

ATTACHMENT 1

PONDBERRY REGIONAL HABITAT REQUIREMENTS

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1. The habitat requirements of pondberry appear to be highly variable across its range. In the Mississippi alluvial plains of Arkansas, Missouri, and Mississippi, pondberry occurs on sites with perched water tables and vegetation similar to that of bottom-land hardwood habitats. In general, it occupies wetland habitats that are normally flooded or saturated during the dormant seasons, but infrequently flooded during the growing season for extended periods (Tucker, 1984). The specific habitat types occupied by pondberry have been variously described; e.g., "mesic to hydric sites" (i.e., bottom-land hardwood habitats, depressions, and margins of sinks and ponds (Wofford, 1983) and sandy sinks and pond margins, swamps and pond margins, and swampy depressions (Porcher, 1980)). Devall, et al. (2000), noted that pondberry has a wide ecological amplitude as long as its requirements for water were met.
2. These habitat types vary from the edges of limestone sinks in South Carolina to depressions within bottom-land hardwoods in Mississippi. Although factors such as associate species and soils may vary across its range, the characteristic of occupying locally depressed or ponded areas is consistent throughout its range. A description of the habitat requirements and its status within the other states will be provided; however, the majority of this discussion will focus on the Mississippi populations based on previously published and unpublished data, as well as field pondberry surveys conducted in 1990, 1991, and 1996 by the U.S. Army Corps of Engineers. The results of the 2000 surveys profile reevaluation will be presented in Section 7.0.

NORTH CAROLINA

3. The Gulf South Research Corporation (GSRC) contacted the North Carolina Natural Heritage Program (NCNHP) on June 2, 2003, to request a list of all known pondberry populations in North Carolina. An Element of Occurrence database was submitted to GSRC on June 30, 2003. Pondberry is one of the two most endangered plant species in North Carolina (NC DACS/PCP, 2001). Currently, there are only two extant populations of pondberry in North Carolina, which include the Pondberry Bay/White Oak Woods site in Sampson County and the Big Pond Bay site in Cumberland County. Recent surveys of the White Oak Pondberry site located in Bladen County have failed to identify pondberry plants. The species was last observed in Bladen County in 1998 (NCNHP, 2003). Table 1 in Appendix C depicts all known occurrences of pondberry in North Carolina according to the NCNHP database.

HABITAT

4. The habitat of pondberry populations within North and South Carolina is notably different. The North Carolina populations are described as inhabiting areas " . . . associated with bay forest or pocosin vegetation (but which has been largely destroyed through fire, resulting in a disclimax composed of more shrubs than formerly)" (Tucker, 1984).

5. The Balden County, North Carolina, site was described by visiting ecologists as "a shallow pond, partially drained and overgrown with a very dense evergreen thicket," "a drained low Pocosin" in 1987, and in 1939, "the margin of a pond subject to drying up in season, but where the roots are at times submerged." The Sampson County site was described as a "small Carolina Bay" by Leonard in 1995. The Cumberland County site is characterized as a Carolina Bay with overstory trees, understory evergreen shrubs, and a sphagnum moss bottom (NCHNP, 2003).

SOILS

6. The North Carolina populations occur on sandy soils with a high content of peat in the subsurface and a high water table (Tucker, 1984). Surface- and groundwater depths were estimated during visits to the Sampson County site. In 1991, the pond was dry and the water table was found at 20 inches beneath the surface. During the fall of 1994, the pond remained dry, but when the site was visited on February 26, 1995, nearly all of the plants were found in standing water ranging from a few inches to more than 1 foot in depth. The site was found to be flooded during a site visit in June 1995 when an above-average rainfall occurred (NCNHP, 2003).

7. The Pondberry Natural Area, located in Sampson County, North Carolina, is comprised of numerous natural communities situated northeast of Roseboro on a flat upland interstream divide with its associated drainages. The most significant single feature is the Carolina Bay containing pondberry. The oval shape of many of these bays is thought to have developed during the Wisconsin Glacial Era 10,000 to 40,000 years ago when wave action, driven by the northwest winds prevailing at that time, elongated the pools from northwest to southeast (NC DACS/PCP, 2001).

ASSOCIATE SPECIES

8. Pondberry was last observed at the Balden County site in 1983 with 50 to 60 specimens in 1983. Surveys in 1994, 1995, and 1998 have failed to relocate any specimens, and pondberry may be presently extirpated from the site. The Balden County site was characterized by Leonard (1995) as "being overgrown with a very dense evergreen thicket of fetter bush (*Lyonia lucida*)" (NCNHP, 2003). When the species was last observed in 1983, associated species were described

as "evergreen shrub thicket with open canopy of pond pine (*Pinus serotina*), red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), sweetbay (*Magnolia virginiana*), and water oak (*Quercus nigra*)" (NCNHP, 2003). Associate plant species with the Sampson County site were described to include bladderwort (*Utricularia sp.*) (when the bay is flooded), black fruit spikerush (*Eleocharis melanocarpa*), and Small's yellow-eye grass (*Xyris smalliana*) by NCNHP in 2000. Associated species inhabiting the Carolina Bay at the Cumberland County site were characterized as an overstory containing loblolly pine (*Pinus taeda*) and pond cypress (*Taxodium ascendens*), with an evergreen shrub layer of fetterbush, inkberry (*Ilex glabra*), and Carolina laurel (*Kalmia carolina*) on the periphery of the bay. Pondspice, another rare species, was also found at the site.

9. Other scientists describe the bay forest or pocosin habitat of one of the North Carolina populations to include redbay (*Persea borbonia*), sweetbay, swamp tupelo (*Nyssa biflora*), pond cypress, red maple, pond pine, longleaf pine (*Pinus palustris*), swamp cyrilla (*Cyrilla racemiflora*), fetterbush, bayberry (*Myrica sp.*), blueberry (*Vaccinium sp.*), and greenbrier (*Smilax sp.*) (Morgan, 1983; Tucker, 1984)

SOUTH CAROLINA

10. The GSRC contacted the South Carolina Heritage Trust (SCHT) on June 2, 2003, to request a list of all known pondberry populations in South Carolina. An Element of Occurrence database was submitted to GSRC on June 30, 2003. The SCHT has 15 records of occurrence for pondberry in the state. Eleven copies are currently known to occur on the Francis Marion National Forest in Berkeley County, two colonies are known from the U.S. Marine Corps Air Station in Beaufort County, one colony is known from private property in Berkeley County, and one in Beaufort County (SCHT, 2003). The largest concentration of pondberry throughout its range occurs in the Honey Hill region of the Francis Marion National Forest in Berkeley County (Porcher and Rayner, 2001). Table 2 in Appendix C depicts all known occurrences of pondberry in South Carolina according to the SCHT database.

HABITAT

11. The habitats of pondberry populations within North and South Carolina are notably different. The North Carolina populations are described as inhabiting areas associated with previously burned bay forest or pocosin vegetation (Tucker, 1984). The South Carolina populations occupy two habitat types--the margins of limestone sinks and shallow depressions in pinelands. The limestone sinks generally maintain water throughout most of the year by either artesian water or rainwater. Pondberry plants are found on the periphery of these limestone sinks at elevations where normal high-water levels occur. The plants are generally free of competing

vegetation at these high-water levels. The shallow pineland depressions are fed by rainwater, often maintaining water for several months. Pondberry generally grows in standing water within these depressions (Porcher, 1980). In the Honey Hill lime sink area, a number of woody shrubs have been determined to be aggressive competitors to the area's pondberry populations. These shrubs include sweet pepperbush (*Leucothoe racemosa*), fetterbush, red maple, and loblolly pine (Roecker, 1998).

SOILS

12. The soils of the South Carolina populations are reported to be very acidic, peaty sand with a surface pH of 4.5 and subsurface pH of 5.5. The water table was 29 inches below the soil surface when measured in October (Radford, 1976). The Honey Hill lime sink uplands contain Chipley or Lakeland soils (Roecker, 1998).

ASSOCIATE SPECIES

13. The associated species within the limestone sink habitat of South Carolina were documented by Radford, et al. (1968). The reported tree species within the sinks are pond cypress and blackgum. The dominant tree species around the sink's edge include loblolly pine, water oak, laurel oak (*Quercus laurifolia*), live oak (*Q. virginiana*), and sweetgum. Associate shrub species within the sinks include dahoon holly (*Ilex cassine*) and pondspice, while additional associate species on the sink's edge include wax myrtle (*Morella cerifera*), black high blueberry (*Vaccinium atrococcum*), St. Andrew's cross (*Hypericum hypericoides*), St. Peter's-wort (*H. stans*), inkberry, American holly (*Ilex opaca*), and staggerbush (*Lyonia mariana*). A common associate in the pineland depressions habitat of South Carolina is the marsh fern (*Woodwardia virginiana*) (Porcher, 1980).

GEORGIA

14. The GSRC contacted the Georgia Natural Heritage Program (GNHP) on July 9, 2003, to request a list of all known pondberry populations in Georgia. An Element of Occurrence database was submitted to GSRC on September 3, 2003. The GNHP has 11 records of occurrence for pondberry in the state; however, only 7 populations are currently known to exist in the state (GNHP, 2003). Pondberry has been found in seven counties: Wheeler, Baker, Worth, Effingham, Chatham, and Calhoun Counties. Currently, two populations are found in Wheeler County, one population in Baker County, two populations in Worth County, one population in Effingham County, and one population in Calhoun County. Table 3 in Appendix C depicts all known occurrences of pondberry in Georgia according to a 2003 GNHP database.

HABITAT

15. Georgia pondberry colonies are found along the edges of sandhill depression ponds or sinkholes such as bald or pond cypress ponds in the coastal and southern parts of the state. Devall, et al. (2002), reports pondberry occurs along the edges of sphagnum bogs in Georgia. Aleric (2003) reported that the pondberry colony at the Joseph Jones Ecological Research Center at Ichauway in Baker County inhabits a pond, which is a cypress-tupelo forested wetland and is classified as an organic depression under the Ichauway Ecological Classification System. In Worth County, the smaller of the two populations are almost entirely surrounded by a pine plantation with small deciduous shrubs and vines (Patrick, 2003). In terms of potential sites, there are hundreds of potential pondberry habitats in Worth County that are characterized by seasonally ponded Coxville soils, which are awaiting to be explored. Both of the Worth County populations were recently discovered by ecologists with the Georgia Department of Natural Resources (GDNR) while conducting flatwoods salamander (*Ambystoma cingulatum*) surveys (Patrick, 2003). Patrick (2003) also reported that Worth County pondberry populations appear to be seasonal ponds with cypress and swamp tupelo, sometimes called "cypress domes" when the cypress is still conspicuous, also cypress-gum ponds. In the Dougherty Plain (all southwest Georgia sites), pondberry populations have been founded in lime sink depression ponds. The pondberry plants are mostly along the edges of these seasonal ponds and not standing in water for long and only when water is near maximum level (Patrick, 2003).

SOILS

16. The soils at the pondberry colony located at the Joseph W. Jones Ecological Research Center at Ichauway in Baker County, as well as the colony in Calhoun County, are characterized by Grady as poorly drained soil which is a slowly permeable soil (Patrick, 2003). Grady soils were formed predominantly in clayey marine sediment in upland depressions. The pondberry sites commonly contain ponded water or the water table is within 1 foot of the surface from winter to early summer.

17. One Worth County population is characterized by Coxville fine sandy loam soil, which is a poorly-drained soil formed in clayey marine sediments in depressions on the uplands (Patrick, 2003). Coxville fine sandy loam soils are slowly permeable and commonly ponded with a seasonally high water table at a depth of 1.5 feet or less from late fall to mid-spring. The second Worth County population is located on an extremely small pond, and the soil has not been characterized. As a result, it is possible that additional pondberry colonies may exist in Georgia and have been missed due to the extremely small areas it would inhabit.

18. The pondberry colonies in Wheeler County are characterized by sandhill depression ponds associated with Pelham Series sandy loam soil and surrounded by Kershaw Series deep white sands (Patrick, 2003). The Kershaw sands are poorly-drained soils found in low flat areas and depressions. Kershaw soil was formed in beds of sandy clay loam and sandy loam materials. The water table of the Wheeler County populations ranges from 0.5 to 1.5 feet in depth from mid-winter to mid-spring.

19. Patrick (2003) reported that the Chatham County pondberry population is characterized by a sandhill depression pond which is too small to be delineated on soil survey maps, although conspicuous on U.S. Geological Survey topographic quadrangles. The depression pond is surrounded by Albany fine sands which are somewhat poorly drained and occur in undulating areas surrounded by Cape Fear very poorly drained soils with clayey subsoil. There are no published soil surveys for Effingham and Screven Counties. As a result, no soils information for the pondberry colonies can be gathered at this time (Patrick, 2003).

ASSOCIATE SPECIES

20. Devall, et al. (2002), observed the dominant tree species at a Wheeler County site to include red maple, sweetgum, and loblolly pine. The pondberry site is very open, and the pondberry stems are growing in nearly full sun. Pondspice was also documented as an associate species. Common overstory tree species at a number of Georgia colonies includes bald or pond cypress, red maple, loblolly pine, and swamp tupelo. Associated shrub species include inkberry and pondspice. Species observed at the Effingham County site include slash pine (*Pine elliotii*), myrtle dahoon (*Ilex myrtifolia*), swamp bay (*Persea palustris*), wax myrtle, pondspice, lesser creeping rush (*Juncus repens*), Maryland meadow beauty/rhexia (*Mariana var. mariana*), handsome Harry (*Rhexia virginica var. purshii*), Elliott's yelloweyed grass (*Xyris elliotii*), fringed yellow-eyed grass (*Xyris fimbriata*), Wright's beaksedge (*Rhynchospora wrightiana*), bunched beaksedge (*Rhynchospora cephalantha*), fascicled beaksedge (*Rhynchospora fascicularis*), purple bluestem (*Andropogon glaucopsis*), cone-cup spikerush (*Eleocharis tuberculosa*), and Virginia chainfern (*Woodwardia virginica*).

ARKANSAS

21. The GSRC contacted the Arkansas Natural Heritage Program (ARNHP) on July 10, 2003, to request a list of all known pondberry populations in Arkansas. An Element of Occurrence database was submitted to GSRC on July 23, 2003. In Arkansas, pondberry has been found in seven counties: Ashley, Clay, Jackson, Lawrence, Craighead, Poinsett, and Woodruff Counties composing 46 documented locations in the state. Table 4 in Appendix C depicts all known occurrences of pondberry in Arkansas according to the ANHP database. Of the occurrences listed in Table 4 in Appendix C, 36 colonies are currently known to be extant, while the remaining 10 colonies have either been destroyed by farming or timber harvesting or have not been relocated in recent decades. Currently, 4 colonies are known in Clay County, 25 colonies in Jackson County, 1 colony in Woodruff County, 4 colonies in Lawrence County, 1 colony in Ashley County, and 1 colony incorporating Craighead and Poinsett Counties (ANHP, 2003).

HABITAT

22. In northeastern Arkansas, pondberry inhabits the edges of, or within seasonally flooded sand ponds within, bottom-land hardwood forests. These sand ponds occupy depressions between ancient sand dunes and are generally flooded from late summer to early fall. Recently, two new populations have been found in Arkansas--one in Ashley County and another at the

St. Francis Sunken Lands Wildlife Management Area in Craighead and Poinsett Counties (ARNHC, 2003). The Ashley County record, located in southeastern Arkansas, represents the only known site in the state outside the sand dune area of northeast Arkansas. The Craighead and Poinsett Counties occurrence is the largest in Arkansas (Osborne, 2003).

23. Pondberry colonies at the Stateline Sandponds Natural Area are characterized by sand pond wetlands and woodlands on a gently undulating series of sand dunes formed from glacial riverine deposits, creating a dune and swale topography. The preserve adjoins 700 acres of protected sand ponds in Missouri and harbors one of the largest known populations of pondberry (The Nature Conservancy, 2003).

24. The Coffee Prairie Natural Area, located in the Upper West Gulf Coastal Complex, is classified as a Lowland Sand Prairie ecosystem. The Natural Area is a part of the Arkansas Game and Fish Commission's Beryl Anthony/Lower Ouachita Wildlife Management Area. The Lowland Sand Prairies are only located in southern Arkansas and northern Louisiana in bottom-land hardwood forests along the Ouachita River (ARHNC, 2003). The last known occurrence for pondberry in Louisiana was across the border along the Ouachita River, perhaps in similar community types (Thomas, et al., 1998).

SOILS

25. The Stateline Sandponds Natural Area is characterized by depressions formed among ancient dune fields, approximately 12,000 to 30,000 years old, deposited on areas glacial outwash in the Delta region. Individual dunes are generally 3 to 5 feet in height composed of fine grained sand. The sands are the result of sediment deposits carried by winds, which were originally deposited in Arkansas by braided streams originating from continental glaciers. The dune fields contain numerous small, enclosed depressions underlain by fine-grained glacial wash deposits. The resulting sediment is a poorly drained substrate which ponds rainfall and overland flow and intercepts or collects perched groundwater for extended periods. The resulting isolated wetlands occur and vary from very small, swale-like systems to large, deep depressions many acres in size. The majority of the sand pond wetlands contains standing water throughout the winter months, gradually drying throughout the growing season (MAWPT, 2003). The Coffee Prairie Natural Area, located in the West Gulf Coastal Plain, was formed in the Quaternary Period from Pleistocene Epoch Lacustrine deposits, which are composed of soils from beaches and sandbars of relict lakes. On average, the Coffee Prairie Natural Area is partially to completely inundated from 1 month to 180 days per year from the late winter to early summer months. The extant pondberry colonies inhabit soils mapped as Guyton frequently flooded (ARNHC, 2003a).

ASSOCIATE SPECIES

26. Vegetation communities at the Stateline Sandponds Natural Area containing the pondberry colonies are thought to have historically contained a diverse forest containing bald cypress, sweetgum, red maple, willow oak (*Quercus phellos*), Nuttall oak, and blackgum (*Nyssa sylvatica*) (The Nature Conservancy, 2003). MAWPT (2003) reports common tree species in sand pond communities include swamp red maple (*Acer rubrum* var. *durmondii*), ironwood (*Carpinus caroliniana*), water hickory, sugarberry (*Celtis laevigata*), persimmon (*Diospyros virginiana*), green ash, (*Fraxinus pennsylvanica*), pumpkin ash (*Fraxinum tomentosa*), water locust (*Gleditsia aquatica*), sweetgum, Nuttall oak, overcup oak, willow oak, and pin oak (*Quercus palustris*). Common understory (shrub, herbaceous, and woody vine) species include rattan (*Berchemia scandens*), American buckwheat vine (*Brunnichia ovata*), sedges (*Carex* sp.), jewelweed (*Impatiens capensis*), common rush (*Juncus effusus*), corkwood (*Leitneria floridana*), pondberry, Virginia creeper (*Parthenocissus quinquefolia*), snowbell (*Styrax amricana*), and wild grape (*Vitis* sp.). The lowland sand prairie of the Coffee Prairie Natural Area is surrounded by mature bottom-land hardwood forests dominated by willow oak-overcup oak flatwoods.

MISSOURI

27. The GSRC contacted the Missouri Natural Heritage Program (MONHP) on June 23, 2003, to request a list of all known pondberry populations in Missouri. An Element of Occurrence database was submitted to GSRC on July 7, 2003. The Missouri and Arkansas populations are considered historically to have been a single contiguous population. However, habitat destruction and alteration have resulted in two disjunct units (Tucker, 1984; FWS, 1993). The only naturally occurring population of pondberry occurs in southeastern Ripley County, Missouri, located near Arkansas. The topography is characterized by dunes and swales composed of sands deposited by winds dating to the Wisconsin glacial period (Smith, 2003). Table 5 in Appendix C depicts all known occurrences of pondberry in Missouri according to the MONHP database.

HABITAT

28. The pondberry populations of Missouri and Arkansas are found in swampy depressions within swales between sand dunes of the Mississippi River alluvial valley (FWS, 1990). This ridge and swale topography was formed during the Wisconsin Stage glaciation by braided streams, which carried glacial outwash (Saucier, 1978). The dunes range from 2 to 10 feet higher than the depressions. These depressions often form drainage nets, which in turn, form natural swamps and ponds. These areas may hold up to 20 inches of water during spring, but are normally dry by October. Pondberry grows in these depressions or swale areas on level ground under a close canopy of bottom-land hardwood species (Klomps, 1980a).

SOILS

29. Tucker (1984) reported that the soils within these swales in Arkansas and Missouri are normally loams or silty loams. Several of the pondberry colonies are found on soils, which have an elevated calcium and magnesium ion exchange complex in the soil subsurface. The soils are acidic as evidenced by the occurrence of mosses such as climacium moss (*Climacium spp.*), polytrichum moss (*Polytrichum spp.*), and leucobryum moss (*Leucobryum spp.*) (Klomps, 1980b). Pondberry populations are found on sites composed of Boskett-Tuckerman Series (Allgood and Persinger, 1979) with Ordovician dolomites as the primary underlying geologic substrate. The soil associations in these areas are also characterized by high-water tables and poor drainage (Tucker, 1984).

ASSOCIATE SPECIES

30. Pondberry typically occupies the depressions or lower side slopes with common spicebush is found on the higher, adjacent, nonflooding ground. The tree species frequently associated with pondberry in Arkansas and Missouri are pin oak, Nuttall oak, willow oak, cherrybark oak (*Quercus falcata* var. *pagodaefolia*), overcup oak, pumpkin ash, sugarberry, American elm (*Ulmus americana*), Drummond's red maple, sweetgum, and common persimmon (Klomps, 1980b; Tucker, 1984). Common shrub, herbaceous, and vine associates in Missouri have been reported to include greenbrier (*Smilax glauca*), lizard's tail (*Saururus cernuus*), Virginia sweetspire (*Itea virginica*), small spike false-nettle (*Boehmeria cylindrica*), jewelweed (*Impatiens spp.*), wild geranium (*Geranium sp.*), sedge, bedstraw (*Galium sp.*), bitter cress (*Cardamine bulbosa*), plum (*Prunus sp.*) and ironwood (Klomps, 1980b).

MISSISSIPPI

31. The GSRC contacted the Mississippi Natural Heritage Program (MNHP) on July 9, 2003, to request a list of all known pondberry populations in Mississippi. An Element of Occurrence database was submitted to GSRC on July 10, 2003. The MNHP database does not contain the current known number of pondberry colonies in the state as their most current records only indicate 26 colonies throughout the state. In addition, their Element of Occurrence database does not contain any population, habitat, soils, or ecology data. As a result, the MNHP Element of Occurrence database was not included in Appendix C.

32. Currently, there are approximately 194 extant pondberry colonies in Mississippi. In the Delta National Forest (DNF), 182 colonies exist while 12 colonies are found on private lands approximately 65 miles north of the DNF (GSRC, 2003). The GSRC contacted DNF on July 11, 2003, to inquire if any new populations of pondberry had been identified on DNF since 2000. The U.S. Forest Service (USFS) reported that to their knowledge, no additional colonies had been discovered by USFS personnel since 2000 (Allison, 2003).

33. In September 2003, a GSRC ecologist visiting DNF discovered two new pondberry colonies in Forest Compartment 39 located southeast of the intersection of Buckhorn Road and Spanish Fort Road. One colony, which is located significantly inside Forest Compartment 39, contains approximately 40 clones. A much smaller, second colony containing four live stems and one dead stem was discovered just inside the DNF boundary, south of the cotton field owned by the Huff family. The first colony is in an open upland community on a side of a ridge approximately 30 feet from a forest wetland edge located in a swale. The second smaller colony is located on the center of an upland ridge approximately 30 feet south of the nearby cotton field and ditch and approximately 130 feet northeast of a previously mapped pondberry colony and a USFS pondberry study plot flag line. Both new sites did not exhibit low chroma soils or any wetland hydrology indicators such as water-strained leaves, watermarks, sediment deposits, or drift lines. As a complete, intensive survey for pondberry in DNF has never been conducted and based on the small size of many of the Mississippi colonies, it is likely that more pondberry colonies have yet to be discovered (Henderson, 2003a).

HABITAT

34. Tucker (1984) reported that pondberry populations in Mississippi are associated with "... mature bottom-land hardwood forests in low depression." Morris (1986) made two collections of pondberry in Mississippi from a 21.2-acre parcel of hardwood forest containing two different pondberry habitats. The western section of the pondberry habitat, located on high ground, contained 5 colonies containing a total of approximately 200 individuals. The eastern section of the pondberry habitat was described as a periodically inundated swamp. The pondberry stems ranged in height from 2.46 to 6.56 feet and 3.28 to 4.92 feet in height.

35. The habitat of Mississippi pondberry is similar to that in Arkansas and Missouri (FWS, 1990). The U.S. Army Corps of Engineers (1991a) reported that pondberry colonies in Mississippi are typically found on slight ridges in a ridge and swale community that are either frequently or periodically flooded or is in proximity to a permanent water body. The GSRC determined in its August 2000 Revised Final Survey Report, Reevaluation of Pondberry in Mississippi, that "The average distance of a colony from a standing body of water, as measured by surveyors, was approximately 64 feet." The report goes on to state that of 50 colonies in the DNF, which GSRC studied, the average distance of a colony from a body of water was approximately 80 feet and only colonies found in Bolivar County were found in inundated areas or where areas that were recently inundated. None of the colonies surveyed in the DNF were found in standing water; however, approximately one-half of the colonies surveyed were in areas that could potentially hold water.

36. The extant populations in Mississippi are associated with bottom-land hardwoods at elevations where rainfall/local hydrology dominates the hydrologic conditions at the pondberry colony site. According to the 1996 Biological Assessment (USACE, 1996), Mississippi populations in the DNF are shade tolerant and found at elevations ranging from the 0- to 2-year flood plain to the 15- to 20-year flood plain of the lower Big Sunflower River. The major population of pondberry on the DNF occurs in the Red Gum Research Natural Area. The Red Gum Research Natural Area is a remnant of virgin forest which is slightly higher in elevation than most of DNF and is only occasionally flooded (Devall, et al., 2001).

SOILS

37. The Mississippi populations are most frequently found on soils characterized by the Sharkey-Alligator-Dowling Association and less frequently on soils characterized by the Alligator-Dowling Forestdale Association as delineated by the Natural Resources Conservation Service (NRCS) soil survey maps of Sharkey County, Mississippi. These soil associations are very similar with both being found on level, poorly drained soils in slack-water areas and depressions. The Alligator-Forestdale Association can also be found on old natural levees (Soil Conservation Service, 1962). The soils within these associations all have poor drainage, high water tables, low permeability rates, and gleyed B and C horizons (Tucker, 1984; Banker and Goetz, 1989). The tight clay subsoils of these associations results in slow permeability rates (0.2 to 0.6 inch per hour near the surface and 0.06 inch per hour in subsoils). Therefore, overland sheet flow dominates water movement in these soils (Banker and Goetz, 1989).

38. The U.S. Army Corps of Engineers (1991a) reported that of 44 pondberry colonies surveyed, 41 percent were located in surface soils classified as silty clay, 32 percent in silty clay loams, and 21 percent in silt loam soils. This indicates that pondberry colonies will not likely be found on strictly heavy Alligator, Sharkey, or Dowling clay soils. Extant pondberry colonies are found on soils with a mixture of heavy clays and lighter soils.

ASSOCIATE SPECIES

39. Devall, et al. (2001), recorded the dominant trees inhabiting the 16.0-ha Red Gum Research Natural Area Sharkey County. Dominant tree species observed includes sweetgum, box elder (*Acer negundo*), American elm, and sugarberry. Dominant shrub layer species include palmetto (*Sabal minor*) and switch cane (*Arundinaria gigantea*). Devall's research team also visited a pondberry colony on private land in Bolivar County. The 195-acre, located in a low wooded area which experiences flooding in the spring and winter, is surrounded by agricultural fields. Devall described the site as "very large with thousands of tall stems." Dominant tree species observed during the field investigation include water oak, sugarberry, and hickories (*Carya spp.*). Eastern poison ivy (*Toxicodendron radicans*), various greenbrier species (*Smilax sp.*), American buckwheat vine, and swamp milkweed (*Asclepias perennis*) were also present (Devall, et al., 2001).

40. Nordman (2002) conducted a botanical inventory of a 164- by 66-foot plot containing pondberry in Compartment 7 of DNF on May 17, 2002. Nordman characterized the pondberry colony as an "Old growth sweetgum stand with canopy gaps containing cedar elm (*Ulmus crassifolia*) trees up to 20 inches dbh in the subcanopy, with a slightly higher topography than most pondberry sites in the Delta National Forest." The dominant sweetgum overstory exhibited a 65 percent canopy coverage while the subcanopy exhibited a 45 percent canopy coverage being dominated by box elder and cedar elm. The shrub layer exhibited a 70 percent canopy coverage being dominated by switchcane, Japanese honeysuckle (*Lonicera japonica*), and palmetto. The herbaceous understory was described as being open with scattered herbaceous species. Other tree and shrub species observed in the pondberry colony included green ash, willow oak, sugarberry, American elm, roughleaf dogwood, and water oak. Herbaceous and vine species observed included heartleaf nettle (*Urtica chamaedryoides*), Boykin's clusterpea (*Dioclea multiflora*), blunt broom sedge (*Carex tribuloides*), Louisiana sedge (*Carex louisianica*), whitenymph (*Trepocarpus aethusae*), Canadian honewort (*Cryptotaenia canadensis*), Canadian blacksnakeroot (*Sanicula canadensis*), southern dewberry (*Rubus trivialis*), spring forget-me-not (*Myosotis verna*), eastern poison ivy, trumpet creeper, Virginia creeper, roundleaf greenbrier (*Smilax rotundifolia*), muscadine, summer grape (*Vitis aestivalis*), and American buckwheat vine.

41. The U.S. Army Corps of Engineers (1991a), through data collection from 44 colonies in Mississippi, was able to more clearly define associate tree and shrub species. The most common overstory species in descending order of frequency that were reported from the Mississippi colonies include oaks (willow, Nuttall, and overcup oak), sweetgum, cedar elm, American elm, and winged elm (*Ulmus alata*). The most frequent associate understory species are sweetgum and sugarberry. Common species in the shrub layer in descending order of frequency included snowbell, deciduous holly (*Llex decidua*), sugarberry, red maple, green ash, elm, roughleaf dogwood (*Cornus drummondii*), oaks, palmetto, common elderberry (*Sambucus nigra ssp. canadensis*), common persimmon, red mulberry (*Morus rubra*), and sweetgum.

42. Morris (1986) characterized two pondberry colonies, one in Sunflower County and the other in Sharkey County, during a site visit on February 25, 1982, and on January 24, 1986. Morris also reported that common overstory and shrub associate species included pawpaw (*Asimina triloba*), sugarberry, stiff dogwood (*Cornus stricta*), persimmon, sweetgum, overcup oak, Nuttall oak, sassafras, and snowbell. Associate herbaceous species included swamp milkweed, thin fruit sedge (*Carex flaccosperma*), Frank's sedge (*Carex frankii*), Carolina wild petunia (*Ruellia caroliniensis*), Canadian black snakeroot, and sand violet (*Viola affinis*).

ALABAMA

43. The GSRC contacted ALNHP in December 2004 to confirm that pondberry had been rediscovered in Alabama. Mr. Al Schotz, Botanist/Community Ecologist for ALNHP, confirmed the first noted occurrence of the species since 1840. Mr. Schotz discovered the two colonies in

Covington County, approximately 10 miles north of the Florida state line (ALNHP, 2004). On January 13, 2005, ALNHP provided GSRC with their Element of Occurrence database for the new colonies (ALNHP, 2005). Table 6 in Appendix C depicts all known occurrences of pondberry in Alabama according to the ALNHP database.

HABITAT

44. Due to the recent discovery of the pondberry in Alabama, limited habitat data have been recorded from the two new colonies. Schotz described the first colony (Colony 1), discovered on August 6, 2004, containing approximately 350 stems, to be of “high-quality habitat” concentrated along the western margin of a shallow depression. The colony is at a 230-foot elevation. The adjacent upland was dominated by various species of pines, most notably longleaf pine. The larger of the two colonies, Colony 2, discovered on August 10, 2004, was described as containing “several thousand stems” occupying the understory of a forest along the northern section of a shallow depression. Colony 2 is at a 235-foot elevation. As the habitat surrounding Colony 2 had been recently cleared of its overstory canopy and converted into a pine plantation, the habitat was described to be “poor.” Schotz also reported that the actual pondberry site appeared to have been recently burned, which perhaps may be partially attributable to the exceptional number of pondberry stems (ALNHP, 2005).

SOILS

45. According to the 1989 Soil Survey of Covington County, Alabama, the soils are mapped as Florala sandy loam (0 to 3 percent slopes) and Fuquay loamy sand (0 to 5 percent slopes) (NRCS, 1989).

ASSOCIATE SPECIES

46. Schotz reported that common overstory and shrub associate species at Colony 1 included swamp tupelo, myrtle dahoon, and red maple. Colony 2 associates included swamp tupelo, laurel oak, myrtle dahoon, and Honduras pine (*Pinus elliottii* var. *elliottii*) (ALNHP, 2005),

THREATS AND REASONS FOR SPECIES DECLINE

47. Several authors have discussed the reasons behind the suspected decline of pondberry throughout its range. There are no literature records of pondberry's historic abundance. However, apparent reasons for pondberry's current endangered status have been documented, as discussed in the following paragraph.

ALTERATION AND HABITAT LOSS

48. The most critical threat to pondberry, as with many endangered species, is the alteration/modification and/or loss of habitat. Three factors, which constitute this threat, are certain timber-harvesting practices, certain drainage activities, and land clearing operations for agricultural, commercial, and private development. Various problems are associated with timber-harvesting activities such as heavy equipment crushing plants, felled trees crushing plants or uprooting adjacent trees, opening closed or dense forest canopies, and possible changes in local hydrology. Kral (1983) reported that single-tree selection harvesting in hardwoods would likely not affect pondberry, while clear-cut harvesting which would result in increased surface water runoff, could potentially increase floodwater levels to a detrimental degree. Within the DNF in Mississippi, the USFS, along with FWS, determined that a 100-foot undisturbed buffer around known pondberry colonies, along with a 40-acre size limit on clear-cut openings, would prevent any major changes in hydrology and maintain an adequate crown closure around a colony (Baker and Goetz, 1989).

49. Several authors have made general statements about drainage activities and subsequent effects on pondberry such as ditching which could reduce the surface and/or ground-water regime in a manner that could reduce the plant's vigor or possibly eliminate it from an existing site (FWS, 1993). The USACE (1991b), through extensive field studies of pondberry within Mississippi and consultation with various experts, determined that activities which significantly alter the local hydrological regime of depressions, ponds, sinks, or other areas governed by localized hydrology would adversely affect pondberry colonies.

50. The third factor associated with the loss of habitat is land clearing due to agricultural interests and other developments. Throughout pondberry's range, bottom-land hardwoods and similar habitats have been extensively cleared. Within the Mississippi River alluvial valley, bottom-land hardwoods decreased 56 percent from 11.8 million acres in 1937 to 5.2 million acres in 1978, while agricultural/croplands increased nearly 5 million ac during the same time period (FWS, 1979). Habitat loss alone appears to be a major factor in the current endangered status of pondberry.