beneath; basin with deep ponded water, present most or all of most years; occurring in steep-sided limesinks ..... **Coastal Plain Depression Swamp (Cypress Dome Subtype)**
    7. Community with a well-developed shrub layer of various species; canopy dominated by either *Nyssa biflora* or *Taxodium ascendens*; water shallow, present only briefly in the growing season in most years; occurring in flat or sloping basins, including clay-based Carolina bays, limesinks, and other depressions.
      8. Shrub layer dominated by varying combinations of *Lyonia lucida*, *Cyrilla racemiflora*, *Ilex glabra*, *Ilex coriacea*, *Zenobia pulverulenta*, *Vaccinium* spp., or *Ilex laevigata*; *Smilax laurifolia* often abundant. .... **Coastal Plain Depression Swamp (Pocosin Subtype)**

8. Shrub layer dominated by other species, such as *Cephalanthus occidentalis*, *Morella cerifera*, *Eubotrys racemosa*, *Itea virginica*, *Leucothoe axillaris*, and *Arundinaria tecta*. .....  
 ..... **Coastal Plain Depression Swamp (Mixed Subtype)**

1. Community not dominated by woody vegetation; trees or shrubs absent or sparse, not dense enough to affect the lower strata.

9. Community with nearly permanent standing water, staying flooded throughout most years, drawing down only in drought.

10. Vegetation a dense, interwoven, free-floating mat of *Sphagnum* or vascular plants. **Floating Bog**

10. Vegetation dominated by floating-leaf plants such as *Nymphaea* and *Nuphar*, submersed plants, or occasionally small floating plants such as *Lemna*. .....  
 ..... **Small Depression Pond (Open Lily Pond Subtype)**

9. Community with seasonal standing water, normally dry sometime in the growing season in all but the wettest years.

11. Season of standing water very short, absent in some years; herb layer dominated by *Andropogon*, *Panicum virgatum*, or species of similar water tolerance..... **Vernal Pool**

11. Season of standing water moderate to long, though drawing down most years.

12. Season of flooding long, drawing down only late in the growing season in most years; soil somewhat mucky; vegetation marsh-like, of more water-tolerant species, relatively stable from year to year.

13. Vegetation dominated by *Leersia hexandra* in most years, though *Kellochloa verrucosa* may dominate at times..... **Small Depression Pond (Cutgrass Prairie Subtype)**

13. Vegetation dominated by other species, usually tall graminoids such as *Hymenachne (Panicum) hemitomom*, *Eleocharis equisetoides*, *Rhynchospora inundata*, or *Rhynchospora harperi*. ..... **Small Depression Pond (Typic Marsh Subtype)**

12. Season of standing water typically medium, intermediate between that of Vernal Pool and Small Depression Pond; soil usually sand, without muck.

14. Community in a broad flat-bottomed basin such as a clay-based Carolina bay; vegetation usually with an open canopy of *Taxodium ascendens*, or evidence of such a canopy in the past; if *Taxodium* canopy is absent, then the herbaceous vegetation containing species such as *Coelorachis rugosa*, *Eriocaulon compressum*, *Saccharum giganteum*, *Diodia virginiana*, and *Hypericum cistifolium* as well as more widespread species; most examples in clay-based Carolina bays in the inner Coastal Plain, very rare in the outer Coastal Plain.

15. Community with a diverse herb layer that varies substantially with water levels, often containing *Dichanthelium wrightianum*, *Rhexia aristosa*, *Scleria reticularis*, *Scleria muhlenbergii*, *Rhynchospora inundata*, *Rhynchospora filifolia*, *Eupatorium leucolepis*, *Eupatorium paludicola*, *Kellochloa (Panicum) verrucosa*, *Pluchea baccharis (rosea)*, *Boltonia asteroides*, and *Eleocharis tricostata*, as well as some more widespread species such as *Hymenachne (Panicum) hemitomom* and *Kellochloa (Panicum) verrucosa*. .....  
 ..... **Cypress Savanna (Typic Subtype)**

15. Community with a less diverse herb layer dominated by species of the most extremely acid-tolerant plants, such as *Sphagnum* spp., *Anchistea virginica*, *Carex striata*, *Carex glaucescens*, *Lachnanthes caroliniana*, *Hymenachne (Panicum) hemitomom*, *Kellochloa (Panicum) verrucosa*, and *Centella erecta*. ..... **Cypress Savanna (Acidic Subtype)**

14. Community in a sloping basin such as a limesink depression or swale; vegetation usually with sparse or no trees (though a dense Small Depression Shrub Border often is present); herb layer lacking the above species, instead containing species such as *Centella erecta*, *Lachnanthes*

*caroliniana*, *Panicum tenerum*, *Juncus pelocarpus (abortivus)*, and *Proserpinaca pectinata*; most examples in limesink depressions in the outer Coastal Plain.

16. Community with a diverse flora including species such as *Euthamia caroliniana*, *Dichanthelium erectifolium*, *Dichanthelium wrightianum*, *Eriocaulon compressum*, *Scleria muhlenbergii*, *Drosera intermedia*, and *Rhexia cubensis* as well as the above species. ....  
..... **Small Depression Drawdown Meadow (Typic Subtype)**

16. Community with a less diverse flora confined to the most acid-tolerant species such as *Anchistea virginica*, *Carex striata*, and *Sphagnum* spp. ....  
..... **Small Depression Drawdown Meadow (Boggy Pool Subtype)**

## SMALL DEPRESSION POCOSIN (TYPIC SUBTYPE)

**Concept:** Small Depression Pocosins are shrubby wetlands of small basins that have shallow and short-lived surface flooding, with dense shrub layers of species shared with Peatland Pocosin communities. They either have no tree canopy or have an open canopy with characteristic pocosin tree species such as *Pinus serotina*, *Magnolia virginiana*, and *Persea palustris*. They are conceptually transitional between the Coastal Plain Depression Swamps and Peatland Pocosins themes. The Typic Subtype encompasses communities where the shrub layer is dominated by the most typical pocosin shrubs, generally *Cyrilla racemiflora*, *Lyonia lucida*, *Ilex coricea*, *Ilex glabra*, and *Smilax laurifolia*. *Vaccinium* spp. often are present but do not dominate in this subtype.

**Distinguishing Features:** Small Depression Pocosins are distinguished from most other depressional wetlands by the presence of a dense shrub layer that fills all or most of the basin. Swamp trees such as *Taxodium ascendens* and *Nyssa biflora* may be present, even abundant, but *Pinus serotina*, *Magnolia virginiana*, and *Persea palustris* are more typically dominant if there is a canopy. Small Depression Shrub Border occurrences may share many species but occur as a narrow band on the edge of a deeper depression. They are more subject to fluctuating water levels and are exposed to natural edge effects from more open vegetation on both sides. Several species are often present in Small Depression Shrub Borders but not often in Small Depression Pocosins, including *Ilex myrtifolia*, *Ilex cassine*, and *Litsea aestivalis*, as well as *Hymenachne hemitomom* and other species of more open pond communities.

Small Depression Pocosins are distinguished from Peatland Pocosin and Streamhead Pocosin communities by occurring in small closed basins where water is ponded at times. Small Depression Pocosins have a number of species that are scarce or absent in other communities called pocosins, including *Vaccinium* spp., *Nyssa biflora*, *Pinus taeda*, *Taxodium ascendens*, and other species more associated with ponds. There is not a defined size limit for Small Depression Pocosins, but few examples are more than 10 acres and most are much smaller.

The Typic Subtype is distinguished from the Blueberry Subtype by the dominance of characteristic pocosin species such as *Cyrilla racemiflora*, *Lyonia lucida*, *Ilex coriacea*, *Ilex glabra*, and *Smilax laurifolia*, with only a small minority presence of *Vaccinium* spp.

It can be difficult to distinguish natural Small Depression Pocosin communities from successional vegetation that can invade open depressional wetlands with drought and exclusion of fire. *Liquidambar styraciflua* is one species that is seldom, if ever, found in true Small Depression Pocosins. Dominant *Pinus taeda* or *Acer rubrum* and weedy herbaceous species may also suggest alteration. However, they may increase in disturbed and fire-suppressed Small Depression Pocosins as readily as in open communities and do not definitively indicate a former open community. The context can also be an important clue; Small Depression Pocosins are likely to be similarly or less altered than the surrounding communities, rather than more altered. The presence of relict species from the open community can also be a clue. Historical accounts or photographs showing nonwoody vegetation, if not taken at a time of artificial clearing, may be crucial for confidence.

**Synonyms:** *Pinus serotina* / *Cyrilla racemiflora* - *Lyonia lucida* - *Vaccinium fuscatum* Woodland (CEGL004434).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Small Depression Pocosins usually occur in shallow limesinks, less often in relict dune swales or small Carolina bays.

**Soils:** Soils have a shallow to deep organic surface layer. Most occurrences are smaller than the minimum map unit for soil surveys and are included in the surrounding upland soil units. A few are mapped as Murville or Lynn Haven (Typic Haplaquods) or Torhunta (Typic Humaquept).

**Hydrology:** Surface water is shallow and seldom persists far into the growing season. Saturation may persist for much of the year. Some Small Depression Pocosins have small, deeper pools that hold water longer.

**Vegetation:** The vegetation is a dense shrubland with a variable density of trees. The shrub layer is a mix of species without strong dominance. In CVS plot data and site descriptions, *Cyrilla racemiflora*, *Lyonia lucida*, *Persea palustris*, and *Vaccinium formosum* are usually present with high cover, while *Ilex coriacea*, *Arundinaria tecta*, and in the southern part of the state, *Ilex myrtifolia* can have high cover in some examples. *Magnolia virginiana*, *Vaccinium fuscatum*, and *Aronia arbutifolia* are frequent but with lower cover, and *Clethra alnifolia*, *Viburnum nudum*, and *Eubotrys racemosa* are also fairly frequent. *Litsea aestivalis* and *Zenobia pulverulenta* have been found occasionally. *Smilax laurifolia* is frequent and may be dense. *Smilax rotundifolia*, *Smilax glauca*, and *Muscadinia rotundifolia* also often are present. Trees are variable in cover and species. *Pinus serotina* is highly constant, but *Nyssa biflora*, *Pinus taeda*, and *Acer rubrum* also are often found. A few have *Taxodium ascendens* or *Chamaecyparis thyooides*. Herbs are generally sparse, with the exception that *Sphagnum* sp. may form substantial mats and *Anchistea virginica* may have moderate cover. The outer edge of the community, where it borders longleaf pine communities, can have diverse ecotonal vegetation with species typical of wetter longleaf pine communities such as Sandy Pine Savanna. The interior of the community may have a small opening where water is the deepest, and species of Small Depression Drawdown Meadow or Depression Pond may be present in small numbers.

**Range and Abundance:** Ranked G2G3. The synonymized association is attributed only to North Carolina and South Carolina, though related communities must occur in much of the Coastal Plain. The abundance of this community is less certain than most. Example are often overlooked in site surveys and plot sampling alike, and they may be lumped if larger pocosin are nearby.

**Associations and Patterns:** Small Depression Pocosins usually fill entire small basins, though rarely they may occupy half a basin. They often occur in complexes with other Coastal Plain Depression Communities in limesink clusters or relict dune systems and are usually set in a matrix of Wet or Dry Longleaf Pine Communities.

**Variation:** Three weakly marked variants are recognized to encourage further study:

1. Pocosin Variant consists largely of species typical of Pond Pine Woodland and High Pocosin, perhaps containing *Vaccinium fuscatum* or *Acer rubrum* var. *trilobum* but lacking “pond” species.

This variant is most closely related to Peatland Pocosins, It is known from the middle outer Coastal Plain and inland areas.

2. Swamp Variant has a typical shrub layer but has a *Pinus taeda*, *Nyssa biflora*, *Acer rubrum* var. *trilobum*, or *Taxodium ascendens* rather than *Pinus serotina* as the primary tree component. It appears transitional to Small Depression Swamp forest. Occurrences are widespread in the Coastal Plain.

3. Pond Variant contains shrub species typical of wetter, more open small depressions, such as *Ilex myrtifolia*, *Litsea aestivalis*, and *Ilex cassine*, in addition to pocosin shrubs. It thus shows a relationship with Small Depression Drawdown Meadow. This variant is known only in the southern Outer Coastal Plain in the state.

**Dynamics:** Dynamics of Small Depression Pocosins are not well known. Like true pocosins, they may burn if fires occur in surrounding vegetation when they are dry. Fires may be mild surface fires that have limited effect or may be catastrophic fires that carry through the shrubs and top-kill all woody vegetation. Fires may more often merely scorch the shrubs on the edges without penetrating the interior.

The ecological processes that create and maintain the distinction between these communities and other Coastal Plain Depression Communities are poorly known. They may result from gradual accumulation of organic matter that reduced water depth, perhaps during the Pleistocene. Organic matter may also keep the soil saturated and reduce drying during drawdown periods, favoring pocosin species. However, it is interesting that they often occur in close proximity to other depression wetlands in limesink complexes or dune systems, suggesting that some range of basin characteristics led them to develop differently.

Shrub-dominated basins are often believed to result from succession in more open wetlands. Belief that most Small Depression Pocosins have developed quickly as a result of modern fire suppression is not compelling. Open wetlands that are known to have become dense recently tend to be dominated by *Acer rubrum*, *Liquidambar styraciflua*, and other species not characteristic of pocosins. Many typical examples of Small Depression Pocosins have more open basins nearby with similar fire histories. However, this question warrants further investigation. The presence of species more typical of other depression communities, interpreted as an indication of their relationships, could be relict species from a past state of vegetation.

**Comments:** The name and theme placement of Small Depression Pocosins indicates their marginal or intermediate character. They share dominance by the suite of woody species characteristic of all pocosins. At the same time, they have a number of additional species shared with other communities, as well as a distinctive environment. Differences in invertebrate communities are not known but may be stronger.

The boundary between Small Depression Pocosins and Peatland Pocosins needs more investigation. Larger peat-filled Carolina bays support pocosin vegetation that is indistinguishable from domed peatlands. They do not tend to contain surface water beyond local puddles, apparently because peat has accumulated above the level where water would pond. Pond Pine Woodland occurs in shallow swales of relict dune topography. These areas too do not tend to contain standing water, and it appears that organic matter, though shallow, has accumulated to the level of the

seasonal high water table. The basins where Small Depression Pocosin occurs are smaller and steeper. They do not have such deep organic deposits and are visibly lower than the surrounding land, with room for water to sit on the surface.

**Rare species:** Rare species associated with Small Depression Pocosins generally occur only on the margin, in the ecotone with adjacent communities. *Lysimachia asperilifolia*, *Drosera filiformis*, or other species of savanna-pocosin ecotones may occasionally be found. *Litsea aestivalis* and *Ilex amelanchier*, species of other Coastal Plain Depression Communities, have been found occasionally.

**References:**

## SMALL DEPRESSION POCOSIN (BLUEBERRY SUBTYPE)

**Concept:** Small Depression Pocosins are shrubby wetlands of small basins that have shallow and short-lived surface flooding, with dense shrub layers of species shared with Peatland Pocosin communities. The Blueberry Subtype consists of those where *Vaccinium formosum* and/or *Vaccinium fuscatum* dominate and other pocosin shrubs are less abundant. This subtype is quite rare, and it is unclear what drives its occurrence and distinction from the other subtype.

**Distinguishing Features:** Small Depression Pocosins are distinguished by the presence of a dense shrub layer that fills all or most of the basin. The Blueberry Subtype is distinguished by the dominance of *Vaccinium fuscatum* and *Vaccinium formosum* over more typical pocosin shrubs. Other deciduous shrubs not characteristic of pocosins, such as *Eubotrys racemosa* or *Viburnum nudum*, should be counted along with the *Vaccinium* in determining predominance.

**Synonyms:** *Vaccinium formosum* - *Vaccinium fuscatum* / *Sphagnum cuspidatum* Shrubland (CEGL003907).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Small Depression Pocosins usually occur in shallow limesinks, less often in relict dune swales or small Carolina bays.

**Soils:** Soils have a shallow to deep organic surface layer. All occurrences are smaller than the minimum map unit for soil surveys and are included in the surrounding upland soil units.

**Hydrology:** Surface water is shallow and seldom persists far into the growing season. Saturation may persist for much of the year. Examples may have small, deeper pools that hold water longer.

**Vegetation:** The vegetation is a dense shrubland with a variable density of trees. *Vaccinium formosum* and *Vaccinium fuscatum* are the most abundant species. Associated shrub species may include abundant *Lyonia lucida*, *Cyrilla racemiflora*, *Lyonia ligustrina*, or *Zenobia pulverulenta*, as well as less typical pocosin species such as *Eubotrys racemosa* or *Lyonia mariana*. *Smilax laurifolia* may be abundant. Trees range from an open canopy to sparse. Species may include *Pinus serotina*, *Nyssa biflora*, *Acer rubrum* var. *trilobum*, and *Pinus taeda*. Herbs are generally sparse, but *Sphagnum* spp. may occur in large patches. *Anchistea virginica* is the only other frequent and abundant herb, but species such as *Rhynchospora fascicularis* and *Andropogon glaucopsis* have been noted in openings.

**Range and Abundance:** Ranked G3? but perhaps rarer. It is extremely rare in North Carolina, with only a handful of examples known. Examples are in the Bladen Lakes region and the far northeastern part of the state, but others could be found elsewhere in the Coastal Plain. This community also occurs in South Carolina.

**Associations and Patterns:** This community tends to fill entire small basins, with only small inclusions that are more open. The Blueberry Subtype is currently known only from relict dune fields.



**Variation:** Examples are too rare to define variants. Some examples are transitional to other communities, with a fairly dense tree canopy or an unusually open shrub layer.

**Dynamics:** Dynamics of the Blueberry Subtype are particularly poorly known. They probably are similar to the Typic Subtype, but the deciduous shrub layer is less likely to carry intense fire through the community. Questions of why this community develops in particular places are similar to those for the Typic Subtype. The occurrence in relict dunes may be important, as these areas more often have Sand Barren communities that carry fire less well than other longleaf pine communities.

**Comments:** Only a single CVS plot is attributed to this community, and it appears to be only marginally developed (e.g., it has a large component of *Pinus palustris*). The factors that create the Blueberry Subtype rather than the Typic Subtype are not known. The Blueberry Subtype may occur in steeper-sided basins. It probably has deeper water and possibly a longer duration of flooding, but it may also dry more and be less saturated when the water goes down.

**Rare species:** No rare species are known to be associated with the Blueberry Subtype.

**References:**

## SMALL DEPRESSION SHRUB BORDER

**Concept:** Small Depression Shrub Border communities are narrow shrub thickets that occur as an outer zone on the rims of Small Depression Pond, Small Depression Drawdown Meadow, and Vernal Pool communities. These communities are narrow enough to be strongly subject to edge effects from both sides. They contain a mix of pocosin species, such as *Cyrilla racemiflora*, *Lyonia lucida*, and *Smilax laurifolia*, along with some characteristic pond species such as *Ilex myrtifolia*, *Ilex cassine*, *Litsea aestivalis*, and *Cephalanthus occidentalis*. Trees may be sparse or dense but have little effect on the shrubs because of open edges. They may include *Pinus serotina*, but more often will be *Nyssa biflora*, *Acer rubrum*, *Magnolia virginiana*, and *Persea palustris*. Herbaceous species of the adjacent open wetland and the adjacent upland are usually present.

**Distinguishing Features:** Small Depression Shrub Border is distinguished from all other communities by the combination of shrub dominance and occurrence in a narrow zone on the edge of other, more open depressional wetlands. Small Depression Pocosins may contain some of the same species but will fill most or all of the basins they occur in and will not contain an appreciable amount of *Ilex myrtifolia*, *Ilex cassine*, *Litsea aestivalis*, or *Cephalanthus occidentalis*. Natural Lake Communities may share some species, but generally have a limited shrub layer. They occur on larger bodies of water where wave action is important.

**Synonyms:** *Cyrilla racemiflora* - *Lyonia lucida* Shrubland (CEGL003844). Small Depression Pond (3<sup>rd</sup> Approximation).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Small Depression Shrub Border communities occur primarily in limesinks but can occur in small Carolina bays and in relict dune swales.

**Soils:** Soils are generally sandy, with only a limited organic layer. Occurrences are smaller than the minimum map unit for soil surveys and are included in the surrounding upland soil units.

**Hydrology:** Surface water may be present early in the growing season and in unusually wet years. These communities occur on the edge of deeper depressions. This may lead to greater soil drainage during drawdown periods.

**Vegetation:** The vegetation is dominated by a dense-to-moderate shrub layer. Trees usually have moderate cover but may be denser or may be absent. Both site descriptions and the limited CVS plot data have *Cyrilla racemiflora* as the most constant and usually dominant species. *Lyonia lucida* often is abundant. Other shrubs that may be present, occasionally abundant, include *Vaccinium fuscatum*, *Vaccinium formosum*, *Ilex glabra*, *Ilex coriacea*, *Ilex myrtifolia*, *Litsea aestivalis*, *Morella cerifera*, *Ilex cassine*, *Zenobia pulverulenta*, and *Symplocos tinctoria*. Vines may include *Smilax laurifolia*, *Smilax glauca*, *Smilax walteri*, and *Gelsemium sempervirens*. The tree component is highly variable. *Pinus serotina*, *Nyssa biflora*, *Pinus taeda*, *Persea palustris*, *Magnolia virginiana*, *Acer rubrum* var. *trilobum*, *Liquidambar styraciflua*, or other species may be abundant. The herb component is also variable, as species of the adjacent open pond community may extend into the woody border in substantial amounts and species of the adjacent upland may also be present. *Sphagnum* spp. is often present in patches. *Lachnanthes caroliniana*, *Centella*

*asiatica*, *Rhynchospora* spp., *Hymenachne hemitomon*, *Proserpinaca pectinate*, *Xyris* spp., *Carex striata*, and *Drosera* spp. have been reported, and many other species may possibly occur.

**Range and Abundance:** Ranked G3? The synonymized associated ranges from North Carolina to Mississippi or Louisiana. This community occurs in a wide variety of basins and is less extremely rare than many Coastal Plain Depression Communities in North Carolina.

**Associations and Patterns:** Small Depression Shrub Border is a zonal community that occurs with other Coastal Plain Depression Communities. Small Depression Drawdown Meadow and Small Depression Pond are the most frequent associates in the interior of the basin, but Cypress Savanna or Vernal Pool also are possible. On the upland side the adjacent community is usually some kind of longleaf pine community. Where Coastal Plain Depression Communities occur in clusters, Small Depression Shrub Borders are usually present around all or most more open communities. However, a few clusters lack them or have few depressions with them.

**Variation:** The indistinct variants parallel to those of Small Depression Pocosin may be recognized. All examples also vary with the transition to adjacent communities and in response to recent disturbances.

1. Pocosin Variant consists largely of species typical of Pond Pine Woodland and High Pocosin, though additional species such as *Vaccinium* spp. and *Morella cerifera* are usually present. *Pinus serotina* is the primary tree.
2. Swamp Variant consists of similar shrubs but with a more substantial canopy dominated by *Nyssa biflora*, *Pinus taeda*, *Liquidambar styraciflua*, or occasionally *Taxodium ascendens*. The presence of *Liquidambar styraciflua* is limited to the Sandhills region and other inland areas and may indicate a fine-textured soil version that should be a distinct variant. However, it is unclear if the *Liquidambar* is a long-term natural component or is a result of alteration.
3. Pond Variant has more shrubs not characteristic of pocosins, such as *Ilex myrtifolia*, *Litsea aestivalis*, and *Ilex cassine*.

**Dynamics:** Small Depression Shrub Border communities are potentially quite variable over time. Their natural dynamics and character are driven by a combination of seasonal but variable flooding and by intrusion of fire from the adjacent uplands, which are almost always longleaf pine communities. With fire suppression, shrub borders expand and shrubs become taller and denser, while the return of fire narrows them and confines them to wetter areas. Natural fires in the summer, fall, and in dry springs, would burn all the way through them and through the adjacent herbaceous wetland communities, top-killing the shrubs and possibly trees. The natural frequency of burning was presumably less frequent than in the uplands, but more frequent than at present. Prescribed fire programs that are confined to the winter or to mild conditions may never burn through these communities, allowing them to expand both into the upland edge and into the open pond communities. Some people believe that shrub border communities are entirely an artifact of inadequate fire. It is likely that some have developed in places where they did not naturally occur. These can be expected to consist solely of the more mobile species, or of species present nearby. However, those with characteristic pond species that are not widespread, such as *Litsea aestivalis*, almost certainly are natural, though perhaps altered in structure.

**Comments:**

**Rare species:** *Litsea aestivalis* is the only tightly associated rare plant. Rare species of longleaf pine/pocosin ecotones, such as *Dionaea muscipula*, occasionally occur on the upland edges. Rare amphibians that breed in depressional wetlands normally are in the adjacent wetter communities.

**References:**

## COASTAL PLAIN DEPRESSION SWAMP (MIXED SUBTYPE)

**Concept:** Coastal Plain Depression Swamps are depressional wetlands with a well-developed, closed or nearly closed tree canopy of *Taxodium ascendens* or *Nyssa biflora* but without a dense graminoid-dominated herb layer. They may or may not have a well-developed shrub layer. They are associated with deeper flooding than Small Depression Pocosins or Nonriverine Swamp Forests. The Mixed Subtype covers examples that do not have the characteristics of the other subtypes. They have shrub layers containing a mix of characteristic pocosin and swamp species. They are generally less deeply flooded than the Cypress Dome Subtype.

**Distinguishing Features:** Small Depression Swamps communities are distinguished from other Coastal Plain Depression Communities by the occurrence of a well-developed canopy of *Taxodium ascendens* or *Nyssa biflora* in a depressional wetland, without a well-developed herb layer. The shrub layer may range from dense to absent. Small Depression Pocosins can have an appreciable cover of these tree species but they do not form a well-developed canopy and are usually associated with pines. Small Depression Swamps are distinguished from other *Taxodium*- and *Nyssa*-dominated swamps, such as Nonriverine Swamp Forest and Cypress–Gum Swamp, by occurring Carolina bays, limesinks, or other closed depressions that are periodically ponded but lack river flooding.

The Mixed Subtype is distinguished from the Pocosin Subtype by the shrub layer having a significant component of species not characteristic of pocosins, such as *Cephalanthus occidentalis*, *Morella cerifera*, *Eubotrys racemosa*, *Itea virginica*, *Leucothoe axillaris*, and *Arundinaria tecta*, with only subordinate amounts of *Cyrilla racemiflora*, *Lyonia lucida*, *Ilex glabra*, *Ilex coriacea*, or *Zenobia pulverulenta*. It is distinguished from the Cypress Dome Subtype by lacking *Ilex myrtifolia* and by having other shrubs present.

**Synonyms:** *Taxodium ascendens* / (*Nyssa biflora*) / *Leucothoe racemosa* - *Lyonia lucida* - *Morella cerifera* Depression Forest (CEGL007420). Nonriverine Swamp Forest (3<sup>rd</sup> Approximation). Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Coastal Plain Depression Swamps usually occur in Carolina bays, larger limesinks, or occasionally in swales in relict dune systems.

**Soils:** Soils may be sandy, loamy, or clayey, and generally have little or no organic surface. Most examples are treated as inclusions in soil mapping.

**Hydrology:** The range of hydrology is not well known but flooding appears to be shallow to moderate and not to typically persist long into the growing season. It is uncertain if soils dry or remain saturated after drawdown.

**Vegetation:** The vegetation has a closed or somewhat open tree canopy dominated by *Taxodium ascendens* or *Nyssa biflora* or both. *Acer rubrum* var. *trilobum*, *Magnolia virginiana*, *Persea palustris*, or occasionally *Liquidambar styraciflua* may be present in the canopy or as an understory. The shrub layer is usually moderate to fairly dense but may be denser on the drier edges. It often contains substantial numbers of pocosin species, especially *Cyrilla racemiflora* and

*Lyonia lucida*, less often *Ilex glabra* or *Lyonia ligustrina*. The shrub layer also contains species not typical of pocosins, such as *Vaccinium formosum*, *Vaccinium fuscatum*, *Eubotrys racemosa*, *Morella cerifera*, *Clethra alnifolia*, *Itea virginica*, *Decodon verticillatus*, and rarely *Litsea aestivalis*. Vines, particularly *Smilax rotundifolia* or *Smilax laurifolia*, can form dense tangles. Herbs are often nearly absent or sparse, but denser patches may be present. *Sphagnum* spp. often is present. *Saururus cernuus*, *Juncus repens*, *Carex striata*, *Anchistea virginica*, *Lorinseria areolata*, *Panicum verrucosum*, or other species occur in some examples, all with very low constancy. *Tillandsia usneoides* may drape the trees, and *Hypericum walteri* or *Hypericum virginianum* may occur on tree bases and cypress knees.

**Range and Abundance:** Ranked G3. The synonymized associated ranges from North Carolina to Louisiana. It appears rare in North Carolina, though it ranges throughout the Coastal Plain and some examples may be overlooked. It may be more frequent in South Carolina, where clay-based Carolina bays are more numerous (Bennett and Nelson 1991).

**Associations and Patterns:** Coastal Plain Depression Swamps tend to fill entire basins. They are naturally bordered by dry or wet longleaf pine communities on their upland edges. Few of the remaining examples have intact surrounding vegetation.

**Variation:** Known examples are extremely variable, from ones transitional to the Pocosin Subtype to those with few pocosin shrubs. Perhaps most distinctive are those with *Decodon verticillatus* dominant in the shrub layer. Only one such example has been documented in North Carolina but several are known in South Carolina. No variants are recognized at present but they may be warranted.

**Dynamics:** The dynamics of the Mixed Subtype are particularly poorly known. The shrub layer is dense enough to potentially carry fire in some examples but not in others. The shrub component tends to be a mix of flammable and less flammable species. As in all Coastal Plain Depression Communities, fluctuating water levels may cause changes from year to year, but the long-lived woody vegetation is unlikely to change as much as in herbaceous communities.

**Comments:** This community is one of the least well understood of the Coastal Plain wetlands. With low potential for rare species, dense vegetation, and sometimes resemblance to more altered forests, site surveys often produce limited description. CVS data are limited, and the variability of vegetation makes classification of the existing plot data difficult. Nifong's (1998) grouping that best fits the Coastal Plain Depression Swamps had 10 vegetation types defined, 9 of them from a single site and most from a single plot.

The ecological factors that drive the occurrence of this community and separate it from other Coastal Plain Depression Communities are unclear. Many of the scarce examples are in altered landscapes and occur without natural context and may be altered as well. More work is needed on how to distinguish this community from successional vegetation that may grow up in more open wetlands with altered hydrology and fire exclusion. However, enough examples are known in better conditions to support belief in a natural community type. However, the relationship among the subtypes and the relationship of this subtype with Small Depression Pocosins, Cypress Savannas, and successional vegetation needs further investigation.

Nifong (1998) recognized several associations within the vegetational variation covered by this subtype: *Nyssa biflora* - *Taxodium ascendens* / *Liquidambar styraciflua* / *Ilex amelanchier* (9.1.1); *Nyssa biflora* - *Taxodium ascendens* / *Decodon verticillatus* / (*Smilax laurifolia*) / *Utricularia purpurea* (8.0.3); *Taxodium ascendens* / *Nyssa biflora* - *Acer rubrum* / (*Leucothoe racemosa* - *Vaccinium* spp. - *Zenobia pulverulenta*) / *Sphagnum* Bog (8.0.6).

**Rare species:** Vascular plants: *Litsea aestivalis* has been found in one example. No other rare species are known.

**References:**

Bennett, S.H., and J.B. Nelson. 1991. Distribution and status of Carolina bays in South Carolina. South Carolina Nongame and Heritage Trust Publications No. 1.

Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.

## COASTAL PLAIN DEPRESSION SWAMP (POCOSIN SUBTYPE)

**Concept:** Coastal Plain Depression Swamps are depressional wetlands with a well-developed, closed or nearly closed tree canopy of *Taxodium ascendens* or *Nyssa biflora* but without a dense graminoid-dominated herb layer. The Pocosin Subtype covers examples, generally in Carolina bays, with a dense shrub layer strongly dominated by the characteristic pocosin shrubs, mainly *Cyrilla racemiflora*, *Lyonia lucida*, *Ilex glabra*, and *Zenobia pulverulenta*, often along with *Ilex amelanquier*, *Vaccinium formosum*, and *Vaccinium fuscatum*. It is thus like a Small Depression Pocosin but with a well-developed swamp canopy.

**Distinguishing Features:** Small Depression Swamp communities are distinguished from other Coastal Plain Depression Communities by the occurrence of a well-developed canopy of *Taxodium ascendens* or *Nyssa biflora* in a depressional wetland, without a well-developed herb layer. The Pocosin Subtype is distinguished by the dense pocosin-like shrub layer beneath a swamp canopy. *Morella cerifera*, *Eubotrys racemosa*, *Itea virginica*, and *Leucothoe axillaris*, and other species not typical of pocosins are absent or scarce, except that *Vaccinium* spp. or *Ilex Amelanquier* often are present. Small Depression Pocosins conceptually grade into this subtype; the distinction is based largely on canopy development but the type of basin is usually different as well.

**Synonyms:** *Taxodium ascendens* / *Cyrilla racemiflora* - *Zenobia pulverulenta* Woodland (CEGL003734).

Ecological Systems: Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245). Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** The Pocosin Subtype occurs most often in Carolina bays, but is also known in limesink depressions and could potentially occur in dune swales.

**Soils:** Sites usually have wet mineral soils, with or without a shallow organic layer. Many examples are small enough not to be distinguished in soil mapping. Soils mapped for some of the larger examples include Torhunta (Typic Humaquept), Pantego (Umbric Paleaquult), and Coxville (Typic Paleaquult). However, at least one example is mapped as an organic soil: Pamlico (Terric Medisaprist).

**Hydrology:** The range of hydrology is not well known but flooding appears to be shallow to moderate and typically not to persist long into the growing season. Soils probably remain saturated after drawdown but this is uncertain.

**Vegetation:** The vegetation has a well-developed closed or somewhat open forest canopy dominated by *Taxodium ascendens* or *Nyssa biflora*. One or both of these species may be the only trees, but *Acer rubrum* var *trilobum*, *Pinus serotina*, and *Liquidambar styraciflua* are known in some examples. The dense shrub layer may be short or tall, and is typically dominated by *Cyrilla racemiflora*, *Lyonia lucida*, *Zenobia pulverulenta*, or *Ilex glabra*. *Ilex amelanquier*, *Vaccinium formosum*, or *Vaccinium fuscatum* may be present, occasionally abundant, in some examples. *Smilax laurifolia* or *Smilax rotundifolia* may form dense tangles. Herbs are sparse and are largely limited to patches of *Sphagnum* spp. and *Anchistea virginica*.



**Range and Abundance:** Ranked G2. This handful of examples in North Carolina are scattered in the southern half of the Coastal Plain, including the outer, middle, and inner Coastal Plain and Sandhills. This community also occurs in South Carolina.

**Associations and Patterns:** Coastal Plain Depression Swamps tend to fill entire basins. They are naturally bordered by dry or wet longleaf pine communities on their upland edges. Few of the remaining examples have intact surrounding vegetation.

**Variation:** No variants are known.

**Dynamics:** Dynamics are poorly known. Given the dense flammable shrub layer, fire likely is more important in the Pocosin Subtype than in other subtypes, but the frequency is not known. Almost no fires have occurred in this community in recent history. *Taxodium ascendens* is fairly tolerant of fire, *Nyssa biflora* less so, but neither would be likely to survive an intense fire burning through dense pocosin shrubs. It seems likely that trees would only regenerate after fires, when the dense cover of shrubs is reduced. Fluctuating water levels may also be important, perhaps periodically reducing shrub cover and allowing tree regeneration. While it is possible that the shrubby vegetation developed recently and that examples once were more like Cypress Savannas, a change from one to another has not been documented. Examples sometimes occur in close proximity to Cypress Savannas, with similar landscape settings and presumably similar disturbance history.

**Comments:** See comments for the Mixed Subtype. The Pocosin Subtype too is among the least well understood of Coastal Plain wetlands.

The Pocosin Subtype is one of two characteristic habitats for *Ilex amelanchier*. The other, banks of blackwater rivers, seems quite different. However, the species cooccurs with *Cyrilla racemiflora* in both habitats.

Nifong (1998) recognized several associations within the vegetational variation covered by this subtype: *Taxodium ascendens* / *Lyonia lucida* / *Carex striata* - *Woodwardia virginica* / *Sphagnum* Bog (8.0.1); *Nyssa biflora* / *Chamaedaphne calyculata* / *Carex striata* / *Sphagnum* spp. Bog (8.0.2); *Taxodium ascendens* / *Nyssa biflora* - *Acer rubrum* / *Zenobia pulverulenta* - *Lyonia lucida* - *Cyrilla racemiflora* / *Woodwardia virginica* Bog (8.0.6); *Taxodium ascendens* / *Lyonia lucida* - *Leucothoe racemosa* / (*Leucobryum* sp.) Bog? (8.0.8).

**Rare species:** No rare species are known to be associated with this community. *Ilex amelanchier*, now on the watch list, is a characteristic species for this subtype.

**References:**

Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.

## COASTAL PLAIN DEPRESSION SWAMP (CYPRESS DOME SUBTYPE)

**Concept:** Coastal Plain Depression Swamps are depressional wetlands with a well-developed, closed or nearly closed tree canopy of *Taxodium ascendens* or *Nyssa biflora* but without a dense graminoid-dominated herb layer. The Cypress Dome Subtype is a deeper, more pond-like community than the other subtypes, associated with steep-sided basins. It is a more southern community that reaches its northern range limit in southeasternmost North Carolina. Farther south it occurs in a variety of settings, but in North Carolina it is largely confined to a few steep-sided limesinks.

**Distinguishing Features:** The Cypress Dome Subtype is distinguished from other communities by having a well-developed canopy of *Taxodium ascendens* in a depressional wetland, without a well-developed herb layer. *Ilex myrtifolia* is usually the predominant shrub. Some aquatic plants such as *Nymphaea odorata* may be present. The Mixed Subtype and Pocosin Subtype are generally dominated by *Nyssa biflora* and have well-developed shrub layers of different species. Some *Taxodium* may be present on the edge or in the interior of Small Depression Drawdown Meadow or Small Depression Pond communities, as well as in Small Depression Shrub Borders, but Coastal Plain Depression Swamp should not be recognized unless the canopy is near complete and covers a large area or fills the basin.

**Synonyms:** Synonyms: *Taxodium ascendens* / *Ilex myrtifolia* Depression Forest (CEGL007418). Small Depression Pond (3<sup>rd</sup> Approximation).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262). Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** The Cypress Dome Subtype, at least in North Carolina, occurs primarily or exclusively in limesink depressions.

**Soils:** Soils are mineral soils with a shallow muck layer. They are generally treated as inclusions or mapped as water in soil surveys.

**Hydrology:** The Cypress Dome Subtype is flooded for long periods, often with water several feet deep. In the wettest parts, the bottom may only infrequently be exposed.

**Vegetation:** The Cypress Dome Subtype has a dense or open canopy usually dominated by *Taxodium ascendens*. *Nyssa biflora* may be present in patches. Usually no other trees are present except on the edge. Shrubs may be fairly dense on the edge but otherwise are sparse. *Ilex myrtifolia*, *Cyrilla racemiflora*, and *Ilex cassine* are most frequent. The water may be permanent enough to support *Nymphaea odorata* in the deepest parts, and floating plants such as *Lemna* spp. or *Utricularia* spp. may be present. *Hymenachne hemitomon*, *Eleocharis tricostata*, *Anchistea virginica*, or other herbs may be present on the edge.

**Range and Abundance:** Ranked G3. This subtype is the quite rare in North Carolina, with only a handful of examples known in the southeastern corner of the state. The synonymized association ranges to Mississippi or Louisiana, and it is apparently more abundant in Florida.

**Associations and Patterns:** The Cypress Dome Subtype may fill the entire basin but in at least one example it occupies half a basin with open water in the other half. A few examples have recognizable Small Depression Shrub Border communities around their outer edge.

**Variation:** No variants are known.

**Dynamics:** The Cypress Dome Subtype may be more stable than most other Coastal Plain Depression Communities. The wetness, limited shrub cover, and sloping basins of our examples make fire unlikely to penetrate them, even during drought. However, fire may be important on the shallower edges. Descriptions of cypress domes in Florida say that fire penetrates them at times, creating a gradient of fire frequency from the shallow edges to the center.

Water levels may fluctuate drastically over the course of a year or among years. Rare periods of low water are crucial to regeneration of the *Taxodium*, whose seedlings cannot tolerate complete submergence.

The ecological factors that distinguish the Cypress Dome Subtype from Small Depression Pond are not clear. Their hydroperiods appear to overlap. It may be that rare episodes of tree regeneration or rare tree-killing disturbances create persistent treed or treeless vegetation. However, examples of one community definitively turning into the other are not documented. It may alternatively be that subtle differences in hydroperiod or fire susceptibility created by basin slope and water table elevation determine which community occurs.

**Comments:** This subtype is named by analogy to the cypress dome swamps of Florida and the Gulf Coast. It does not appear, however, that our examples generally have the dome-shaped appearance of those farther south.

**Rare species:** Rare plants associated with Small Depression Drawdown Meadow or Small Depression Ponds may occasionally occur in the Cypress Dome Subtype but are less likely to.

**References:**

## VERNAL POOL

**Concept:** Vernal Pools are herb-dominated depressional wetlands with reliably short hydroperiods, which contain wetland plants absent in surrounding communities but lack indicators of deeper water and longer hydroperiod. These communities generally completely fill shallow depressions. The Typic Subtype covers most examples in North Carolina, all those that don't meet the criteria for the specialized Sphagnum Subtype. There may be a need for further breakdown of this group, but the basis for doing so is unclear at present.

**Distinguishing Features:** Vernal Pools are distinguished from other depressional wetlands by the absence of plants associated with longer hydroperiods and the presence of plants intolerant of long inundation. Typical plants include *Panicum virgatum*, *Erianthus giganteus*, *Carex glaucescens*, *Aristida virgata*, *Woodwardia virginica*, *Aristida palustris*, *Schizachyrium scoparium*, and any of several *Andropogon* species. Marsh and pond species, such as *Hymenachne hemitomon*, *Rhynchospora tracyi*, *Rhynchospora inundata*, *Rhynchospora careyana*, *Leersia hexandra*, *Coelorachis rugosa*, *Diodia virginiana*, *Rhexia aristosa*, and *Juncus repens* are generally absent. (These species may become scarce in wetter communities during drought.) *Centella asiatica*, *Kellochloa (Panicum) verrucosa*, *Lachnanthes caroliniana*, *Eleocharis tricostata*, and *Coleataenia rigidula* may be present in small numbers, in wet microsites, or during unusually wet periods but are not generally abundant. Vegetation resembling Vernal Pool may occur on the upper edges of some deeper ponds, but only expanses that cover a significant part of a basin or that cover a substantial area in a larger basin should be considered this type.

**Synonyms:** *Panicum virgatum* - *Andropogon (capillipes, glaucopsis)* - *Aristida palustris* Herbaceous Vegetation (CEGL004100). Small Depression Pond (3<sup>rd</sup> Approximation - outer zone). Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Vernal Pools occur in limesinks, swales in relict dune systems, and other shallow basins with short hydroperiods.

**Soils:** Soils are sandy, loamy, or clayey mineral soils. Examples are small enough that they are treated as inclusions in upland soil units in soil surveys.

**Hydrology:** Surface water is shallow to moderate, usually a few inches to a couple feet deep. Standing water seldom persists far into the growing season, and water may be absent in drier winters.

**Vegetation:** The vegetation is dominated by graminoids, which may be fairly sparse but usually are moderately dense. The most characteristic species, highly constant and often dominant, are *Panicum virgatum* var. *cubense*, and *Andropogon* spp. The *Andropogon* are variously identified as *virginicus*, *glaucopsis*, *capillipes*, or *dealbatus*. Other frequent species in CVS plots and site descriptions include *Centella asiatica*, *Anchistea virginica*, *Carex glaucescens*, *Erianthus giganteus*, *Aristida virgata*, and *Lachnanthes caroliniana*. Other less frequent but sometimes abundant herbs include *Juncus scirpoides*, *Juncus pelocarpus (abortivus)*, *Euthamia caroliniana*, *Dichanthelium ravenelii*, *Pluchea baccharis*, *Drosera capillaris*, *Aristida palustris*, *Eupatorium leucolepis*, *Eupatorium mohrii*, *Dichanthelium wrightianum*, *Proserpinaca pectinata*, *Eleocharis*

*tricostata*, *Kelloggloa verrucosa*, *Muhlenbergia torreyana*, *Rhynchospora filifolia*, *Rhynchospora chalarocephala*, other *Rhynchospora* species, and *Sphagnum* sp. Species shared with wet longleaf pine communities, such as *Polygala lutea*, *Rhexia alifanus*, *Rhexia nashi*, *Eupatorium leucolepis*, *Lobelia nuttallii*, *Sorghastrum nutans*, *Lycopodiella alopecuroides*, and others, may be present with low constancy. A few shrubs and vines may be present, most frequently *Smilax rotundifolia*, *Smilax walteri*, *Smilax laurifolia*, *Ilex glabra*, *Lyonia mariana*, and *Ilex myrtifolia*. At least a few stems of *Nyssa biflora* often are present, and *Pinus taeda*, *Pinus serotina*, *Magnolia virginiana*, or other trees may be present.

**Range and Abundance:** Ranked G2? In North Carolina Vernal Pools are clustered in the Sandhills region and in limesink complexes in the southern part of the outer Coastal Plain. The synonymized association ranges from North Carolina to the Gulf Coast states. Its distribution on the Gulf Coast appears uncertain. If it is abundant there, it may be less rare than G2. Vernal Pools appear to be sometimes overlooked or not emphasized in site reports in North Carolina.

**Associations and Patterns:** Vernal Pools may fill entire small basins or may occur as a broad edge zone in larger depressions. Small Depression Shrub Border may be present as an outer zone around them. They often occur in in limesink clusters or relict dune systems complexes with other Coastal Plain Depression Communities nearby, particularly Small Depression Drawdown Meadow and the various subtypes of Small Depression Pond. The surrounding matrix is usually Wet or Dry Longleaf Pine Communities.

**Variation:** Variation is not well known in this community, but two variants are provisionally recognized, based on geography and floristic differences, though in need of further clarification:

1. Sandhills Variant occurs in the Sandhills Region. Species more likely to be found in it include *Anchistea virginica*, *Carex glaucescens*, *Eleocharis tricostata*, *Rhynchospora torreyana*, *Aristida virgata*, and *Erianthus giganteus*.
2. Coastal Plain Variant occurs in the outer to middle Coastal Plain. Species more likely in it include *Centella asiatica*, *Lachnanthes caroliniana*, and *Drosera capillaris*.

**Dynamics:** Vernal Pools demonstrate variation in response to changing water levels as other herbaceous Coastal Plain Depression Communities do. Because their typical hydroperiod is shorter, dry spells have less effect on them than wet periods. In dry periods, upland plants may establish there. In wet periods, at least those that are associated with wetter communities may see *Hymenachne hemitomom* and other more water-tolerant species spread into them.

Natural fire would be more frequent in Vernal Pools than in wetter depressions, since they are more likely to be dry when the surrounding areas burn.

**Comments:** The Fourth Approximation Guide included a *Sphagnum* Subtype of Vernal Pool as well as a Typic Subtype. This subtype has been dropped. It is equivalent to the NVC's *Sphagnum cuspidatum* Nonvascular Vegetation (CEGL004384) and is described as having very little vascular vegetation but is not otherwise well described. For the Fourth Approximation, it was conceived as being a drier analogue of Small Depression Drawdown Meadow (Boggy Pool Subtype). However, no examples have been identified. It appears reasonable that the greater frequency of fire in drier depressions would prevent persistence of a moss layer. All *Sphagnum*-dominated

depressions that have been found to have substantial presence of *Anchistea virginica*, *Carex striata*, or other vascular plants. They appear wetter than typical Vernal Pools and appear to fit the concept of Small Depression Drawdown Meadow. However, the possibility of finding a *Sphagnum* community that fits within the Vernal Pool concept should be remembered.

**Rare species:** Vascular plants: *Lobelia boykinii*, *Ludwigia linifolia*, *Muhlenbergia torreyana*, *Panicum tenerum*, *Rhexia aristosa*, *Rhynchospora pleiantha*, *Sagittaria isoetiformis*, *Scleria reticularis*, and *Stylisma aquatica*.

Vertebrate Animals: *Ambystoma tigrinum*, *Rana capito*, and *Triodopsis soelneri*.

**References:**

## CYPRESS SAVANNA (TYPIC SUBTYPE)

**Concept:** Cypress Savannas are wetlands of flat-bottomed depressions, typically clay-based Carolina bays, with dense, diverse herbaceous layers. A canopy of *Taxodium ascendens* is usually present but trees may be absent. Cypress Savannas are intermediate in wetness between Vernal Pools and Small Depression Pond communities, so overlap in hydroperiod with Small Depression Drawdown Meadows; however, their vegetation and flora are different. Water typically stands well into the growing season but disappears from the surface in all but the wettest year. The hydroperiod is too short to support floating or emergent aquatic plants on a long-term basis, and too wet to support trees other than *Taxodium ascendens* and *Nyssa biflora* on a long-term basis under natural conditions.

The Typic Subtype covers examples with diverse herb layers of species typical of mineral soils. Boggy species such as *Woodwardia virginica* and *Carex striata* may be present but are not strongly dominant. The Typic Subtype generally supports a diverse mixture of plants that emerge when water goes down and those that grow in the water, but the vegetation may vary drastically from year to year.

**Distinguishing Features:** Cypress Savannas are distinguished from Vernal Pools by the absence of less flood-tolerant plants such as *Panicum virgatum* and *Schizachyrium scoparium*. Other more upland species, such as *Andropogon virginicus*, *Andropogon capillipes*, *Andropogon glaucopsis*, *Eupatorium compositifolium*, *Eupatorium album*, and *Pinus taeda*, may invade during droughts but are not present most of the time in the interior of the community. Cypress Savannas are distinguished from most subtypes of Small Depression Pond by lacking plants indicative of longer term inundation. They may include some of the more broadly tolerant emergent species, such as *Panicum hemitomon* and *Leersia hexandra* but will lack true aquatics and the more restricted emergents such as *Eleocharis equisetoides*, *Rhynchospora tracyi*, and *Rhynchospora inundata*.

Small Depression Drawdown Meadows may share some plants with Cypress Savanna communities, but overall flora will differ. Plants that are characteristic of Cypress Savanna and uncommon in Small Depression Drawdown Meadow include *Coelorachis rugosa*, *Eriocaulon compressum*, *Saccharum giganteum*, *Diodia virginiana*, and *Hypericum cistifolium*. Plants characteristic of the Small Depression Drawdown Meadows and not of Cypress Savannas include *Centella erecta*, *Lachnanthes caroliniana*, *Panicum tenerum*, *Juncus pelocarpa (abortivus)*, and *Proserpinaca pectinata*. Some plant species, such as *Dichanthelium erectifolium*, *Dichanthelium wrightianum*, *Polygala cymosa*, *Rhexia aristosa*, *Pluchea baccharis (rosea)*, *Scleria reticularis*, *Eupatorium leucolepis*, and *Panicum verrucosum*, may be frequent in either subtype. Distinguishing these communities is made more difficult by the fact that dominant plants and aspect dominants may vary drastically from year to year, depending on rainfall.

The Typic Subtype is distinguished from the Acidic Subtype by a diverse and characteristic herbaceous flora that is not dominated by boggy species. In the Acidic Subtype, *Woodwardia virginica*, *Carex striata*, *Sphagnum*, and a few other extremely acid-tolerant species dominate. These species may be present in the Typic Subtype but do not dominate.

Presence or absence of *Taxodium ascendens* is not a reliable characteristic for distinguishing

among these communities. Natural patterns of tree abundance are believed to be confused by long-lasting effects of past logging and potentially of fire exclusion. Cypress Savannas usually have an open but substantial canopy of *Taxodium ascendens*; a few examples have sparse or no trees but are otherwise identical. Most Small Depression Drawdown Meadows have no trees or only sparse trees, which are as likely to be *Nyssa biflora* as *Taxodium* but they may locally have a more substantial canopy. A denser canopy dominated by *Taxodium ascendens* or *Nyssa biflora* indicates Small Depression Swamp.

**Synonyms:** *Taxodium ascendens* / *Panicum hemitomom* - *Polygala cymosa* Woodland (CEGL003733). Cypress Savanna (Typic and Depression Meadow variants) (3<sup>rd</sup> Approximation) (in part). Small Depression Drawdown Meadow/Savanna (Typic Cypress Savanna Subtype) (earlier 4<sup>th</sup> approximation guide drafts).

Ecological Systems: Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245).

**Sites:** Cypress Savannas are predominantly in clay-based Carolina bays – small to medium size, middle to inner Coastal Plain Carolina bays mineral soils. A few examples are known in shallow, flat-bottomed limesink depressions or swales on high river terraces.

**Soils:** Soils of most examples are wet Ultisols. McColl (Typic Fragiaquult) is mapped for more than half of the known examples. Pantego (Umbric Paleaquult), Coxville (Typic Paleaquult), and Rains (Typic Paleaquult) are mapped in several examples. The one river terrace example is mapped as Johns (Aquic Hapludult). The term “clay-based” has been used by ecologists for these sites for many years. It refers to the fragipan that is found in many examples, which restricts water penetration when wet. It appears that not all Cypress Savanna soils have a fragipan, and its importance to their occurrences is not well known.

**Hydrology:** Cypress Savannas have surface water of shallow-to-moderate depth, a few inches to a couple of feet, in times of normal rainfall. Surface water typically persists well into the growing season but is gone before the end of summer in ordinary years. However, water levels and hydroperiods vary substantially in response to weather cycles. Examples have been known to remain dry for periods of years or to stay flooded through whole years. The relatively flat bottom of the basins leads to similar water levels over large areas, in contrast to more sloping depressions where zones of a given water depth may shift but remain present somewhere in the basin.

Carolina bays generally have little local watershed, so most of the water that floods them may come from rainfall. It is not well known how closely the hydrology of these depressions is linked to ground water. Because they have an impermeable clay layer, water presumably is perched when the water table is low, even if it connected to the water table at wetter times.

**Vegetation:** Cypress Savanna (Typic Subtype) usually has an open canopy of *Taxodium ascendens*, though trees can range from absent or sparse to fairly dense. The thin crowns of this species cast limited shade even at fairly high densities. Some *Nyssa biflora* may be present. *Pinus taeda*, generally smaller individuals, is often present in examples and is sometimes dense. It is believed to be an invader not characteristic of more natural conditions. The herb layer is dense and often diverse when water levels are down. Dominants can vary from time to time. Species that are at least fairly frequent in plots and sometimes dominant include *Dichanthelium*



*wrightianum*, *Rhexia aristosa*, *Scleria reticularis*, *Scleria muhlenbergii*, *Rhynchospora inundata*, *Rhynchospora filifolia*, *Eupatorium leucolepis*, *Eupatorium paludicola*, *Kelloggloa (Panicum) verrucosa*, *Pluchea baccharis (rosea)*, *Boltonia asteroides*, and *Eleocharis tricostata*. Species fairly frequent in plots and sometimes abundant include *Sclerolepis uniflora*, *Rhynchospora perplexa*, *Eriocaulon compressum*, *Erianthis giganteus*, *Diodia virginiana*, *Euthamia caroliniana*, *Lachnanthes caroliniana*, and *Hymenachne hemitomon*. The latter two species, though occasionally abundant, are almost never as abundant as they often are in Small Depression Drawdown Meadow or Small Depression Pond communities. Other herbs sometimes reported to be abundant include *Centella erecta*, *Coelorachis rugosa*, *Hypericum cistifolium*, *Coleataenia longifolia* var. *combsii* (*Panicum rigidulum* var. *combsii*), *Proserpinaca pectinata*, *Rhynchospora perplexa*, *Dichantherium erectifolium*, *Sabatia difformis*, and *Sagittaria isoetiformis*, though some of these species too are much more frequent in other communities. *Andropogon virginicus* or other *Andropogon* species, *Eupatorium capillifolium*, and other upland species may appear during drought periods. Shrubs are generally sparse and mostly limited to tree bases, cypress knees, and other raised microsites except on the edge. Species may include *Vaccinium fuscatum*, *Vaccinium formosum*, *Ilex amelanchier*, *Cyrilla racemiflora*, *Eubotrys racemosa*, *Ilex glabra*, *Morella cerifera*, or other species. *Smilax rotundifolia* may form dense tangle on the edge, and it or other vines such as *Muscadinia rotundifolia* may root in drier microsites.

**Range and Abundance:** Ranked G2G3. In North Carolina examples are concentrated in the southern inner Coastal Plain outside of the Sandhills region, with most in Robeson, Hoke, and Scotland counties. They once were fairly common there, but remaining intact examples are rare. Scattered examples occur farther east. This community is more abundant in South Carolina, though there too intact examples are rare. It is questionably attributed to Georgia.

**Associations and Patterns:** Cypress Savannas tend to fill entire basins, though a Small Depression Shrub Border may be present on the edge. They naturally were surrounded by upland longleaf pine communities but virtually no remaining examples have natural surroundings.

**Variation:** The Typic Subtype appears highly variable. Two variants are tentatively recognized at this time, but more likely could be recognized.

1. Inland Variant occurs in the inner Coastal Plain, in the areas where clay-based Carolina bays are most common. It fits most of the above description and applies to most examples known.
2. Outer Coastal Plain Variant covers the few examples known in that region, which occur in depressions other than Carolina bays and have floristic differences that may represent either biogeography or the different environment. Species in this variant that are scarce or absent in plot data for the Inland Variant include *Andropogon glaucopsis*, *Centella erecta*, *Eupatorium mohrii*, *Aristida palustris*, *Coleataenia tenera*, *Polygala ramosa*, and *Sagittaria subulata*.

More variants may be warranted, perhaps for the few middle Coastal Plain examples, perhaps for different grouping in the Inland Variant. Temporal variation in vegetation makes it difficult to sort out enduring differences among sites. Changes caused by alteration of hydrology and exclusion of fire also have confused understanding of natural variation more than in most communities. The 3<sup>rd</sup> Approximation recognized Typic and Depression Meadow variants of Cypress Savanna, based largely on the presence or absence of a *Taxodium* canopy or evidence of one in the recent past. Nifong (1998) found only minor floristic differences between the two; he believed that those

without canopy had once had trees. These variants have been dropped, though a different breakdown of variants may be warranted.

Cypress Savanna (Typic Subtype) equates primarily to the Nifong (1998) categories called subclass 9.2, Cypress-Gum Pond, 9.3, Drawdown Savanna/Meadow, and some of 9.4, Wet Savanna/Meadow. However, he noted that the deeply flooded Cypress-Gum Ponds probably were a temporal subclass of Drawdown Savanna/Meadows. He suggested that the Wet Savanna/Meadow subclass had a more stable hydroperiod and was dominated by longer-lived plants. This warrants further investigation. Nifong (1998) recognized multiple further divisions in each subclass, most of them known from only a single site and often from closely spaced plots. Understanding of the complex patterns within Cypress Savannas may await both extensive studies that compare sites under uniform weather conditions and additional site-specific studies that provide details of temporal changes.

**Dynamics:** Cypress Savanna vegetation, presumably fauna and ecosystem processes as well, vary drastically among years and over periods of years in response to changing hydroperiods. Because conditions are more uniform than in steeper-sided basins, the changes are more likely to appear as complete changes in dominants rather than as short-distance shifting of zones. Long-lived seed banks are extremely important in Cypress Savannas, apparently more so than in any other community in North Carolina. Species unseen for years may abruptly reappear in abundance when conditions change, and such species have at times been found in dormant seed banks (Kirkman and Sharitz 1994)

Among Coastal Plain Depression Communities, fire appears particularly important in Cypress Savannas. The invasion by *Pinus taeda* and *Liquidambar styraciflua* in dry periods and subsequent persistence is most pronounced in them, and fire was the likely natural mechanism keeping it in check. Some good examples of Cypress Savanna have seen substantial ecological alteration by this process.

The woody vegetation of Cypress Savannas is necessarily more stable than the herb layer. While *Taxodium ascendens* trees are not usually large, they may be old. Mature trees are tolerant of fire and could readily survive dry periods. Opportunities for reproduction of *Taxodium* may have been limited, leading to an age structure with only a few widely separated cohorts. Observations of older aerial photography suggest that tree density and cover often is stable over decades (Peroni 1988). Alterations in the tree component also can be stable. Examples with old stumps but no trees can be observed. Nifong (1998) and other observers have suggested that the treeless depression meadows that show no evidence of stumps nevertheless once had trees that were removed.

**Comments:** Despite long interest of the land conservation community, the classification of Cypress Savannas and related depression wetlands has been among the most difficult to work out for this document. Early drafts of the 4<sup>th</sup> Approximation tried several different approaches, including treating them together with Small Depression Drawdown Meadow and tentative recognition of a separate Depression Meadow type. In the end the classification has returned to something more similar to that used in the 3<sup>rd</sup> Approximation, with the added recognition of the Acidic Subtype as distinct. Inner Coastal Plain areas called Depression Meadows are treated as

Cypress Savannas, but many treeless outer Coastal Plain depressions that were called Depression Meadow fit better into the Small Depression Drawdown Meadow type.

**Rare species:** Vascular plants: *Agalinis virgata*, *Amphicarpum muhlenbergianum*, *Boltonia asteroides* var. *glastifolia*, *Carex verrucosa*, *Dichanthelium hirstii*, *Eleocharis atropurpurea*, *Eleocharis robbinsii*, *Eupatorium leptophyllum*, *Eupatorium paludicola*, *Gratiola ramosa*, *Helianthium tenellum*, *Iva microcephala*, *Lobelia boykinii*, *Ludwigia suffruticosa*, *Muhlenbergia torreyana*, *Oldenlandia boscii*, *Oxypolis canbyi*, *Paspalum dissectum*, *Persicaria hirsuta*, *Rhexia aristosa*, *Rhynchospora harperi*, *Rhynchospora microcarpa*, *Rhynchospora tracyi*, *Sagittaria isoetiformis*, *Scleria reticularis*, *Sclerolepis uniflora*, *Solidago leavenworthii*, *Stylisma aquatica*, *Tridens ambigua*, and *Utricularia cornuta*.

Vertebrate animals: *Ambystoma mabei*, *Ambystoma tigrinum*, *Rana capito*, *Pseuacris ornata*, *Deirochelys reticularia reticularia*, *Eurycea quadridigitata*, *Pseudacris nigrita*, and *Liodites rigida*.

Invertebrate animals: *Lynceus gracilicornis*.

#### **References:**

- Kirkman, L.K. and R.R. Sharitz. 1994. Vegetation disturbance and maintenance of diversity in intermittently flooded Carolina bays in South Carolina. *Ecological Applications* 4: 177-188.
- Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.
- 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 North Carolina Nature Conservancy.

## CYPRESS SAVANNA (ACIDIC SUBTYPE)

**Concept:** Cypress Savannas are wetlands of flat-bottomed depressions, typically clay-based Carolina bays, with dense, diverse herbaceous layers. A canopy of *Taxodium ascendens* is usually present but trees may be absent. Cypress Savannas are intermediate in wetness between Vernal Pools and Small Depression Pond communities, and so overlap in hydroperiod with Small Depression Drawdown Meadows; however, their vegetation and flora are different.

The Acidic Subtype covers Cypress Savannas with vegetation that is dominated by acid-loving or boggy plants such as *Anchistea virginica*, *Carex striata*, and *Sphagnum* spp. and is generally relatively low in species richness.

**Distinguishing Features:** Cypress Savannas are distinguished from Vernal Pools by having a longer typical hydroperiod and from Small Depression Ponds by having a shorter hydroperiod. They are most similar in hydroperiod to Small Depression Drawdown Meadows but differ in basin shape and have different flora.

The Acidic Subtype is distinguished by vegetation dominated by plants tolerant of extreme acidity. *Sphagnum* spp, *Anchistea virginica*, and *Carex striata* usually are dominant or prominent. The less acid-tolerant species characteristic of the Typic Subtype may be present only in small numbers and with low diversity. An open canopy of *Taxodium ascendens* or *Nyssa biflora* is generally present. Shrubs shared with either ponds or pocosins may be present but the shrub layer is open.

The Acidic Subtype is distinguished from the Small Depression Pond (Boggy Pool Subtype) by occurring in broad, flat basins, by the presence of a well-developed *Taxodium* or *Nyssa* canopy, and by greater species richness. It is distinguished from the Coastal Plain Depression Swamp (Mixed Subtype) by a more open canopy, well developed herb layer, and absence of a dense shrub layer. It is distinguished from Small Depression Pocosin by lacking a dense shrub layer.

**Synonyms:** *Taxodium ascendens* / *Woodwardia virginica* Woodland (CEGL004441). Cypress Savanna (3<sup>rd</sup> Approximation). Small Depression Drawdown Meadow/Savannas (Acid Cypress Savanna subtype) (earlier 4<sup>th</sup> approximation guide drafts).  
Ecological Systems: Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245).

**Sites:** The Acidic Subtype is known largely from clay-based Carolina bays but could occur in other kinds of depressions.

**Soils:** The few examples are mapped as a variety of different soils, most mineral soils with an organic layer or mineral soils similar to the Typic Subtype. Series mapped include Lynn Haven (Typic Alaquod), Pantego (Umbric Paleaquult, and McColl (Typic Fragiaquult).

**Hydrology:** The Acidic Subtype appears to be similar to the Typic Subtype in having surface water of shallow-to-moderate depth, a few inches to a couple of feet, in times of normal rainfall. Surface water typically persists well into the growing season but is gone before the end of summer in ordinary years. However, water levels and hydroperiods vary substantially in response to weather cycles through whole years. The relatively flat bottom of the basins leads to similar water

levels over large areas, in contrast to more sloping depressions where zones of a given water depth may shift but remain present somewhere in the basin.

**Vegetation:** The Acidic Subtype usually has an open canopy of *Taxodium ascendens*, though trees can range from absent or sparse to fairly dense. The thin crowns of this species cast limited shade even at fairly high densities. *Nyssa biflora* is often present in patches or as an understory. *Pinus taeda*, generally smaller individuals, is often present in examples and is sometimes dense. It is believed to be an invader not characteristic of more natural conditions. The herb layer is moderate to dense. It is dominated by species tolerant of extremely acidic conditions and is low in species richness. *Anchistea virginica* is the most constant species and usually abundant. *Carex striata*, *Carex glaucescens*, or *Lachnanthes caroliniana* are often abundant. *Sphagnum* spp. is usually present, sometimes abundant, but does not form a large continuous cover. Other herbs that are noted with lower frequency include *Hymenachne hemitomon*, *Erianthus* spp., *Utricularia minor*, *Utricularia purpurea*, *Rhynchospora inundata*, *Scirpus cyperinus*, *Dulichium arundinaceum*, *Drosera intermedia*, and *Dichantheium* sp. Other herbs characteristic of the Typic Subtype may occasionally occur. Shrubs are usually present at low-to-moderate density with *Cyrilla racemiflora*, *Lyonia lucida*, *Vaccinium fuscatum*, *Vaccinium formosum*, and *Ilex Amelanchier* most frequent. *Ilex myrtifolia*, *Itea virginica*, and other species occur occasionally. *Smilax rotundifolia* and occasionally *Smilax laurifolia* may be locally abundant.

**Range and Abundance:** Ranked G2?. Most examples in North Carolina are in the inner Coastal Plain concentration of clay-based Carolina bays in Robeson and adjacent counties. A few are reported farther east in the Coastal Plain. They range through South Carolina, where they are apparently more abundant.

**Associations and Patterns:** Cypress Savanna (Acidic Subtype) communities tend to fill entire basins, with the exception of a Small Depression Shrub Border community around the edge. They occur near other bays with the Typic Subtype, Coastal Plain Depression Swamp, or other depression communities.

**Variation:** Patterns of variation have not been identified. Some examples seem more similar to the Typic Subtype than others.

**Dynamics:** Dynamics are believed to be similar to those in the Typic Subtype. Variation in vegetation in response to changing water levels may be less because of the small pool of species. As in the Typic Subtype, fire appears to be important in preventing establishment of *Pinus taeda* and *Liquidambar styraciflua* during drought. Many of the known examples now have these species present.

The factors that lead to this subtype rather than the Typic Subtype are not known. Often the two occur in close proximity. The acidic character of the vegetation appears to be stable and of long standing. However, this needs further investigation.

**Comments:** The name of the Acidic Subtype is meant to convey the bog-like extremely acidic conditions suggested by the species composition and abundance of *Sphagnum*. However, the Typic Subtype too has acidic soils. It is unclear if sites of the Acidic Subtype were initially more

acidic or became so because of the vegetation.

This subtype includes the *Taxodium ascendens* / *Pinus taeda* - *Acer rubrum* - *Liquidambar styraciflua* / *Lindera* / *Smilax glauca* / *Carex glaucescens* Swamp (9.1.3); *Taxodium ascendens* / (*Nyssa biflora*) Swamp (9.1.4) of Nifong (1998).

**Rare species:** Vascular plants: *Carex verrucosa*, *Hypericum fasciculatum*, *Lindera melissifolia*, *Litsea aestivalis*, and *Rhexia aristosa*.

Vertebrate Animals: *Ambystoma maybeii*.

**References:**

Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.

## SMALL DEPRESSION DRAWDOWN MEADOW (TYPIC SUBTYPE)

**Concept:** Small Depression Drawdown Meadows are herbaceous communities of seasonally flooded mineral soil depressions with fairly long hydroperiods. They may fill a basin but often occur as outer zones surrounding open water or marshy ponds. Most occur in limesink depressions, with occasional examples in inland dune swales or other natural depressions but generally not in clay-based Carolina bays. These communities have longer hydroperiods than Vernal Pools and shorter than Small Depression Pond communities. The Typic Subtype covers the more widespread examples that lack the abundant *Sphagnum* and other strongly acid-tolerant plants characteristic of the Boggy Pool Subtype. The Typic Subtype examples often have high species richness.

**Distinguishing Features:** Small Depression Drawdown Meadows are distinguished from Vernal Pools by having a longer hydroperiod, with standing water or saturated soil persisting well into the growing season. Flora intolerant of longer flooding, such as *Panicum virgatum*, *Saccharum giganteum*, *Carex glaucescens*, *Aristida virgata*, *Woodwardia virginica*, *Aristida palustris*, *Schizachyrium scoparium*, and any of several *Andropogon* species, are absent, are confined to the shallowest edges, or invade only for short periods during drought. *Hymenachne (Panicum) hemitomom*, *Rhynchospora tracyi*, *Rhynchospora inundata*, *Rhynchospora careyana*, *Leersia hexandra*, *Coelorachis rugosa*, *Diodia virginiana*, *Rhexia aristosa*, *Juncus repens*, *Centella asiatica*, *Kelloggloa (Panicum) verrucosa*, *Lachnanthes caroliniana*, *Eleocharis tricostata*, *Coleataenia (Panicum) rigidula* or plants tolerant of even wetter conditions are generally present, though they may not be visible during drought.

Small Depression Drawdown Meadows are distinguished from Cypress Savannas by occurring in different kinds of basins and being floristically distinct. Plants that are characteristic of Cypress Savanna and uncommon in Small Depression Ponds include *Coelorachis rugosa*, *Eriocaulon compressum*, *Erianthus giganteus*, *Diodia virginiana*, and *Hypericum cistifolium*. Plants characteristic of Small Depression Drawdown Meadows and not of Cypress Savannas include *Centella asiatica*, *Lachnanthes caroliniana*, *Panicum tenerum*, *Juncus pelocarpus (abortivus)*, and *Proserpinaca pectinata*. Some plant species, such as *Dichanthelium erectifolium*, *Dichanthelium wrightianum*, *Polygala cymosa*, *Rhexia aristosa*, *Pluchea baccharis (rosea)*, *Scleria reticularis*, *Eupatorium leucolepis*, and *Kelloggloa* may be frequent in either community. Cypress Savannas occur in flat-bottomed basins, while Small Depression Drawdown Meadows generally occur in more sloping basins, often in association with wetter subtypes.

Small Depression Drawdown Meadows are distinguished from Small Depression Pond communities, which they often adjoin, by a diverse flora that is not tolerant of longer flooding, and by the presence of mineral soil. The wetter pond communities tend to have a least some muck accumulation in the soil, which is visible even during dry periods. Small Depression Drawdown Meadow vegetation generally consists of small-to-medium size graminoids and abundant forbs, in contrast to the large emergent graminoids or floating aquatic plants of wetter Small Depression Pond communities. A sparse canopy of *Taxodium ascendens*, *Nyssa biflora*, *Acer rubrum*, or several kinds of shrubs may be present in either. During unusually wet periods, Small Depression Drawdown Meadows may remain flooded; the less flood-tolerant plants may not be visible and rhizomatous marsh graminoids may expand and become dominant. However, these communities will still lack the more flood-tolerant plants that are slower to invade and will lack a mucky soil.

It will generally help to know whether water levels are higher or lower than usual and to interpret communities in this light.

The Typic Subtype is distinguished from the Boggy Pool Subtype by having a diverse flora that is not confined to the most acid-tolerant species such as *Anchistea virginica* and *Carex striata*. *Sphagnum* is generally limited or absent.

**Synonyms:** *Dichantheium wrightianum* - *Dichantheium erectifolium* Herbaceous Vegetation (CEGL004105), Small Depression Pond (3<sup>rd</sup> Approximation). Small Depression Drawdown Meadow/Savanna (Pond Margin Subtype) (earlier 4<sup>th</sup> approximation guide drafts).  
Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Small Depression Drawdown Meadows usually occur in limesink depressions but may occur in relict dune swales or other depressions.

**Soils:** Soils are sandy, loamy, or clayey mineral soils. Many examples are small enough that they are usually treated as inclusions in upland soil units in soil surveys, while others are mapped as water.

**Hydrology:** Surface water is shallow to moderate, usually a few inches to a couple feet deep at the most. Water persists well into the growing season but is gone before the end of summer in ordinary years. The soil may remain saturated for much or all of the rest of the year.

**Vegetation:** The vegetation is dominated by a dense herbaceous layer of small to medium size graminoids and forbs. The dominant species and overall flora are highly variable from place to place and sometimes from year to year. In 22 CVS plots representing this community, only a handful of species had constancy above 50%. The most constant species, also often abundant, are *Centella asiatica* and *Lachnanthes caroliniana*. Other frequent and sometimes abundant species in plot data include *Euthamia caroliniana*, *Dichantheium erectifolium*, *Dichantheium wrightianum*, *Eriocaulon compressum*, *Scleria muhlenbergii*, *Drosera intermedia*, and *Rhexia cubensis*. Other species sometimes abundant in plot data and/or in site descriptions include *Coelorachis rugosa*, *Eupatorium mohrii*, *Eupatorium leucolepis*, *Ludwigia suffruticosa*, *Pluchea baccharis*, *Polygala cymose*, *Panicum tenerum*, *Coleataenia longifolia* var. *combsii*, *Proserpinaca pectinata*, *Dichantheium erectifolium*, *Rhynchospora perplexa*, *Eriocaulon decangulare*, *Ludwigia linifolia*, *Ludwigia linearis*, *Ludwigia suffruticosa*, *Eleocharis melanocarpa*, *Muhlenbergia torreyana*, and several other *Eleocharis* and *Rhynchospora* species. *Hymenachne hemitomom* may be present, even moderately abundant, but not dominant. Other species of wetter zones, such as *Rhynchospora tracyi* and even *Nymphaea odorata*, may be present in small numbers. Species of Vernal Pool, such as *Panicum virgatum* and *Andropogon* spp. may be present but do not dominate under normal water conditions. The Typic Subtype is often has high species richness compared to most Coastal Plain Depression Communities. The CVS plots averaged 24 species plots, with most plots being only 10 meters square.

Though the herbaceous layer is the dominant vegetation, woody plants may be present at low to moderate density. *Litsea aestivalis* sometimes occurs scattered in this community, and sparse *Vaccinium fuscatum*, *Vaccinium formosum*, *Cyrilla racemiflora*, *Ilex myrtifolia* may be present.



*Nyssa biflora* or *Taxodium ascendens* may be present as scattered or sparse trees but not as a well-developed canopy. Small *Pinus taeda* are often present after periods of drought.

**Range and Abundance:** Ranked G2?. Examples occur in the southern half of the Coastal Plain, including a few in the Sandhills, but most are concentrated in several clusters from Carteret to Brunswick County. The synonymized association ranges from North Carolina to Mississippi. The association as defined probably is less rare than the G2 rank suggests, but it likely represents several unrecognized associations.

**Associations and Patterns:** Small Depression Drawdown Meadows often occur as zones in association with Small Depression Pond communities, sometimes with Vernal Pool, and often with Small Depression Shrub Border, but they can also fill an entire depression. The depressions may be isolated but often are clustered, so that multiple patches of this community and several other Coastal Plain Depression Communities occur close by. The surrounding landscape generally is some kind of longleaf pine community.

**Variation:** The Typic Subtype shows more variation than most communities in this document, including substantial changes among years as well as differences between basins and heterogeneity within single patches. Descriptions of individual ponds are sometimes organized around multiple zones within the area recognizable as Small Depression Drawdown Meadow, varying in wetness and dominant plants. At the same time, the boundary with adjacent communities such as Small Depression Pond (Typic Marsh Subtype) or Vernal Pool can be unclear because species of some zones are shared with them. While it appears undesirable to define more finely divided zones within a given pond as subtypes, the Typic Subtype may be split in the future into two or more subtypes that are related to basin configuration or biogeography. Richard LeBlond, in a series of Natural Heritage Program documents and communications, suggested that steeper-sided basins, flatter basins, and basins with outlets that stabilized their water levels might be significantly different. Differences between Small Depression Drawdown Meadows of the outer Coastal Plain and those of the Sandhills also warrant investigation. From the viewpoint of fauna, there may be important consistent differences between Small Depression Drawdown Meadows associated with Small Depression Ponds and those where it is the wettest community in the basin. At present, no variants are defined.

**Dynamics:** Small Depression Drawdown Meadows are unusually dynamic on several different scales. The normal annual cycle of flooding and drawdown causes substantial changes in the environment, allowing different plants to become active and shifting the smaller fauna from aquatic to terrestrial. Variation in water levels from year to year and in longer climatic cycles can result in substantial changes in vegetation. As in Cypress Savanna, long term seed banking may be important. However, since Small Depression Drawdown Meadows more often occur in zones surrounded by wetter or drier communities, migration of species within a basin may be more important. The wettest climatic cycles likely are important for keeping uncharacteristic species such as *Pinus taeda* out of the community. In drier periods, fire likely burned into or through the meadows, and this too is probably important for excluding uncharacteristic species.

In limesink complexes, the most frequent habitat of Small Depression Drawdown Meadows, rarer but more permanent changes can also occur. At least one sinkhole newly appeared a few years ago. Continued underground solution could also permanently change existing sinkholes.

**Comments:** The classification of what is now called Small Depression Drawdown Meadow has been one of the most difficult to resolve. The boundaries with adjacent wetter and drier communities, the clarification of the range of variation over time in individual sites, and the possible recognition of variants or finer subtypes particularly need further investigation. The relationship with Cypress Savanna and with various sites called depression meadows needs more clarification. Both plot data and site descriptions pose problems in sorting out these communities because they can include portions of other communities.

The classification and naming of this community have varied substantially, reflecting their complexities and limited understanding. Drawdown zones were treated in the 3<sup>rd</sup> Approximation as part of a more heterogeneous Small Depression Pond community type. Earlier drafts of the 4<sup>th</sup> Approximation called it Small Depression Drawdown Meadow/Savanna, suggesting a closer relationship to Cypress Savannas. Other sources have called them Coastal Plain pond shore communities, emphasizing their relationship to communities with that name in states farther north.

*Rhynchospora filifolia* - *Juncus abortivus* Herbaceous Vegetation (CEGL004131) is another Coastal Plain small depression association attributed to North Carolina. It may overlap the concept of Small Depression Drawdown Meadow or of Vernal Pool.

**Rare species:** Vascular plants: *Agalinis virgata*, *Bacopa caroliniana*, *Carex verrucosa*, *Cladium mariscoides*, *Cyperus lecontei*, *Eleocharis elongata*, *Eleocharis melanocarpa*, *Eleocharis robbinsii*, *Eupatorium leptophyllum*, *Lindera melissifolia*, *Litsea aestivalis*, *Ludwigia linifolia*, *Ludwigia suffruticosa*, *Rhexia aristosa*, *Rhynchospora harperi*, *Rhynchospora pleiantha*, *Rhynchospora tracyi*, *Sagittaria isoetiformis*, *Scleria reticularis*, and *Utricularia olivacea*. A large number of watch list plants, many tracked until recently, also are associated, including *Agalinis linifolia*, *Dichanthelium erectifolium*, *Panicum tenerum*, *Rhynchospora scirpoides*, *Scleria georgiana*, *Xyris flabelliformis*, *Xyris iridifolia*, and *Xyris smalliana*.

Animals: *Ambystoma tigrinum*, *Dierochelys reticularis*, *Hyla andersoni*, *Rana capito*, and more rarely *Alligator mississippiensis*.

**References:**

## SMALL DEPRESSION DRAWDOWN MEADOW (BOGGY POOL SUBTYPE)

**Concept:** Small Depression Drawdown Meadows are herbaceous communities of seasonally flooded mineral soil depressions with fairly long hydroperiods. The Boggy Pool Subtype covers examples with vegetation dominated by the most acid-tolerant, boggy species, and generally having abundant *Sphagnum*. Trees and shrubs are usually absent or sparse.

**Distinguishing Features:** Small Depression Drawdown Meadows are distinguished from Vernal Pools by having a longer hydroperiod, with standing water or saturated soil persisting well into the growing season. They are distinguished from Small Depression Pond communities by a flora that is not tolerant of longer flooding. Dense cover of *Sphagnum* can make it difficult to distinguish surface water and presumably extends the time of soil saturation.

The Boggy Pool Subtype is distinguished from the Typic Subtype by having a low-diversity flora dominated by the most acid-tolerant species, such as *Anchistea virginica*, *Carex striata*, and *Sphagnum* spp. Other species characteristic of the Typic Subtype will be present only in small numbers and with low diversity. Most will be the more broadly tolerant species such as *Andropogon* spp., *Erianthus giganteus*, and *Hymenachne hemitomon*.

The Boggy Pool Subtype is similar floristically to the Acidic Subtype of Cypress Savanna. It is distinguished by occurrence in smaller, more steeply sloping basins, by the absence of trees, and usually by more extensive coverage of *Sphagnum*.

**Synonyms:** *Woodwardia virginica* / *Sphagnum cuspidatum* Herbaceous Vegetation (CEGL004475), Small Depression Pond (3<sup>rd</sup> Approximation).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** The Boggy Pool Subtype usually occurs in limesinks, less often in swales in dune systems, and occasionally in Carolina Bays.

**Soils:** All examples are small enough that they are usually treated as inclusions in surrounding soil units in soil surveys. The abundance of *Sphagnum* may contribute to accumulation of an organic layer on the soil surface, in contrast to the Typic Subtype, but this is not known.

**Hydrology:** Surface water is shallow to moderate, usually a few inches to a couple feet deep at the most. Water persists well into the growing season but is gone before the end of summer in ordinary years. The soil may remain saturated for much or all of the rest of the year.

**Vegetation:** The vegetation is dominated by a moderate to dense herbaceous layer with low species richness. *Sphagnum cuspidatum* or some other *Sphagnum* species is usually abundant, often covering the ground beneath other plants or covering the water surface. *Anchistea virginica* is highly constant and often dominates. *Carex striata* is frequent and is abundant in some examples. *Dulichium arundinaceum*, *Xyris difformis*, *Hymenachne hemitomon*, *Lachnanthes caroliniana*, *Juncus repens*, *Proserpinaca pectinate*, *Erianthus* sp., *Carex bullata*, and species of *Rhynchospora* or *Dichantheium* may be present. Shrubs or trees may be absent, sparse, or moderately abundant. *Nyssa biflora* is the most frequent tree species but *Taxodium ascendens*

occurs occasionally. *Vaccinium formosum*, *Vaccinium fuscatum*, *Eubotrys racemosa*, *Cyrilla racemiflora*, or *Litsea aestivalisi* may be present. *Smilax rotundifolia* sometimes forms tangles.

**Range and Abundance:** Ranked G2. The Boggy Pool Subtype is scattered throughout the outer Coastal Plain with a few occurrences in the middle Coastal Plain. Though rarer, this subtype is more widely distributed than most Coastal Plain Depression Communities, occurring in several northern sites extending to the Virginia border. However, none are known in the Sandhills or areas with a concentration of clay-based bays. The synonymized NVC association ranges from New Jersey to Florida.

**Associations and Patterns:** The Boggy Pool Subtype usually occupies all of a basin or is surrounded by a Small Depression Shrub Border rim. Examples sometimes occur in limesink or dune swale clusters with other depression communities but often occur as the only depression community in a site. Most were naturally surrounded by longleaf pine communities.

**Variation:** No patterns of variation have been identified other than those associated with the transition to other communities.

**Dynamics:** The dynamics of the Boggy Pool Subtype are particularly unknown. The mossy, extremely acidic character is believed to be long-standing even as water levels change. The author has observed *Sphagnum* beds floating in some flooded depressions but submerged on other occasions. If the moss floats, its cover may remain high during wet periods. During drought, other herbaceous vegetation could produce enough cover to reduce the vigor of the moss but it can persist under heavy cover.

The water-holding capacity of *Sphagnum* and limited abundance of grass presumably makes this subtype unable to carry fire, even though it occurs in landscapes with frequent ignition.

The factors that lead to the formation of this subtype are not known. Many examples are distant from other depression communities and could lack seed sources for other species. Many are in northern or inland areas where fire may have been less frequent and where it has been absent longer. Nevertheless, a number of well-developed examples are in clusters with other depression communities and some are in landscapes where fire frequency has been greater. It is possible that some specific circumstance leads to proliferation of *Sphagnum* and that, once established, it is competitive enough to persist. Given the limited number of observations over time, it is possible that some don't persist. Current evidence suggests these communities are distinct and stable over long time periods.

**Comments:** A related community called Vernal Pool (*Sphagnum* Subtype) in the Fourth Approximation Guide has been dropped. That community was described as consisting almost solely of *Sphagnum cuspidatum*, with little vascular plant component. No examples have been found in North Carolina. It was interpreted at that time as representing less wet conditions than the Boggy Pool Subtype. This no longer seems likely. If a depression with dense *Sphagnum cuspidatum* were found in North Carolina, it is expected to fit within the concept of the Boggy Pool Subtype. Its NVC equivalent, *Sphagnum cuspidatum* Nonvascular Vegetation (CEGL004384), could be treated as a synonym to the Boggy Pool Subtype.

*Carex striata* var. *brevis* Herbaceous Vegetation (CEGL004120) is an association described for New Jersey to Virginia and attributed to North Carolina and South Carolina. It might fit within this subtype's concept or that of the Cypress Savanna (Acidic Subtype). Given the close association of *Carex striata* with *Woodwardia virginica*, it does not appear that such a distinction is warranted here. No distinct examples are known in North Carolina.

**Rare species:** Vascular plants: *Litsea aestivalis*.

Vertebrate Animals: The acidic conditions apparently are unfavorable for the breeding of rare amphibians associated with other depression communities.

**References:**

## SMALL DEPRESSION POND (TYPIC MARSH SUBTYPE)

**Concept:** Small Depression Ponds are the communities in mainland Coastal Plain small depressions, with permanent flooding or with hydroperiods lasting most of the growing season. The Typic Marsh Subtype covers those with emergent vegetation of various large grasses or sedges but without the characteristics of the Cutgrass Prairie Subtype. This concept differs somewhat from the 3<sup>rd</sup> Approximation, where the Small Depression Pond type covered all zones in basins that contained permanent or near permanent water in their center. As now defined, Small Depression Pond will often occur in association with one or two drier zonal community types such as Small Depression Drawdown Meadow, Vernal Pool, or Small Depression Shrub Border.

**Distinguishing Features:** The Small Depression Pond type is distinguished from Small Depression Drawdown Meadow by vegetation and soils characteristic of deeper and more permanent standing water, with a hydroperiod lasting most, if not all, of the growing season. They tend to have soils with at least some muck accumulation. They tend to be dominated either by floating-leaf plants, submersed plants, or by large emergent graminoids, though smaller water-tolerant graminoids may dominate. Small Depression Drawdown Meadows tend to have smaller graminoids and abundant forbs, dominated by species adapted to less permanent water. The Small Depression Pond type is distinguished from Natural Lake Shoreline by occurring in small, shallow depressions, less than 20 acres, where wave action is not significant, and where emergent or floating vegetation is generally able to occur all the way across.

Small Depression Ponds are closely related to Interdune Ponds; they are distinguished by occurring in coastal fringe or inland locations, not on barrier islands, nor in association with maritime communities and salt spray. Upland Pool communities of the Piedmont and Blue Ridge may be closely related, including containing some Coastal Plain flora, but are easily distinguished by their location in those provinces and by their distinctive vegetation.

The Typic Marsh Subtype is distinguished from the Open Lily Pond Subtype by the dominance of emergent plants. It is distinguished from the Cutgrass Prairie Subtype by the absence or scarcity of *Leersia hexandra*.

**Synonyms:** *Panicum hemitomon* - *Eleocharis equisetoides* - *Rhynchospora inundata* Herbaceous Vegetation (CEGL004127). Includes the Boggy Marsh Subtype and Maidencane Subtype of earlier 4<sup>th</sup> approximation drafts.

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Typic Marsh Subtype communities occur primarily in limesinks but could potentially be found in other kinds of Coastal Plain depressions.

**Soils:** Soils are sandy, loamy, or clayey mineral soils but generally have a thin layer of muck. Many examples are small enough that they are usually treated as inclusions in upland soil units in soil surveys, while others are mapped as water.

**Hydrology:** Surface water is shallow to deep, usually 1 to several feet deep. Standing water is present for most or all of the growing season in normal years. When it is not present, the soil remains saturated.

**Vegetation:** The Typic Marsh Subtype is generally dominated by emergent herbs, mostly grasses and sedges. *Hymenachne hemitomon* is highly constant and can be strongly dominant, sometimes almost to the exclusion of other species. *Eleocharis equisetoides*, *Rhynchospora inundata*, and *Rhynchospora tracyi* are also frequent and may be abundant. Other fairly frequent species include *Eleocharis elongata*, other *Eleocharis* species, *Rhynchospora harperi*, *Proserpinaca pectinata*, *Leersia hexandra*, and *Juncus repens*. Many species shared with Small Depression Drawdown Meadow (Typic Subtype) are often mentioned in site descriptions or found in plots. Some of them include *Centella asiatica*, *Lachnanthes caroliniana*, *Polygala cymosa*, *Eriocaulon compressum*, *Pluchea baccharis*, *Rhexia cubensis*, *Xyris ambigua*, and *Rhynchospora pleiantha*. Species more typical of the Open Lily Pond Subtype may also be present in small numbers, including *Nymphaea odorata* and *Utricularia* spp. Woody species are absent or sparse, but some *Taxodium ascendens*, *Nyssa biflora*, *Ilex myrtifolia*, or other shrubs may be present. The plant species richness of this community generally is lower than that of nearby Small Depression Drawdown Meadows.

**Range and Abundance:** Ranked G3? The Typic Marsh Subtype is known from the outer and occasionally middle Coastal Plain in the southern half of the state, but they could potentially be found farther north or in the Sandhills. Most examples are in a few clusters from Carteret to Brunswick County. The synonymized association ranges from North Carolina to Georgia and potentially to Florida and Alabama.

**Associations and Patterns:** Small Depression Pond (Typic Marsh Subtype) usually occurs as a zone in association with other depression communities. The Open Lily Pond Subtype may occur in deeper water in the center of a depression. Small Depression Drawdown Meadow, Vernal Pool, or Small Depression Shrub Border may occur on the shallow outer edge of the basin. The depressions may be isolated but often are clustered, so that multiple patches of this community and several other Coastal Plain Depression Communities occur close by. The surrounding landscape generally is some kind of longleaf pine community.

**Variation:** The fine-scale spatial heterogeneity and temporal variability in vegetation makes it difficult to distinguish appropriate natural divisions of these communities with plot studies or site descriptions. Some examples are relatively diverse while others appear to consist of little other than *Hymenachne hemitomon*. It is unclear if this is an enduring characteristic or a result of limited survey. These examples often are more isolated and may represent a naturally depauperate variant. Alternatively, they may be a result of alteration.

*Eleocharis (elongata, equisetoides) - Rhynchospora tracyi* Semipermanently Flooded Herbaceous Vegetation (CEGL004960) is an additional small depression pond association that has been attributed to North Carolina and appears to overlap the concept of this subtype. Nifong (1998) also recognized a depauperate *Panicum hemitomon* association, which was not recognized in NVC. These could potentially represent variants or subtypes but need further investigation of how distinct they are in North Carolina. Nifong (1998) also recognized an *Eleocharis quadrangulata - Rhynchospora inundata - Rhynchospora* sp. 1 / *Sphagnum* Marsh association, which is not

represented in NVC. It needs clarification of its concept and character but may warrant recognition as a distinct subtype.

**Dynamics:** Small Depression Ponds, including the Typic Marsh Subtype, are expected to be more stable than the drier herbaceous-dominated depression communities. Vegetation may still change in response to unusually wet or dry periods. Because these communities remain wet much of the time, they rarely burn when surrounding areas are ignited. Because of wetness, they are less prone to invasion by uncharacteristic trees such as *Pinus taeda* during drought.

**Comments:**

**Rare species:** Vascular plants: *Eleocharis melanocarpa*, *Eleocharis robbinsii*, *Myriophyllum laxum*, *Paspalum dissectum*, *Rhynchospora harperi*, *Rhynchospora pleiantha*, *Rhynchospora scirpoides*, *Rhynchospora tracyi*, *Sagittaria chapmanii*, *Sagittaria isoetiformis*, and *Utricularia olivacea*.

Vertebrate Animals: *Rana capito*.

**References:**

Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.



## SMALL DEPRESSION POND (CUTGRASS PRAIRIE SUBTYPE)

**Concept:** Small Depression Ponds are the communities in mainland Coastal Plain small depressions, with permanent flooding or with hydroperiods lasting most of the growing season. The Cutgrass Prairie Subtype encompasses examples typically in small, flat Carolina bays or other depressions with loamy soils and a hydroperiod slightly shorter than other marsh subtypes, in which the vegetation is dominated by or has a substantial component of *Leersia hexandra*.

**Distinguishing Features:** The Small Depression Pond type is distinguished from Small Depression Drawdown Meadow by vegetation and soils characteristic of deeper and more permanent standing water, with a hydroperiod lasting most, if not all, of the growing season. They tend to have soils with at least some muck accumulation. The Cutgrass Prairie Subtype is distinguished by the dominance or codominance of *Leersia hexandra* during wet periods and a continued substantial presence of it during droughts.

**Synonyms:** *Leersia hexandra* - (*Panicum verrucosum*, *Scleria reticularis*) Herbaceous Vegetation [Provisional] (CEGL004047).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** The Cutgrass Prairie Subtype occurs primarily in clay-based Carolina bays but may occur in other kinds of depressions.

**Soils:** Soils are believed to be mineral soils with a thin layer of muck. Most of the few examples are mapped in soil surveys as water.

**Hydrology:** Surface water is shallow to deep, usually 1 to several feet deep. Standing water is present for most or all of the growing season in normal years. When it is not present, the soil remains saturated. Studies of *Leersia*-dominated vegetation in South Carolina suggest that this community has deeper water and more variable water levels than other marshes (Kirkman and Sharitz 1994, Mulhouse, et al. 2005).

**Vegetation:** The Cutgrass Prairie Subtype is largely treeless, though *Pinus taeda* and hardwoods may invade them during prolonged drought. The herbaceous vegetation is dense. *Leersia hexandra* dominates in times of typical water levels, often in nearly pure stands. *Kellochloa (Panicum) verrucosa* may be abundant, even codominant, right after drawdown. *Hymenachne hemitomon* may become abundant in longer droughts. Other herbs sometimes, generally at low frequency, include *Scleria reticularis*, *Eleocharis robbinsii*, *Eleocharis melanocarpa*, *Dichanthelium wrightianum*, *Rhynchospora filifolia*, *Lachnanthes caroliniana*, *Rhexia aristosa*, and *Nymphoides cordata*.

**Range and Abundance:** Ranked G2G3. Only a few well-developed examples are known in North Carolina but more may be overlooked. The synonymized NVC association is only attributed to North Carolina. It might be expected in South Carolina, but Nifong's (1998) extensive study of Carolina bays did not identify any there.

**Associations and Patterns:** The Cutgrass Prairie Subtype may fill most or all of a basin or may occur as a zone in bays with other communities. Sites are naturally surrounded by longleaf pine communities but it now more often occurs in heavily altered landscapes.

**Variation:** No enduring patterns of variation have been identified. Examples may vary drastically in response to changing water levels. Nifong (1998) classified three associations, which he indicated were short-term successional stages.

**Dynamics:** Dynamics in general are similar to other herb-dominated depression communities, with vegetation potentially varying dramatically in response to weather patterns. Kirkman and Sharitz (1993) demonstrated some of the biological characteristics of *Leersia hexandra*, showing that it has the ability for stem elongation when flooded and that it elongated more than the other species studied. This presumably makes it able to withstand deeper flooding than *Hymenachne hemitomom*, but how this compares to the other sometimes-dominant marsh species is not known. It grows and reproduces best in flooded conditions. At the same time, it had less stomatal control, making it more prone to drought. Mulhouse, et al. (2005) showed that areas dominated by *Leersia* in South Carolina showed more vegetation change during severe drought than did areas dominated by *Hymenachne* or *Carex striata*; they attributed this to less competitive standing vegetation, but noted *Leersia* marshes also had deeper water and more substantial seasonal water level fluctuations.

Nifong (1998) recognized three *Leersia* associations: *Leersia* Prairie (2.0.1), *Leersia/Panicum verrucosum* Prairie (2.0.2), *Pinus taeda/Panicum hemitomom/Leersia* “successional prairie” (2.0.3). He emphasized the successional relationships among the three, suggesting that they are different phases that can occur in the same site at different times in normal climatic cycles.

As in other herbaceous wetlands, fire may be important for keeping uncharacteristic woody vegetation from establishing during drought, but known examples appear to be less subject to tree invasion than Cypress Savanna.

**Comments:** The Cutgrass Prairie Subtype is one of the least well understood of North Carolina’s communities. Only a few examples are known in site reports or in the Nifong (1998) plots. *Leersia hexandra* may be present in patches in other depression communities, making it difficult to recognize well-developed examples of this community.

Nifong (1998) called this community intermittently flooded depression prairie. He suggested that it was intermediate between marshes and wet meadows. It appears wetter than Cypress Savanna. It may perhaps bear the same relationship to Cypress Savanna that the Typic Marsh Subtype does to Small Depression Drawdown Meadow (Typic Subtype). It is unclear if it is analogous to any of the communities called prairies farther south.

**Rare species:** Vascular plants: *Agalinis virgata*, *Drosera filiformis*, *Eleocharis robbinsii*, *Iva microcephala*, *Rhexia aristosa*, *Ludwigia suffruticosa*, *Paspalum dissectum*, *Rhynchospora microcarpa*, *Rhynchospora tracyi*, *Sagittaria isoetiformis*, and *Scleria reticularis*.

Vertebrate Animals: *Ambystoma maybei*, *Ambystoma tigrinum*, *Anaxyrus quercicus*, *Dierochelys reticularia reticularia*, *Pseudacris nigrita*, *Pseudacris ornate*, and *Rana capito*.

**References:**

Kirkman, L.K. and R.R. Sharitz. 1993. Growth in controlled water regimes of three grasses common in freshwater wetlands of the southeastern USA. *Aquatic Botany* 44: 345-359.

Mulhouse, J.M., D. De Steven, R.F. Lide, and R.R. Sharitz. 2005. Effects of dominant species on vegetation change in Carolina bay wetlands following a multi-year drought. *Journal of the Torrey Botanical Society* 132: 411-420.

Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.

## SMALL DEPRESSION POND (OPEN LILY POND SUBTYPE)

**Concept:** Small Depression Ponds are the mainland Coastal Plain small depression communities with permanent flooding or with hydroperiods lasting most of the growing season. The Open Lily Pond Subtype covers the deepest, most permanently flooded zones, where floating or submersed aquatic plants such as *Nymphaea*, *Lemna*, or *Utricularia* dominate. It generally occurs in zoned complexes with other depression communities.

**Distinguishing Features:** Small Depression Pond (Open Lily Pond Subtype) is distinguished from other Coastal Plain Depression Communities by having permanent or near-permanent standing water and lacking extensive emergent vegetation. Floating, floating-leaf, or submersed aquatic plants dominate, typically *Nymphaea odorata*, *Nuphar advena*, *Nymphoides aquatica*, *Lemna* spp., or *Utricularia* spp. This subtype largely lacks emergent marsh plants such as *Eleocharis equisetoides*, *Eleocharis elongata*, *Eleocharis melanocarpa*, *Rhynchospora tracyi*, *Rhynchospora inundata*, *Rhynchospora careyana*, *Panicum hemitomon*, *Leersia hexandra*, and *Panicum verrucosum*. Trees and shrubs are generally absent or sparse. This subtype should not be classified unless it covers a major part of the basin or covers a large area in a larger basin.

Floating Mat communities may also have permanent standing water but have dense floating vegetation bond together by roots and covering the water.

The Open Lily Pond Subtype is distinguished from Natural Lake Shoreline Marsh by occurring in small basins, with less than 20 acres of water. It is distinguished from Coastal Plain Semipermanent Impoundment by occurring in small natural basins in uplands rather than in impoundments in floodplains, with corresponding lack of stream flooding.

**Synonyms:** *Nymphaea odorata* - *Nuphar advena* - (*Nymphoides aquatica*, *Xyris smalliana*) Herbaceous Vegetation (CEGL004326).

Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Small Depression Pond (Open Lily Pond) communities occur most often in limesink depressions, but a few are known in clay-based Carolina bays or other kinds of depressions.

**Soils:** Soils generally have a shallow muck layer on the surface. Soil surveys treat them as inclusions in surrounding map units or map them as water.

**Hydrology:** Ponds are flooded most of the time, with water drawing down only at the end of drier summers or in severe drought. Water is often a meter or more deep.

**Vegetation:** The Open Lily Pond Subtype is dominated by aquatic plants. *Nymphaea odorata* is nearly always present and usually dominant, though it may range from low to high cover. Some species of *Utricularia* is often present; *U. purpurea* most frequently noted but *Utricularia biflora*, *olivacea*, *gibba*, and other species have been noted. *Nuphar advena*, *Nymphoides aquatica*, *Brasenia schreberi*, *Myriophyllum laxum*, and *Lemna valdiviana* are sometimes present. Species rooted on the bottom, such as *Eleocharis vivipara* or *Juncus repens* may become evident when water levels are low. Emergent species shared with the Typic Marsh Subtype, such as *Hymenachne*

*hemitomon*, *Leersia hexandra*, *Eleocharis equisetoides*, or *Rhynchospora inundata* may be present in the edges but are limited in cover. Other emergent species such as *Xyris* spp. or *Eriocaulon* spp. may be present on the edges. In extreme droughts, when the bottom may be exposed for longer times, ruderal species such as *Cyperus* spp. may appear. Woody species usually are absent, but scattered individuals of *Taxodium ascendens* or *Nyssa biflora* may be present.

**Range and Abundance:** Ranked G3?. Most North Carolina examples are in the southeastern outer Coastal Plain but some reach the inner Coastal Plain and a few occur farther north. The synonymized association ranges to South Carolina and is questionably attributed to Georgia and Florida. Open lily ponds are more common in Florida, so the question is primarily about whether they should be regarded as the same association.

**Associations and Patterns:** The Open Lily Pond Subtype usually occurs in zoned complexes, where it occupies the center or the portion with deepest water. Not all zones are well developed in most depressions, but surrounding communities are likely to include the Typic Marsh Subtype or Cutgrass Prairie Subtype of Small Depression Pond, Small Depression Drawdown Meadow, Vernal Pool, or Small Depression Shrub Border. All of these communities often occur in close proximity in multiple patches in limesink clusters. The surrounding uplands in natural condition are dry or wet longleaf pine communities.

**Variation:** Ponds vary in their mix of aquatic plant species, but patterns of variation have not been identified.

**Dynamics:** The Open Lily Pond Subtype is subject to water level fluctuations, but it may be more stable than most of the other herbaceous depression communities because only the more extreme dry spells lead to loss of standing water. However, in such extreme times, Mullhouse, et al. (2005) documented that *Nymphaea* and other floating aquatics could completely disappear and that the vegetation was more susceptible to the establishment of new plants than was the denser marsh vegetation. Even with the water gone, the vegetation of the Open Lily Pond Subtype is unlikely to carry fire unless the pond has been dry long enough for a dense stand of grass to develop.

**Comments:** This community was called Nymphaea Pond (3.0.1) in Nifong 1998. Only a couple of examples are known in Carolina bays.

**Rare species:** Vascular Plants: *Bacopa caroliniana*, *Eleocharis elongata*, *Eleocharis robbinsii*, *Eleocharis vivipara*, *Eupatorium leptophyllum*, *Myriophyllum laxum*, *Paspalum dissectum*, and *Utricularia olivacea*.

Vertebrate Animals: *Alligator mississippiensis*, and *Rana capito*.

**References:**

Mulhouse, J.M., D. De Steven, R.F. Lide, and R.R. Sharitz. 2005. Effects of dominant species on vegetation change in Carolina bay wetlands following a multi-year drought. *Journal of the Torrey Botanical Society* 132: 411-420.

Nifong, T.D. 1998. An ecosystematic analysis of Carolina bays in the Coastal Plain of North Carolina. Ph.D. Dissertation, University of North Carolina, Chapel Hill.

## FLOATING BOG

**Concept:** Floating Bogs are rare communities developed on floating vegetation mats in deep water. They may occur in limesink depressions, or in natural or artificial impoundments. Vegetation usually includes a mixture of species shared with northern quaking bogs and pocosins. Characteristic species are *Rhynchospora alba*, *Dulichium arundinaceum*, *Hypericum virginicum*, *Eleocharis baldwinii*, *Sarracenia rubra*, *Sarracenia flava*, *Chamaedaphne calyculata*, and *Sphagnum cuspidatum*.

**Distinguishing Features:** Floating Bogs are distinguished from almost all other communities by their substrate, which consists of organic mats floating on water. The few examples known are in very different settings, including a limesink pond, a naturally blocked creek embayment, and an old mill pond impounded in a pocosin. The only similar community, Riverine Floating Mat, occurs in flowing or tidal waters and consists of species such as *Hydrocotyle ranunculoides* or *Sacciolepis striata* rather than species associated with bog environments.

**Synonyms:** *Rhynchospora alba* Saturated Herbaceous Vegetation (CEGL004463).  
Ecological Systems: Southern Atlantic Coastal Plain Depression Pondshore (CES203.262).

**Sites:** Floating Mat communities are known from only a handful of sites. They may potentially occur in any standing water, including limesink depressions, long-standing natural or artificial impoundments, or stagnant creeks. The conditions that lead to their formation in the handful of sites and not in others are unknown.

**Soils:** The soil consists of a mat of floating organic matter formed by vegetation and bound together by live roots.

**Hydrology:** Floating mats occur in permanent or near-permanent water.

**Vegetation:** The vegetation is quite different in each of the handful of examples. It has in common a mix of species tolerant of extremely acidic wetland conditions, forming a dense floating herb mat and having small individuals of woody species. *Sphagnum cuspidatum* or some other species of *Sphagnum* seems to form the matrix or substrate of the mat in most or all examples. *Rhynchospora alba* often is present. In one example, *Dulichium arundinaceum* and *Decodon verticillatus* are abundant. In a second one nearby, *Rhynchospora inundata*, *Calopogon tuberosus*, and *Xyris smalliana* are the primary additional species. One has a mix of *Xyris* sp., *Drosera intermedia*, *Andropogon glaucopsis*, *Sarracenia flava*, *Hymenachne hemitomon*, and *Chamaedaphne calyculata*. Another has *Eleocharis microcarpa*, *Hydrocotyle verticillata*, *Anchistea virginica*, *Persicaria* sp., and at least some *Vaccinium macrocarpon*. Woody species in examples include *Pinus serotina*, *Morella cerifera*, *Smilax laurifolia*, and *Smilax walteri*.

**Range and Abundance:** Ranked G1?. This community is known from three examples in North Carolina. The NVC association has not been attributed to any other state but it should be sought in similar settings in nearby states.

**Associations and Patterns:** The known examples vary in their associations in accordance with their setting. One occurs in limesink depressions, where it is associated with Small Depression Pond and Small Depression Shrub Border communities. One is in an artificially impounded peat-filled Carolina bay, where it is surrounded by Coastal Plain Semipermanent Impoundment (Open Water Subtype) and by Low Pocosin. The third is along a small drowned river, where it is bordered by pocosin communities.

**Variation:** All known examples are extremely different from each other and could be regarded as distinct variants if not subtypes.

**Dynamics:** Virtually nothing is known about the dynamics of these communities. The factors that led to their formation are not known, beyond general conditions that are similar to numerous sites that do not have Floating Bogs. At least one example has developed in the last 200 years, in an impounded pocosin. The age of the others is not known. They may be relatively transient communities, though none have been observed to appear or disappear. The mechanism of mat development seems to include both accretion onto floating vegetation such as *Nymphaea* or *Sphagnum* and extension by vegetative spread at the edge of the mat.

Floating Mats may be long-term primary successional communities, with the mats gradually extending and thickening until their peat fills the basin. They resemble at least superficially the primary successional communities of northern glacial kettle hole bogs that are believed to undergo this process. If so, once grounded and stable, they likely will develop some kind of pocosin vegetation. Alternatively, they may represent a kind of dynamic equilibrium or cyclic succession, their spread and development checked by conditions or periodically destroyed by natural disturbances

**Comments:** Floating Bog communities are among the more enigmatic communities of North Carolina. The examples are tied together by a distinctive phenomenon of mat development that is extremely rare and poorly understood.

This community type does not fit cleanly into any theme but fits Coastal Plain Depression Communities better than any other.

**Rare species:** Vascular Plants: *Rhynchospora alba* and *Vaccinium macrocarpon*.

**References:**