Mississippi Valley Division,
Regional Planning and Environment Division South

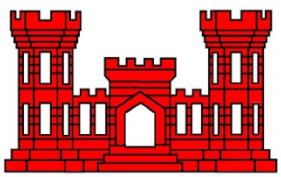
Yazoo Backwater Area Water Management Project

APPENDIX G- Threatened and Endangered Species U.S.

November 2024

Appendix G

Threatened and Endangered Species



U.S. Army Corps of Engineers

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, VICKSBURG DISTRICT
4155 CLAY STREET
VICKSBURG, MS 39183-3435

July 25, 2024

Project Name: Yazoo Backwater Area Water Management Project

Mr. James Austin
Field Supervisor
Mississippi Field Office
U.S. Fish and Wildlife Service
6578 Dogwood View Parkway
Jackson, MS 39213

Dear Mr. Austin,

The U.S. Army Corps of Engineers (USACE), Vicksburg District (CEMVK) has prepared this Biological Assessment (BA) to evaluate potential impacts to pondberry (*Lindera melissifolia*) associated with the proposed flood risk management project, *Yazoo Backwater Area Water Management Project*. The BA provides information required pursuant to the Endangered Species Act (ESA) and implementing regulation (50 CFR 402.13), to comply with the ESA. Additionally, potential project impacts to other listed species requested to be considered by the U.S. Fish and Wildlife Service (USFWS) are being addressed through informal consultation with the USFWS.

The project is located in west-central Mississippi, immediately north of Vicksburg, Mississippi and lies within, or in portions of Bolivar, Coahoma, Issaquena, Warren, and Washington counties.

The purpose of the project is to develop flood risk reduction solutions for the Yazoo Backwater area. The proposed water management alternatives consist of a pumping station with a 25,000 cubic feet per second (cfs) capacity to manage water levels; management of the flood water levels via the established water control plan, and non-structural components consisting of acquisition of primary residential properties in the most frequently flooded areas and optional acquisition or placement of restrictive easements of agricultural lands in the most frequently flooded lands. Implementation of the water management alternatives would be anticipated to decrease flood depth and duration within the study area.

Based on available data, review of current literature and studies, and collaboration with USFWS, USACE has determined that the proposed water management solution would be "*Likely to Adversely Affect*" a subset of extant federally endangered pondberry colonies between the elevation 90.0 and 93.0 ft National Geodetic Vertical Datum (NGVD 29) flood zone or within a 15-m buffer of this elevation range. For the remaining 100 extant colonies that occur above elevation 93.0 feet NGVD, USACE has determined that the proposed water management solution "*May affect, but is not likely to adversely affect*" these higher-elevation colonies.

CEMVK is submitting this BA as a request to initiate formal consultation and conference pursuant to Section 7 of the ESA of 1973, as amended (16 U.S.C. § 1536), and the consultation procedures at 50 C.F.R. Part 402.

JEREMIAH A GIPSON
Colonel, EN
Commanding

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, VICKSBURG DISTRICT
4155 CLAY STREET
VICKSBURG, MS 39183-3435

29 August 2024

Regional Planning and
Environmental Division South

David Felder
U.S. Fish and Wildlife Service
Mississippi Ecological Services Field Office
6578 Dogwood View Parkway
Jackson, MS 39213

Dear Mr. Felder,

The U.S. Army Corps of Engineers (USACE), Vicksburg District, proposes to implement a flood risk reduction solution for the Yazoo Backwater Area. The Water Management Plan consists of high-volume pumps to manage water levels, management of the flood water levels via the established water control plan, and a non-structural component consisting of acquisition of primary residential properties in the most frequently flooded areas and optional acquisition or placement of restrictive easements of agricultural lands in the most frequent flooded lands. Project implementation is anticipated to decrease flood depth and duration, and these changes are estimated to decrease wetland and ecological functions. However, establishment of compensatory mitigation is proposed to offset these estimated losses.

Coordination and collaboration with the U.S. Fish and Wildlife Service (USFWS) to determine which federally listed threatened and endangered species within the Yazoo Study Area that could potentially be impacted by project implementation has concluded that the endangered pondberry (*Lindera melissifolia*), northern long-eared bat (*Myotis septentionalis*), pallid sturgeon (*Scaphirhynchus albus*), and fat pocketbook mussel (*Potamilus capax*), along with the proposed threatened alligator snapping turtle (*Macochelys temminckii*) and proposed endangered tricolored bat (*Perimyotis subflavus*). Additional communication between USACE and USFWS has determined that of those species, only pondberry would have the potential to be indirectly impacted through project implementation and is therefore being addressed separately through formal consultation.

However, in contrast to pondberry, USACE has made the determination that any potential impacts that might occur with implementation of the proposed water management solution would be insignificant and not likely to adversely affect the northern long-eared bat, tricolored bat, alligator snapping turtle, pallid sturgeon, or fat pocketbook mussel, due to probability of occurrence in the area or through the implementation of avoidance measures (*e.g.*, mist net surveys to detect potential bat presence and/or winter tree clearing during hibernation periods, as well as incorporation of adequate safeguards such as outer trash racks of appropriate size to prevent potential alligator snapping turtle entrainment within the pumps and pump intakes). Additionally, no evidence of bald eagles, or their nests, were observed at the proposed pump station location. The bald eagle is no longer listed as a threatened species, but is still protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act.

Pursuant to Section 7 of the Endangered Species Act, as amended, USACE requests your concurrence with the aforementioned effect determination for the endangered northern long-eared bat, pallid sturgeon, fat pocketbook mussel, the proposed threatened alligator snapping turtle, and proposed endangered tricolored bat. As previously noted, determinations for pondberry are being addressed through formal consultation.

Sincerely,

Jeremiah A. Gipson
Colonel, Corps of Engineers
Commander

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mississippi Ecological Services Field Office
6578 Dogwood View Parkway, Suite A
Jackson, Mississippi 39213
Phone: (601)965-4900 Fax: (601)965-4340

October 16, 2024

IN REPLY REFER TO:
2024-0116749

Colonel Jeremiah A. Gipson
Vicksburg District Commander
U.S. Army Corps of Engineers
4155 East Clay Street
Vicksburg, Mississippi 39180

Dear Colonel Gipson:

The Fish and Wildlife Service (Service) has reviewed your correspondence dated August 28, 2024, regarding the proposed Yazoo Backwater Area Water Management Project. Our comments are submitted in accordance with the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

The proposed project is located in west-central Mississippi immediately north of Vicksburg, Mississippi, and includes all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo counties, Mississippi, and part of Madison Parish, Louisiana (i.e. Yazoo Study Area). The proposed water management project consists of high-volume pumps to manage water levels, management of the flood water levels via the established water control plan, and a non-structural component consisting of acquisition of primary residential properties in the most frequently flooded areas and optional acquisition or placement of restrictive easements on agricultural lands in the most frequently flooded areas.

Your office determined that six federally listed or "proposed for listing" species could be found within the Yazoo Study Area. Based on information provided in your correspondence, you determined that the proposed project "may affect, but is not likely to adversely affect" (MANLAA) five of these species. Provided below is a short analysis of effects to each species along with our concurrence with your determination. Also, formal consultation for the federally endangered pondberry was initiated on August 30, 2024. The Service anticipates providing a biological opinion on or before December 7, 2024.

Alligator Snapping Turtle - The alligator snapping turtle (*Macrochelys temminckii*) is a large freshwater turtle that is currently being proposed for listing as threatened throughout 14 states in

the Southeast and Midwest United States. They are generally found in large rivers and major tributaries; however, they also inhabit a variety of small streams, bayous, canals, swamps, oxbow lakes, and reservoirs associated with these large rivers.

The proposed project is expected to result in minor losses (0.09%) of nesting habitat and inundated foraging habitat when pumps are in operation; however, the project will result in increased shoreline complexity that may result in increased aquatic habitat availability. In addition, improved flood control resulting from the project may prevent the destruction of existing nests during future high-flow events.

Your agency proposes safeguards to prevent alligator snapping turtle entrainment at the pumping station. Specifically, outer trash racks of appropriate size will be installed to prevent potential turtle entrainment within the pumps and pump intakes.

Based on this information, we concur with your determination of MANLAA for the alligator snapping turtle. We conclude that potential adverse effects are expected to be insignificant and that some beneficial effects may occur as a result of the proposed project.

Fat Pocketbook - Within Mississippi, the endangered fat pocketbook mussel (*Potamilus capax*) can be found in the Mississippi River, particularly secondary channels and chutes. A single historical record exists within the Yazoo Study Area in the Big Sunflower River in Sharkey County, Mississippi. The 2019 five-year review for the fat pocketbook recommended delisting due to recovery.

Based upon extensive survey efforts over the past few decades, as well as current low flow and hypoxic conditions, it is likely that the fat pocketbook is extirpated from the Yazoo Study Area. Therefore, we concur with your determination of MANLAA for the fat pocketbook.

Northern Long-eared and Tricolored Bats - On November 29, 2022, the Service published a final rule to reclassify the northern long-eared bat (*Myotis septentrionalis*; NLEB) as endangered under the ESA. The bat faces extinction due to the range-wide impacts of white-nose syndrome, a deadly disease affecting cave-dwelling bats across the continent. On September 13, 2022, the Service also announced a proposal to list the tricolored bat (*Perimyotis subflavus*; TCB) as endangered under the ESA.

The proposed project is expected to result in up to 11,000 acres no longer being inundated by flood waters. These acres could see more vegetation in the shrub and subcanopy layers thereby making this acreage less suitable for bats. This represents 3.5 percent of the total forested habitat in the Yazoo Study Area. Based on the fact that there are few records of the NLEB and TCB from the 317,000 acres of potential habitat available to these species within the Yazoo Study Area, we expect the adverse effects of reduced flooding on bat foraging and roosting habitat to be insignificant. Positive effects to roosting and hibernating bats may also occur from the nine culverts and bridges that will no longer be inundated by flood waters once the project is in place.

Finally, the USACE has proposed tree clearing restrictions and/or mist net surveys in advance of tree clearing in order to avoid impacts to these species. Specifically, either mist net surveys will

be conducted in advance of any tree clearing activities; or tree removal activities will NOT take place during the pup season (May 1-July 31) or during the torpor season (December 15-February 15). Based on this information, the Service concurs with your determination of MANLAA for the NLEB and TCB.

Pallid Sturgeon - Within Mississippi, the federally endangered pallid sturgeon (*Scaphirhynchus albus*) occurs primarily within the mainstem of the Mississippi River. There is a single historical record from the Big Sunflower River, however, no recent records of the pallid sturgeon have been reported within the Yazoo Study Area.

Current conditions within the Yazoo Study Area include diminished minimum flows and seasonal hypoxia, which are not favorable for the presence of pallid or shovelnose sturgeon. In addition, the riverine habitat within the project area is not conducive to spawning or larval recruitment for any sturgeon species. Therefore, we concur with your determination of MANLAA for the pallid sturgeon.

No further consultation with this office is required for these species unless there are changes in the scope or location of the proposed project, or if any federally listed species are discovered during construction. If the proposed project has not been initiated within one year of this letter, follow-up consultation should be initiated with the Service.

If you have any questions, please contact David Felder in our office, telephone: (769) 487-6850, email: david_felder@fws.gov.

Sincerely,

_____
James A. Austin
Field Supervisor
Mississippi Field Office

Biological Assessment for Pondberry (*Lindera melissifolia*) (Walt.) Blume

U.S. Army Engineer Research and Development Center
Environmental Laboratory
Ecological Resources Branch
Vicksburg, Mississippi

1 INTRODUCTION

1.1 Purpose

The U.S. Army Corps of Engineers (USACE), Vicksburg District (CEMVK), is preparing an environmental impact statement titled "Yazoo Backwater Area Water Management Project" and is requesting concurrence with our determination that the project is "**Likely to Adversely Affect**" a subset of 22 extant federally endangered pondberry (*Lindera melissifolia*) colonies that occur in the Action Area specifically between the elevation 90.0 and 93.0 ft National Geodetic Vertical Datum (NGVD 29) flood zone or within a 15-m buffer of this elevation range. It is important to note that isolated depressional areas that are entirely surrounded by higher elevations and that would not receive backwater until a higher water elevation is reached are not included in this subset of colonies. In addition to these 22 extant pondberry colonies, five colonies have an unknown status; therefore, until future surveys can confirm whether they are extant or extirpated, these colonies within the 90.0 to 93.0 ft elevation zone will also be considered the same as the 22 colonies confirmed to be extant in 2023. For the remaining 100 extant colonies that occur in the Action Area above elevation 93.0 feet NGVD, we conclude that the pumps project **"May affect, but is not likely to adversely affect"** these higher-elevation colonies.

The CEMVK, in coordination with the U.S. Army Engineer Research and Development Center (ERDC), Environmental Laboratory (EL), completed two prior Biological Assessments (BA) (USACE 2005, 2020) for the Yazoo Backwater Reformulation Project and concluded that implementation of the Yazoo Pump Project was not likely to adversely impact pondberry on the Delta National Forest (DNF). Those assessments were based on research into the impacts of backwater flooding and localized hydraulic regimes on the distribution of pondberry (U.S. Army Corps of Engineers, 2000b, 2000c, 2005; Lockhart et al. 2009). In its 2007 Biological Opinion, the U.S. Fish and Wildlife Service (USFWS) did not concur with USACE findings regarding the relationship between flooding and pondberry, concluding that the magnitude of reduction in flooding by the Project likely would adversely affect pondberry. At the heart of the disagreement was the role of hydroperiod on the distribution, growth, and development of pondberry, and the need for improved knowledge on pondberry biology and ecology. To initially address this, and to help conserve and facilitate recovery of pondberry, the CEMVK designed investigations with the U.S. Department of Agriculture (USDA) Forest Service (USFS), to address data and recovery tasks contained in the USFWS Recovery Plan for pondberry (USFWS 1993). In 2003, the CEMVK and USFS entered a 7-year, $5 million interagency agreement to conduct extensive research on pondberry's biological and ecological requirements (USACE 2007). In addition, in 2007, the CEMVK and USFWS signed a Memorandum of Agreement to establish two new pondberry populations in the study area and conduct additional field experiments evaluating the effects of flooding, stand thinning, competition, and pathogens on pondberry. The CEMVK provided funding to the USFS, Southern Research Station, Center for Bottomland Hardwoods Research, to investigate a wide array of research topics, including biology, ecology, and ecophysiology of pondberry. At that time, the USACE was interested in the effects of light availability (which *in situ* for pondberry is influenced by canopy and midstory cover) and hydroperiod on the growth and development of pondberry. The results of a plethora of these investigations are included in this BA.

More recently, to further address the role of hydrology, including backwater flooding and precipitation-driven events that contribute to ground- and surface-water inundation at pondberry colonies, the CEMVK, in coordination with the ERDC-EL, installed 149 groundwater monitoring wells in 2021-2022 throughout the Yazoo Backwater Area. Of those, 58 were installed directly adjacent to pondberry colonies (40 adjacent to extant colonies out of a total of 122 extant colonies; 18 near extirpated colonies (or colonies of unknown status), out of a total of 191 colonies. CEMVK also installed eight groundwater monitoring wells adjacent to pondberry colonies within the Hester Tract, Bolivar County, Mississippi, to the north of the YBA to monitor hydrology associated with those colonies as well. A subset of those groundwater monitoring well data, though relatively short-term (i.e., up to 30 months of continuous daily data) compared to a proposed long-term strategy in this BA, are reported to show initial hydrologic inputs and hydroperiods (for both surface and subsurface water levels) from precipitation, and potentially other local hydrologic inputs, on pondberry colonies.

Subsequent to the most recent (USACE 2020) pondberry BA for the Yazoo Backwater Reformulation Project SEIS, a significant amount of information and field data on pondberry in Mississippi have been collected, assessed, and analyzed by the ERDC-EL from 2021-2024, in coordination with the USFWS. That updated information, and new data, are included in this BA, that specifically evaluates the potential effects of the proposed Water Management Plan in the Yazoo Backwater Area, Mississippi, to evaluate whether the proposed actions may affect pondberry.

During June 2024 communication between the ERDC-EL and USFWS, the USFWS suggested that the extant pondberry colonies noted in our initial draft BA that occur between elevation 90 and 93 ft NGVD 29 in the Yazoo Backwater Area (YBA), and within the primary "effect zone" of the Yazoo Pumps Project, could potentially be impacted differently than those above elevation 93 ft NGVD, and thus could be analyzed and addressed separately in this BA. The USFWS suggested they may not concur with a blanket effects determination of "Not Likely to Adversely Affect" if applied to all pondberry colonies within the YBA. Because of this, the ERDC-EL has put additional emphasis on the current status of those 22 colonies, which represent 18% of the known extant colonies within the YBA and contain approximately 10.4% of all pondberry stems within the YBA.

The CEMVK is submitting this BA to the USFWS pursuant to Section 7 of the Endangered Species Act (ESA), as amended. This BA is prepared in accordance with legal requirements set forth under Section 7 of the ESA (15 U.S.C. 1536 (c)) and applicable guidance documents and uses the best scientific and commercial information available when assessing the risks posed to pondberry by federal actions. This BA has been prepared to address all of the potential 'effects of the action' (as defined in 50 CFR 402) on pondberry that could be associated with the proposed project in accordance with Section 7 and associated implementing regulations (50 CFR 402). The BA includes the description of the Action Area, proposed actions, species account and status, effects of the proposed actions, mitigation and conservation measures, and effects determination. Pertinent biological and ecological data for pondberry are based on published and unpublished literature, communication with experts, and findings of recent ERDC-EL studies. If

the proposed Water Management Plan associated with the Project is modified or another alternative plan is selected, a reevaluation of the potential impacts would be conducted.

1.2. Authorities

- The proposed project is authorized by the Flood Control Act of 18 August 1941.
- Fish and Wildlife Coordination Act (16 U.S.C. 661-667e; the Act of March 10, 1934; Ch. 55; 48 Stat. 401), as amended
- Endangered Species Act (1973), as amended

The ERDC-EL developed an Endangered Species Act Section 7(a)(1) Conservation Plan for Pondberry in conjunction with this draft BA. That Conservation Plan, which will be provided to the USFWS along with the BA, outlines the purpose of Section 7(a)(1) and provides details on multiple recommended conservation actions intended to elevate baselines of pondberry colonies, and populations, in the Yazoo Backwater Action Area. Further details on Section 7(a)(1) are provided in Section 6.1 of this document, and the Conservation Plan itself.

2 ACTION AREA

The Yazoo Backwater Area (YBA; Figure 1), herein the "Action Area," includes the entire project footprint and all areas that may be directly (pump construction) or indirectly (changes in hydrology) affected by federal actions and not merely the immediate area involved in the action (50 CFR 402.02).

The ERDC-EL has put significant focus on identifying and addressing those pondberry colonies that occur within the "effect zone" of the YBA Water Management Plan, and we define the effect zone as the land area in the YBA encompassing all elevations between 90.0 and 93.0 ft NGVD that are most likely to be affected (and would most frequently be affected) by the proposed Water Management Plan. There are no known extant or historic colonies within or near the construction footprint of the pumps that would be directly affected by pump construction.

2.1 The Yazoo Backwater Action Area

The Action Area is located in west-central Mississippi immediately north of Vicksburg, Mississippi, and includes all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo counties, Mississippi, and part of Madison Parish, Louisiana. The triangular-shaped area, also referred to as the Yazoo Backwater Area (Figure 1), extends northward about 65 miles to the latitude of Hollandale and Belzoni, Mississippi, and comprises about 1,446 square miles.

The Big Sunflower and Little Sunflower rivers, Deer Creek, and Steele Bayou flow through the Action Area. These four streams drain 4,093 square miles of the Mississippi Alluvial Valley (MAV) and include a major portion of the Mississippi Delta. The drainage area extends from the confluence of Steele Bayou with the Yazoo River north to the vicinity of Clarksdale, Mississippi, and has an average width of approximately 30 miles. The Action Area is bordered by the left descending bank of the mainline Mississippi River levee on the west, the west bank levees of the Whittington Auxiliary Channel and the Sunflower River and Steele Bayou connecting channel on the east, and the Yazoo River on the south. The Mississippi Delta alluvial plain is generally flat with slopes averaging 0.3 to 0.9 feet per mile. Interior drainage of the Action Area is regulated by structures at the mouth of the Little Sunflower River (upper ponding area) and the mouth of Steele Bayou (lower ponding area).

The Action Area contains approximately 926,000 acres of which approximately 500,000 acres are lands within the 100-year flood frequency (Figure 2). The majority of current and historic pondberry colonies occur at or below the 100-year floodplain, with the majority of colonies occurring in the Delta National Forest (DNF) within the 5-year floodplain (Figure 3). The area historically has been subject to periodic backwater flooding from the Mississippi and Yazoo Rivers, and headwater flooding (when the Steele Bayou gates are closed due to high water levels from the Mississippi River) from the Big Sunflower River and Steele Bayou.

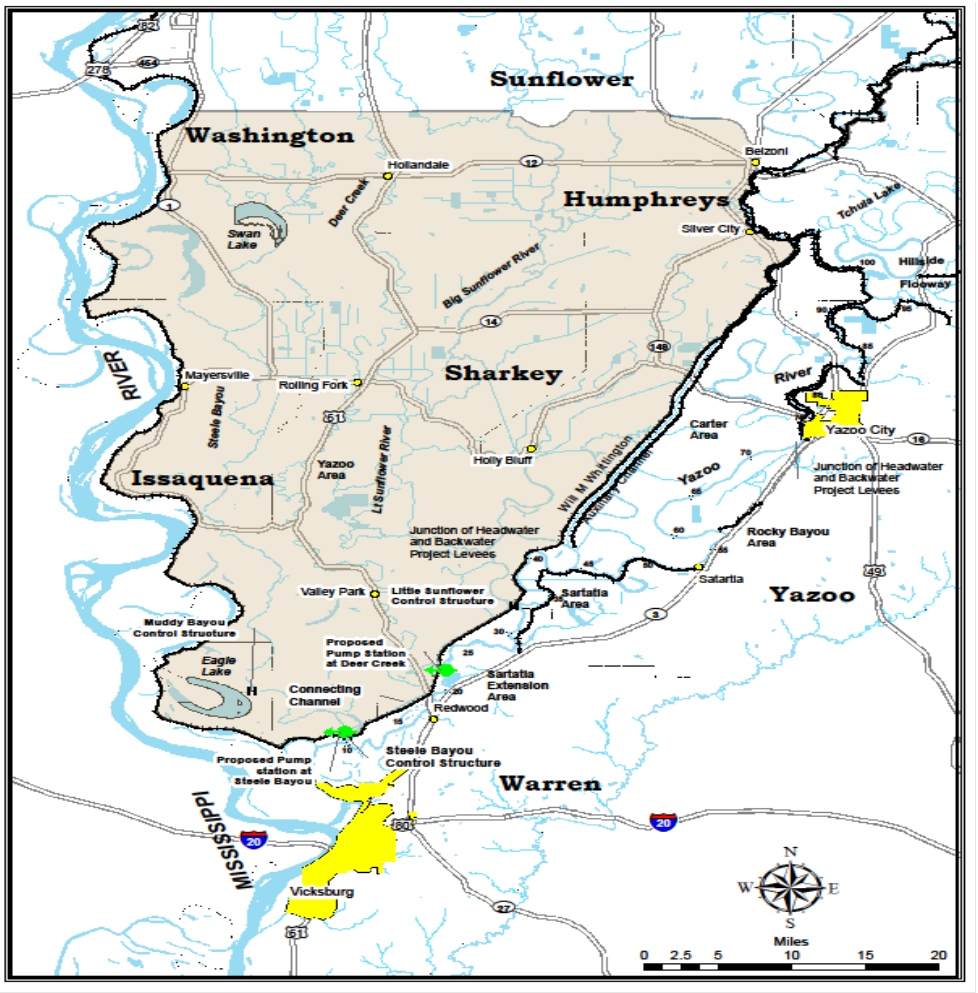


Figure 1. The Yazoo Backwater Area (YBA; tan shading) includes Issaquena, Humphreys, and Sharkey Counties, and parts of Washington, Sunflower, and Warren Counties, in west-central Mississippi.

The 100-year floodplain has changed over time in response to Flood Damage Reduction (FDR) features of the Mississippi River and Tributaries Project. The Corps has analyzed the flood frequency elevations for the Vicksburg gauge many times over the years. The most recent analysis came as part of the Mississippi River Levees Project in the SEIS that was published in 2020 (USACE 2020b). In addition to flood frequency analysis, the USACE has analyzed wetland flood duration for the Mississippi River. Historical analysis of stage data is restricted by the availability of data. The Mississippi River gauge at Vicksburg was established in 1871. The first gauge established within the Yazoo Basin was the Yazoo City gauge in 1890. The first gauge established within the Project Area was Holly Bluff in 1932. The second gauge established was the Big Sunflower River at Sunflower (1935). The Big Sunflower gauges at Little Callao and Anguilla were established in 1949 and 1950, respectively. Other gauges used in the historical analysis of duration data were the Yazoo River at Satartia and Redwood, and the Steele Bayou gauges at Onward and Grace. There is scant data available for the period between 1900 and 1931, but the USGS operated two gauges on the Big Sunflower River upstream of the Little Callao gauge from 1908 through 1913.

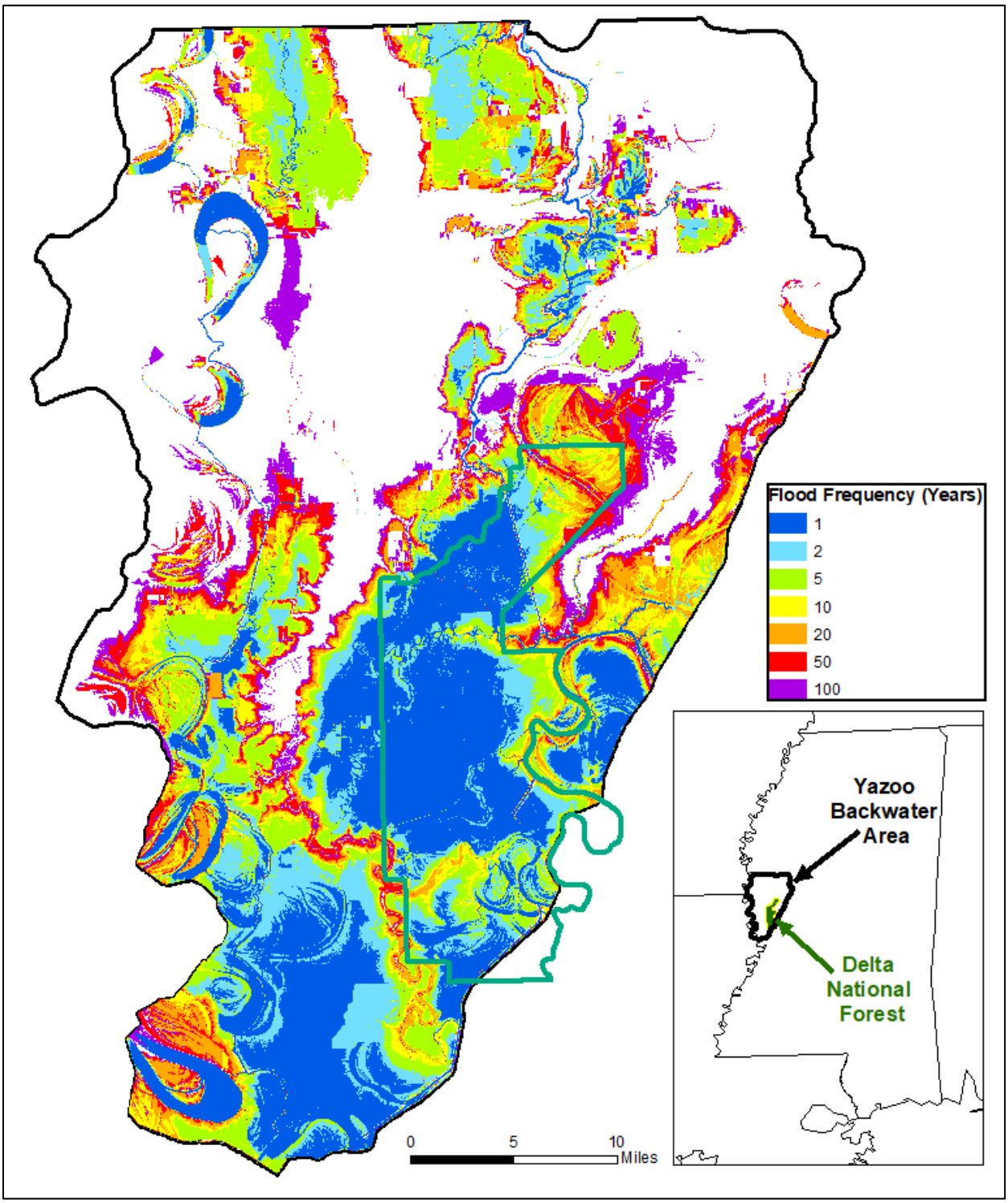


Figure 2. Map of the 1, 2, 5, 10, 20, 50, and 100-year flood frequency zones within the YBA of Mississippi as modeled using historical stream gauge data for this area in Mississippi.

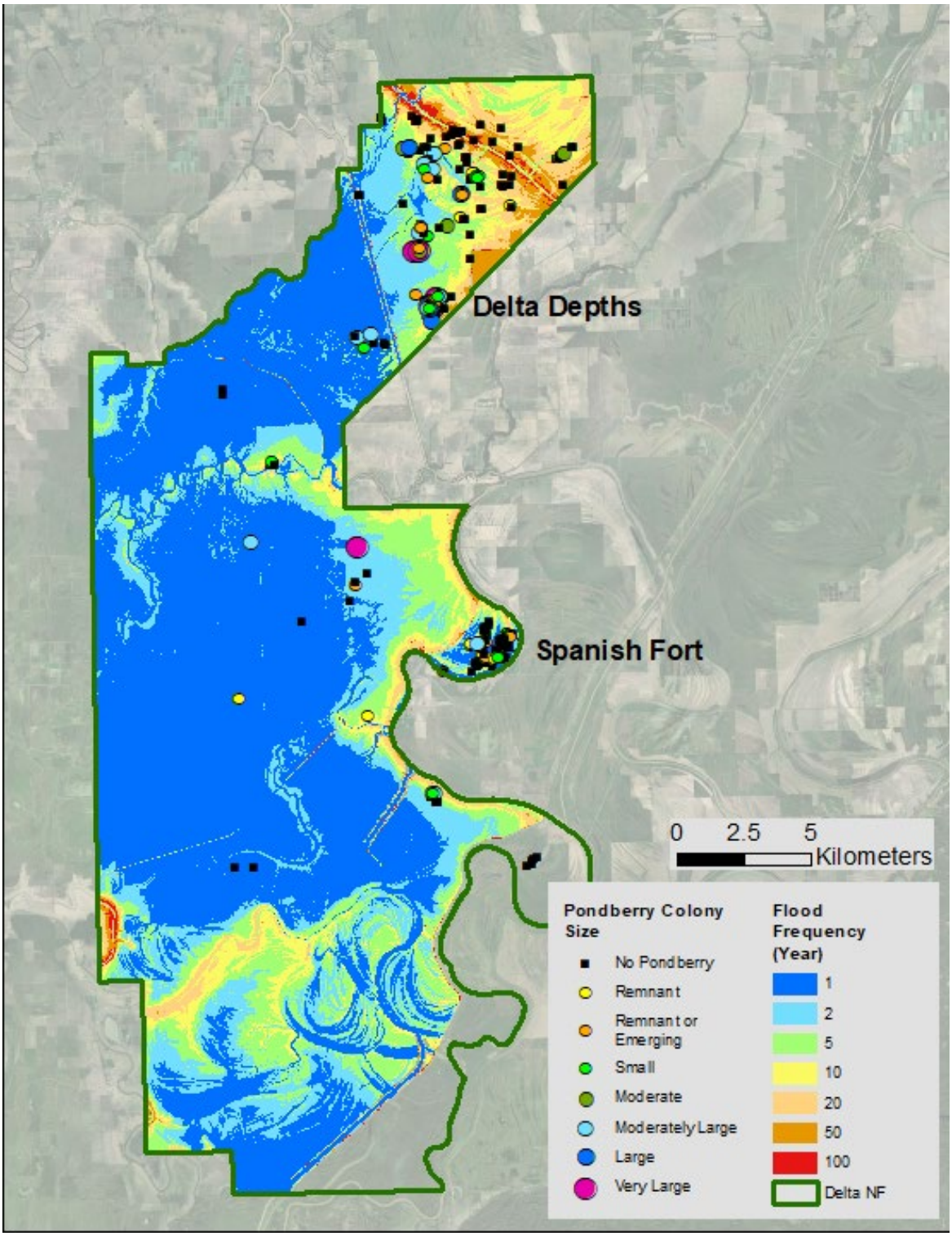


Figure 3. Map of 313 historical or extant pondberry colony locations within the Delta National Forest as well as the 1, 2, 5, 10-, 20-, 50-, and 100-year flood frequencies according to conditions that have occurred over the 43-year period of record.

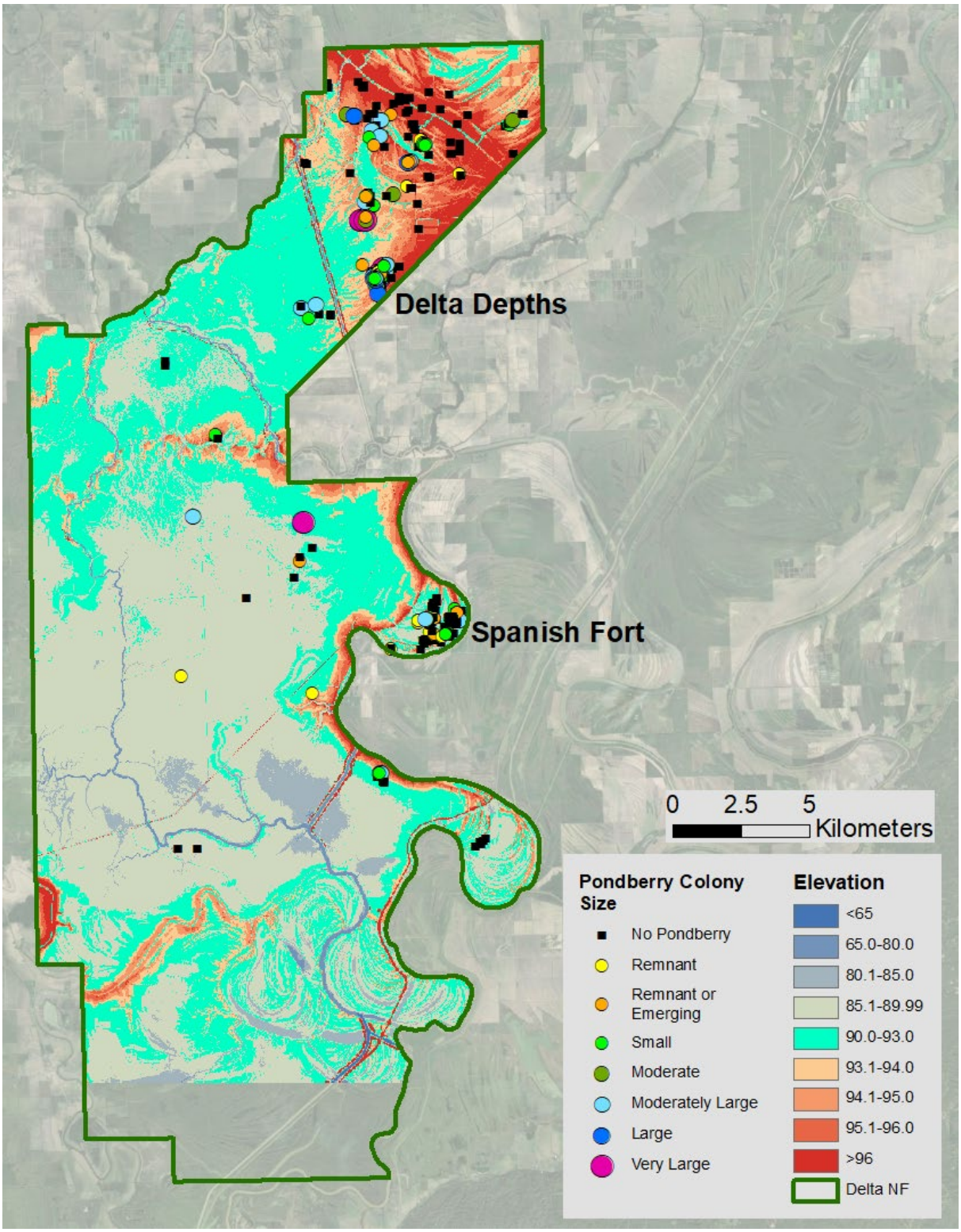


Figure 4. Delta National Forest within the Yazoo Backwater Area depicting elevation zones and the relative size of pondberry colonies. Table 2 defines pondberry colony size referenced within figures of this BA.

2 PROJECT DESCRIPTION

3.1 Proposed Plan

The proposed YBA Water Management Plan would implement a 25,000 cubic foot per second (cfs) pump station that would be in operation when the Steele Bayou Water Control Structure (SBWCS) is closed, and landside water levels reach 93.0 ft NGVD during the non-crop season or 90.0 ft during the crop season (see Appendix A-Engineering Report). The proposed Yazoo Pumps are designed to pump water out of the YBA into the Yazoo River during high flooding events. At the SBWCS, when the interior landside water level approaches and is projected to surpass 93.0 ft NGVD during the non-crop season, the proposed pumping would be initiated when water levels reach elevation 92.5 ft NGVD to reduce the water level to 90.0 ft NGVD during each flood event (16 Oct-14 Mar, Alternative 2 or 16 Oct-24 Mar, Alternative 1). During the crop season (15 Mar-15 Oct, Alternative 2; or 25 Mar-15 Oct, Alternative 1), when water levels are expected to surpass 90.0 ft NGVD, the proposed pumping would be initiated when water levels reach elevation 89.5 ft NGVD to maintain the level at or below a threshold of 90.0 ft NGVD.

Pump operation will result in a reduction of the extent and duration of flooded acres above 90.0 ft NGVD during the crop season for some years, primarily within the southern portion of the YBA. The most likely impacts of the Proposed Water Management Plan within the YBA on federally endangered pondberry would be changes in hydrology between elevations 90.0 and 93.0 NGVD that could result in alteration of forest composition and structure, potentially impacting pondberry habitat over time. This is discussed in more detail throughout this document. Though the proposed Water Management Plan potentially could impact pondberry, it should be noted that across the 1978-2020 Period of Record (POR), under each pumping alternative, had the project been constructed and put into operation at the beginning of the POR, the pumps would have operated at least one day in just 3 of 43 (7%) years during the non-crop season and would have operated at least one day in 20 of 43 (46.5%) of years during the crop season (Figure 2-110 in Appendix A-Engineering Report).

3.1.1 Pump Station/Inlet Channel/Outlet Channel/Access Road/Utilities

The pump station will be located in Warren County, Mississippi, adjacent to the Steele Bayou water control structure (0.5 miles), between the authorized Yazoo Basin, Yazoo Backwater, Mississippi levee and the Yazoo River, and approximately 4.75 miles west of Highway 61 and approximately 7.5 miles north of Vicksburg, Mississippi. The pump station capacity will be 25,000 cubic feet per second (cfs), total station capacity. The increase in pumping plant capacity requires an increase in the length of the pump station (perpendicular to flow) from 377 feet to 475 feet. This affects the intake structure, substructure, and superstructure; as well as architectural, mechanical, and electrical features.

The managed water elevations have been modified to 93.0 feet during non-crop season and 90.0 feet during crop season. Refer to the draft EIS Appendix A-Engineering Report for more details

on pump operation under various proposed Alternatives. Table 1, drafted by CEMVK, provides the design elevations of the current design.

Table 1. Design Elevation of Current Design

Description	Elevation (feet, NGVD29)
Project Flood – 2-Year	90.0*
Project Flood – 100-Year	99.0*
Pump Floor	115
Top of Structure (Floodwall)	119
Pump On/Off	89.5 or 92.5
Inlet Channel Invert	71
Discharge Channel Invert	76

Major design features include:

- The service bay and control house structures will be slab-on-grade foundations with grade beams. This will reduce the overall cost of the structure by reducing the concrete volume and by reducing the total excavation and backfill requirements. The substructure tunnels will be accessed via a reinforced concrete stairwell.

- The pump station superstructure will be a prefabricated metal building.

- It is assumed that potable water will be provided by Valley Park Water District.

- It is assumed that on-site pump storage will not be required because the project will be solicited under one contract and pumps will be installed upon delivery.

- The standby emergency generator building has been removed. The generator will be housed in an enclosure near the service bay.

- The pump station will be heated by natural gas unit heaters, eliminating the hydronic heating system, including boilers, pumps, heaters, and piping. Engines will be cooled by remote radiators, one each per engine, eliminating the centralized raw water-cooling system. The bridge crane will be used to provide vertical movement of equipment to the tunnels, eliminating the need for an elevator. The potable water system (exterior hose bibbs and pressure washer) will be used for exterior building maintenance, which eliminates the "fire hose" type wash down system, including the water storage tank.

- Supplemental low flow groundwater wells will be installed in 34 strategic locations throughout the Mississippi Delta as an environmental feature to the project. Future engineering studies will evaluate the geologic and hydro-geologic conditions of each of the well field sites, and the wells will be pumped to supplement annual low flow conditions. It is estimated that each well site will impact approximately 0.25 to 1.25 acres of land.

Construction and permanent access to the new pump station will be accessed by traveling southwest on the existing Highway 465 for approximately 6.8 miles from Highway 61, or in the alternative, traveling along the existing authorized Yazoo Basin, Yazoo Backwater, Mississippi, Levee across the Steele Bayou structure. The new levee and pump station are joined and tie into the Yazoo Backwater levee and Highway 465.

The existing levee road does not need to be widened for construction. The access road will enter the restricted facility by way of the new levee. The new levee and pump station are joined and tie into the Yazoo Backwater levee. Utilities (both natural gas and electricity) are readily available and in proximity to the pump station.

An inlet channel will be constructed to connect the pump station to the existing auxiliary channel. The inlet channel will be approximately 3,100 feet long and require the excavation of approximately 381,846 cubic yards of material for construction. The inlet channel will be lined with riprap and filter stone to provide protection against erosion. An outlet channel will connect the pump station to the Yazoo River. The outlet channel will be approximately 3,500 feet long and require the excavation of approximately 333,169 cubic yards of material for construction. The outlet channel will be lined with riprap and filter stone to provide protection against erosion. The inlet and outlet channel will form a third means of transferring floodwaters from the YBA into the Yazoo River via the pump station to reduce the flood risk resulting from Mississippi River flooding.

3.1.2 Borrow Area

The proposed borrow area is located on the east side of Highway 61, 0.60 miles north of the intersection of Highway 465 and Highway 61 and approximately 7.4 miles east of the proposed pump station. The borrow area ROW is approximately 210 acres. Access to the borrow site will be from Highway 61. The borrow area(s) will also be used as a disposal site for unsuitable material.

Material from the on-site borrow pit will be used to fill in the gap of the existing cofferdam and preload pad. Material from an offsite borrow pit will be used to construct the new levees, structural fill and pads, and the new road for Highway 465 across the outlet channel. The new levee will be constructed to finish grade elevation of 112.80 feet, NGVD29, with 1 on 4 side slopes. A bridge will be constructed across the outlet channel to connect the existing authorized levee for continued public use, however access to the new pump station will be restricted. The new bridge will be pile founded and approximately 1,150 feet long. Construction will require the use of a cofferdam that will be at an elevation of 107 feet, NGVD29, and will have 1 on 3 side slopes. The cofferdam will require approximately 46,355 cubic yards of borrow material for construction. Construction will require a preload at the site which will have a crown elevation of 125 feet, NGVD29, and a berm at elevation 107 feet, NGVD29, which will be 850 feet wide and 450 feet long. The preload will be removed prior to construction and the cofferdam will be removed upon completion of construction. All construction activities associated with constructing the new pump station will adhere to federal, state, and local laws.

4 SPECIES/HABITAT CONSIDERED IN THIS CONSULTATION

4.1 Species Potentially Impacted by the Project and Included in this Biological Assessment

The following species may be affected by the proposed action:

- Pondberry (*Lindera melissifolia*) federally **Endangered**

These additional species (and associated ESA status) were excluded from this BA because they are being addressed separately and/or through informal consultation with the USFWS.

- Pallid Sturgeon (*Scaphirhynchus albus)* **Endangered**
- Fat Pocketbook (*Potamilus capax)* **Endangered**
- Alligator Snapping Turtle (*Macrochelys temminckii*) **Proposed Threatened**
- Northern Long-eared Bat (*Myotis septentrionalis*) **Endangered**
- Monarch Butterfly (*Danaus Plexippus*) **Candidate Species**

4.2 Critical Habitat

Critical habitat is defined in Section 3 of the Endangered Species Act as: (1) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the act, on which are found those physical or biological features, (2) that are essential to the conservation of the species and that may require special management considerations or protection, and (3) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. The FWS has not proposed establishing pondberry critical habitat in either Mississippi or in other states in which the species is known to inhabit. Therefore, there is no critical habitat in the Action Area associated with pondberry.

4.3 Pondberry Status

Pondberry was federally listed as an endangered species on 31 July 1986 (Federal Register 51(47):27495-27500). A Recovery Plan (USFWS 1993) was completed and published in 1993. The two most recent USFWS 5-Year Reviews (USFWS 2014, 2021) recommended "No Change is Needed" and that pondberry continues to meet the definition of endangered under the ESA. The USFWS (2021) believes that the species currently is stable to declining from a range-wide perspective. Though new populations have been discovered since the 2014 5-Year Review, and many more colonies discovered in Mississippi since the 2021 5-Year Review (as detailed in this BA), population declines and recent extirpations have been noted throughout the range. The lack of comprehensive and recent monitoring data across the range has led to uncertainty for a proper rangewide species assessment. The USFWS (2021) summarized what is known about pondberry

populations (see USFWS 2007 for definition of "population"[1]) by state, noting that populations are considered stable to declining, with generally stable populations in Alabama, Arkansas, and Missouri; and declining populations in North Carolina, South Carolina, Georgia, and Mississippi (USFWS 2021). Much more comprehensive data collected annually by the ERDC-EL from 2020-2023, and reported herein, provides an updated and relatively comprehensive assessment of all known pondberry populations in Mississippi.

4.4 Pondberry Description and Species Account

Pondberry is a low-growing, deciduous shrub ranging in height from 1.5 to 6.5 feet, though taller stems [8 feet] have been observed during 2022 surveys in the Hester Tract north of the YBA in Bolivar County, Mississippi (R. Fischer, Pers. Obs.). The plants commonly grow in clumps of numerous scattered stems and spread vegetatively by stolons. The older portions of the stems are dark green to almost black with numerous irregularly spaced, but prominent lenticels, which appear very similar to saplings of young sassafras (*Sassafras albidum*) stems. The leaves are drooping and have a distinct and unique "lemony" sassafras-like odor when crushed (Buchanan and Finnegan 2010). Leaves are 0.75 to 2.5 inches wide and 2 to 6.5 inches long with a round to cordate base. The leaf veins are prominent, and the undersurface of the leaf is hairy. Pondberry is distinguished from the two other North American members of the genus (*Lindera benzoin* and *Lindera subcoriacea*) by its drooping foliage, obtuse or rounded leaf base, conspicuous venation and the two lowest pairs of lateral nerves are not parallel to the ones above.

Pondberry is dioecious with male and female flowers found on separate plants; flowers of both sexes are pale yellow and small. The flower stalks and buds are often hairy. The plant flowers in the second to fourth year of growth. The fruit is about 0.5 inch long at maturity, elliptical, and turns bright scarlet red at maturity in the fall. The flowers develop in spring before leaves emerge (generally in early March) with mature fruit evident by October. Fruit stalks are often present until next year's flowering (USFWS 1990; Klomps 1980a; Tucker 1984).

Pondberry can form short-term persistent soil seed banks for 1-2 years (Connor *et al*. 2006, 2012; Hawkins *et al*. 2011) and some seeds may remain viable for longer periods in the soil seed bank (e.g., Smith 2003). Seed and seedling depredation may partially explain the lack of observed seedlings (e.g., Tucker 1984; Wright 1989; Devall *et al*. 2001; Aleric and Kirkman 2005b; Connor *et al*. 2006) and seeds on the soil surface with intact pulp presumably are sometimes removed by both birds and mammals (Aleric and Kirkman 2005b). Smith et al. (2004) documented both seed predation (Northern Cardinal [*Cardinalis cardinalis*]) and short-distance seed dispersal (Hermit Thrush [*Catharus guttatus*]) at five fruiting colonies in the DNF. They concluded that bird dispersal of seeds, such as that documented with Hermit Thrush, is unlikely to result in pondberry colony establishment in unoccupied suitable habitat that is further away than ~55-150 m from fruiting colonies (based on mean distances moved by radio-tracked Hermit Thrush within 45-minute typical regurgitation periods), such as forest patches separated by open spaces. Northern Cardinal (*Cardinalis cardinalis*), Brown Thrasher (*Toxostoma rufum*), Swamp Rabbit (*Sylvilagus aquaticus*), Nine-banded Armadillo (*Dasypus novemcintus*), and Gray

[1] Devall et al. (2002) considered a pondberry population as a colony or colonies separated by at least 1 mile from other colonies, as an interim working definition, based on long-distance flights of ground dwelling bees that pollinate the species.

Squirrel (*Sciurus carolinensis*) (Abilio *et al*. 2008; Leininger *et al*. 2009) all were initially identified as potential pondberry seed or seedling predators. Subsequently, Martins et al. (2015) significantly expanded the list of avian and mammalian seed and seedling predators using videography. Other factors have also been hypothesized to lead to the lack of observed seeds or seedlings, such as late frosts that may kill flowers (Tucker 1984), or fungal infections (Devall et al. 2001, Unks 2011). Deep and prolonged flooding during the growing season, as experienced in the DNF during extreme backwater flood events in 2019 and 2020 (Table 6), leads to at least short-term stress on pondberry colonies, and populations as a whole. Deep and prolonged backwater flood events at most of the known and historic pondberry locations have been infrequent since the POR began in 1979, with SBWCS landside pool levels >93.0 ft for ≥30 d in 1979 (39 d), 1983 (30 d), 2019 (159 d), and 2020 (97 d). Seasonality of backwater flooding >90.0 ft has remained mostly consistent since 1979, with Apr-May remaining the most common backwater flooding months, while Jan-Mar flooding has also occurred on a less frequent basis. However, extensive backwater flooding only occurred in the month of June in 2019 and 2020, and in 2020 the flooding extended through Aug 6. Without pumps, it is possible that deep and prolonged flooding events during the growing season may become more frequent in the future, as a trend of increasing precipitation in the region has been documented over the past century (NCEI 2020). The Water Management Plan and associated pumping would lessen the depth and duration of future extreme flood events, potentially benefitting colonies that experience prolonged inundation during the growing season. Data in this BA provide some insight into post-flood growth and regrowth, as well as reduction of stem counts and colony extirpations following these extreme flood events. However, these aspects of pondberry life history require additional research.

The most comprehensive reviews on the life-history and habitat of pondberry are included in the pondberry recovery plan (USFWS 1993), the USFWS's (2007) Biological Opinion for the prior Yazoo Backwater Area Reformulation project, Devall (2013), and the USFWS 5-Year Reviews (USFWS 2014, 2021) for pondberry.

4.5 Taxonomic Status

Pondberry is a member of the family Lauraceae. It is one of three members of the genus *Lindera* found in the southeastern United States, which also includes *L. benzoin* and *L. subcoriacea*, a new species described by Wofford in 1983. Pondberry was first described as a new species by Tomas Walter in 1788 (Tucker, 1984). The material upon which he based this description was collected from what is present-day Berkeley County, South Carolina (Mercer 1984). The USFWS (2014) reviewed the taxonomy of *Lindera melissifolia* for both the listing document (51 FR 27495) and recovery plan (USFWS 1993) and is currently recognized as an accepted taxon by the Integrated Taxonomic Information System (2012) and Flora of North America (van der Werff 1997).

4.6 Pondberry Range and Population Level

Pondberry occurs in the Mississippi River alluvial plains of Missouri, Arkansas, and Mississippi, and the Coastal Plains region of Alabama, Georgia, South Carolina, and North Carolina (Figure 5). In the early 2000's approximately 262 colonies/populations/sites of pondberry were known to exist across its seven-state range (Figure 6), including approximately 194 colonies in Mississippi, primarily in the DNF (182 colonies in DNF and 12 colonies on private lands approximately 65 miles north of the DNF); two colonies in Alabama; 36 in Arkansas; 8 in Georgia; 15 in South

Carolina; two in North Carolina; and five composing one natural population in Missouri. The USFWS (2021)

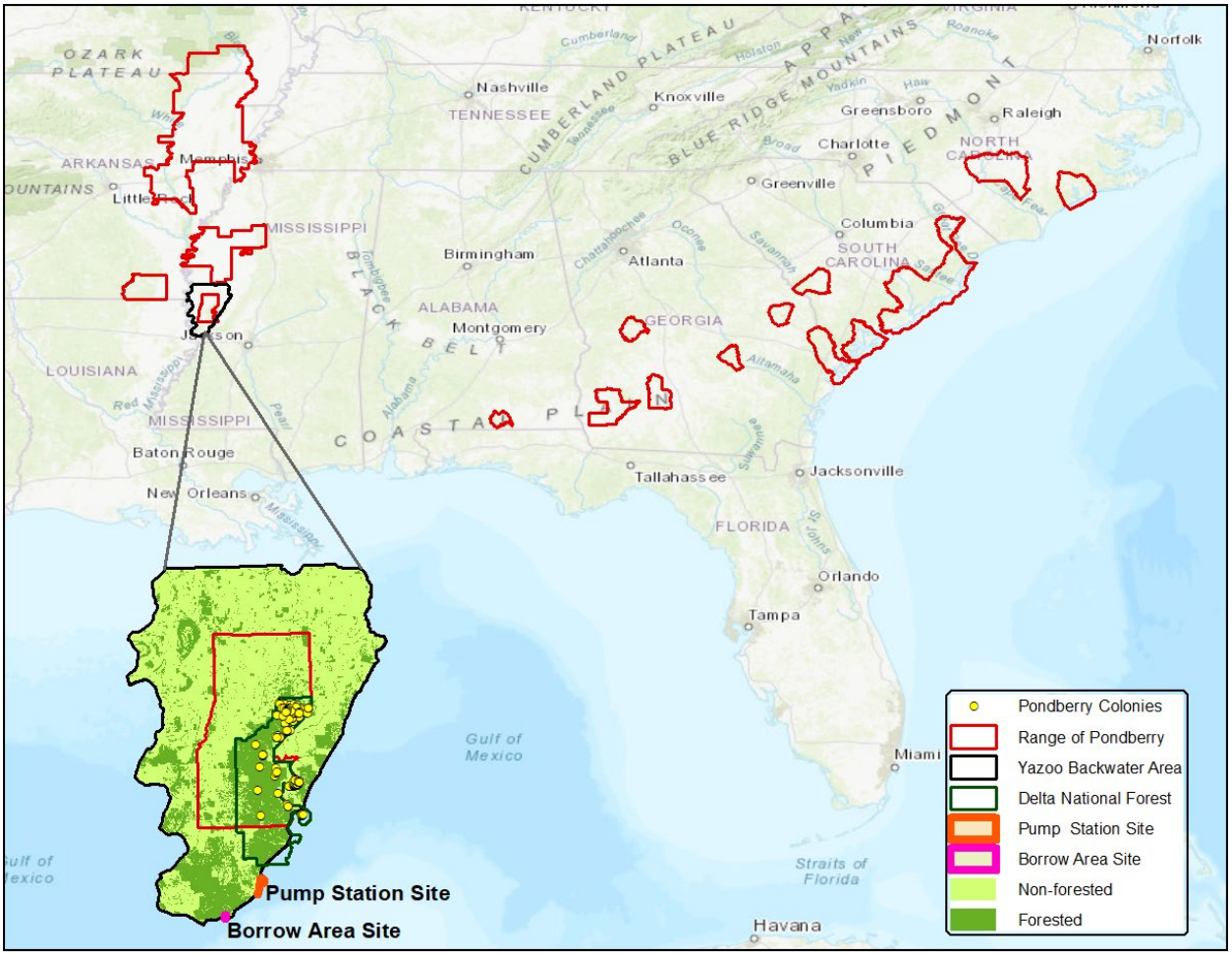


Figure 5. Pondberry Range (source: USFWS (2020)). Inset shows Delta National Forest, Mississippi with Gulf South Research Corporation (GSRC 2001, GSRC 2005) pondberry colony locations.

noted that there currently are as many as 73 extant natural populations of pondberry, but only 35 of these populations have been confirmed extant by recent surveys. There are 46 natural pondberry populations known in six of the seven states where protection is afforded on conservation lands. Of these, 25 of 39 populations are known extant on state or federal lands; the remaining 14 populations have no known recent observations. Seven populations are known to occur on privately-owned or non-governmental conservation lands, two of which are confirmed extant while the remaining five have no available recent observations to confirm extant.

For individual states, the most recent data on extant populations suggest there is one population in Alabama, 18 in Arkansas (but only five confirmed extant); 16 in Georgia; 20 in Mississippi (but only seven recently confirmed extant as of the 2021 5-year Review, and updates available in this BA to re-evaluate this number); one in Missouri (potentially, the largest population with >70,000 stems); two in North Carolina; and 10 in South Carolina. It was clear that there are many additional populations with unknown status in some states that have no recent survey data

to confirm their status. The USFWS (2021) 5-Year Review of pondberry provides more recent details for states and the most recent range-wide evaluation of population sizes/estimates for pondberry across its range.

Specifically for Mississippi, at the time of the most recent USFWS 5-Year Review (2021), the USFWS used the best available data to estimate the number and population sizes of pondberry in the state and reported 17 pondberry populations on conservation lands. Of these, 14 were known from the DNF but only five were confirmed extant. There is one known population (a single colony) in Dahomey National Wildlife Refuge (Figure 7), and two populations on private lands with little to no recent data (but see ERDC data in this BA). All colonies within these populations were found in bottomland hardwood forests within the Mississippi Alluvial Plain. The USFS historically conducted extensive searches within the DNF in Sharkey County, and these DNF plants/colonies accounted for 13 of the state's known pondberry populations with an estimated minimum of 35,000 stems/plants (USFWS 2007, USFWS 2014). Despite USFS best management practices to avoid adverse ground-disturbing activities to these plants/colonies during forest management (Banker and Goetz 1989; Bowker 1989, *in litt*.), some pondberry colonies were extirpated or experienced declines, potentially related to stem dieback, changes in hydrology, interspecific plant competition, and natural canopy disturbances (Gulf South Research Corporation 2005, USFWS 2007, USFWS 2014). Other populations in Mississippi have been known to occur in Bolivar (two pondberry populations on private lands with as many as 20,000 and 5,000 stems) and Sunflower Counties (private lands population of approximately 1,500 stems). Leonard (2010) conducted searches in Panther Swamp National Wildlife Refuge in Yazoo County but found no pondberry during 2006 and 2007. Although the ERDC-EL and USFWS conducted extensive pondberry surveys from 2020-2023 in the DNF (Sharkey County), on private lands (Sunflower County), and in the Hester Tract (Bolivar County) within Mississippi (Figure 8) to update status of these populations and associated colony stem counts, additional monitoring is needed to more adequately quantify and understand pondberry's current distribution and abundance, health, long-term colony and population dynamics, effects of forest management, and persistence in Mississippi. References to current colony sizes within Mississippi are found within figures of the report, and general colony sizes are stated in Table 2.

Subsequent to the last submission of a pondberry BA to the USFWS in 2020, the USACE (ERDC-EL) and USFWS worked collaboratively to conduct comprehensive pondberry colony surveys in Mississippi during 2021-2023. Using the most comprehensively available data compiled from USFWS, CEMVK, and the USFS, the ERDC-EL (with field assistance and cooperation from USFWS, Jackson Mississippi Ecological Services Office) attempted to visit every historically known pondberry colony in Mississippi. We believe we visited at least 95% of those colony sites since, at many locations, permanent markers such as PVC pipe were still present even if pondberry was not detected. During 2022, our comprehensive surveys yielded a minimum of 74,865 total stems in all colonies visited in Mississippi. General results of those efforts are summarized below and a full list of those colonies with stem counts during 2021, 2022, and 2023 will be provided in a companion Microsoft Excel file. The ERDC-EL is submitting a comprehensive Excel database along with this BA that includes all known available historical and contemporary data on pondberry colonies in Mississippi.

Dahomey National Wildlife Refuge. In summer 2022, the ERDC-EL visited Dahomey NWR (with coordination from USFWS Refuge personnel) and counted 443 stems in the refuge's single known colony (north of the Action Area; Figure 7). This is an increase from previously reported counts in 2014 (220 stems) and 2017 (432 stems) by USFWS. During the 2022 stem count, ERDC-EL noted that soils were very dry, there was no standing water in the vicinity of the colony, and there was extensive hog rooting in and near the colony.

Table 2. Relative colony sizes (# of stems) for pondberry colonies referenced in figures of report with symbology of remnant up to very large.

Colony size description	# of stems within size designation
Remnant	<5
Remnant or Emerging	<5
Small	6-20
Moderate	21-50
Moderately Large	51-250
Large	251-500
Very Large	>500

Private Land. (Pondberry 248-251). During summer 2022, the ERDC-EL and USFWS visited a historically known colony site on private land north of the Action Area in Sunflower County, which included Gulf South Research Corporation (GSRC) plots 59-62 (Figures 6-8). Despite extensive searching throughout all areas at and near each point, no pondberry was found. Following those surveys, it appears that inaccurate coordinates may have been provided, with updated coordinates of Pondberry 249-251 (aka, GSRC plots 60-62) still to be surveyed in future searches. Pondberry 248 was surveyed with accurate coordinates; however, after extensive searches in the small parcel of forest surrounded by agricultural lands no pondberry was detected.

Private Land. (Pondberry 310-315). Also, during summer 2022, the ERDC-EL and USFWS visited a second private land parcel north of the Action Area, which included GSRC plots 49, 57, 58, 68, and 69. We found pondberry at all five colony sites with a total of 1,597 stems (Figures 6-8). Most of the colony sites were situated within a small, isolated island of flooded forest surrounded by agricultural fields. Most colonies, and pondberry stems, were inundated with a few inches, up to ~ 12 inches of standing water.

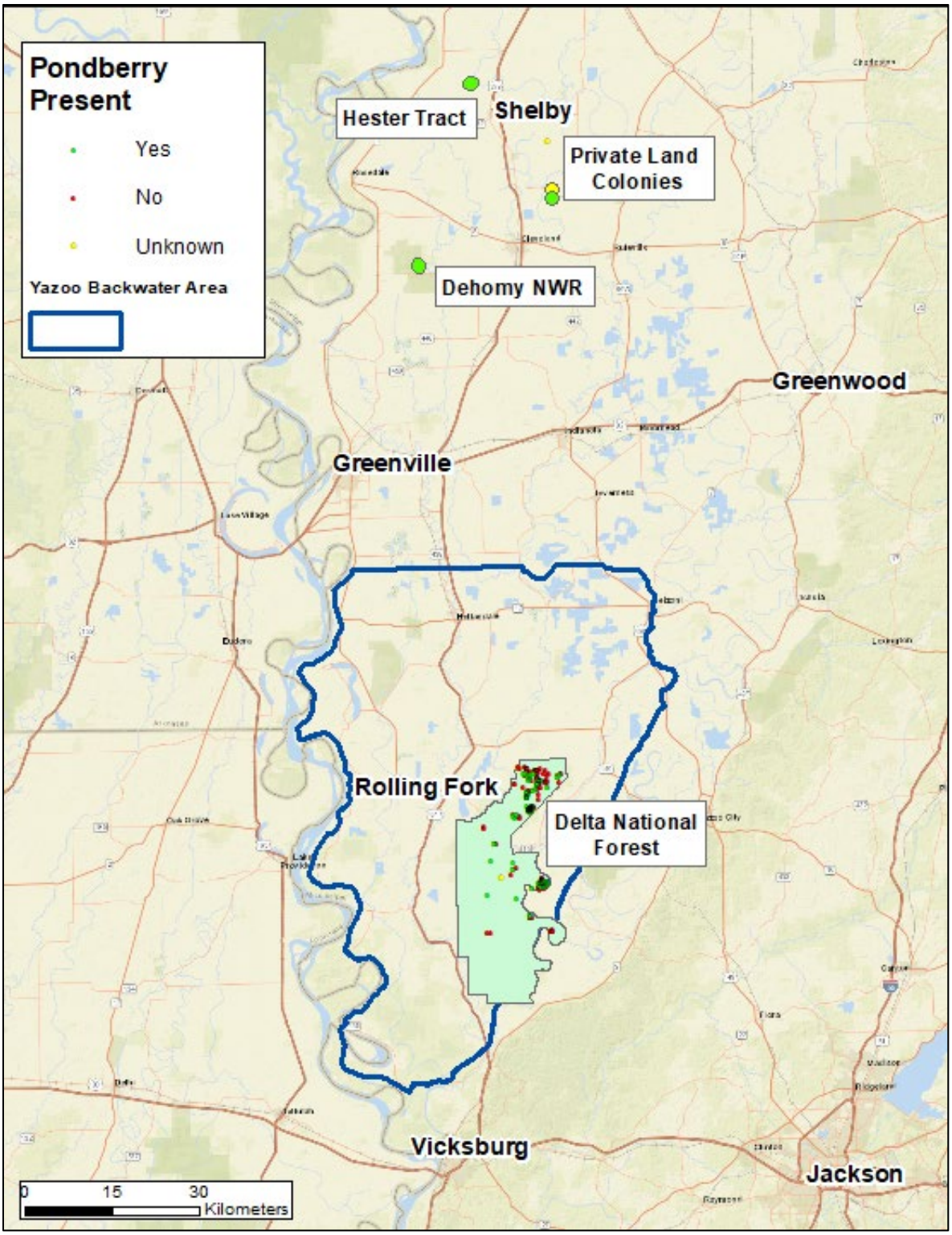


Figure 6. Known location of all pondberry colonies within Mississippi following surveys by ERDC-EL during 2020-2023.

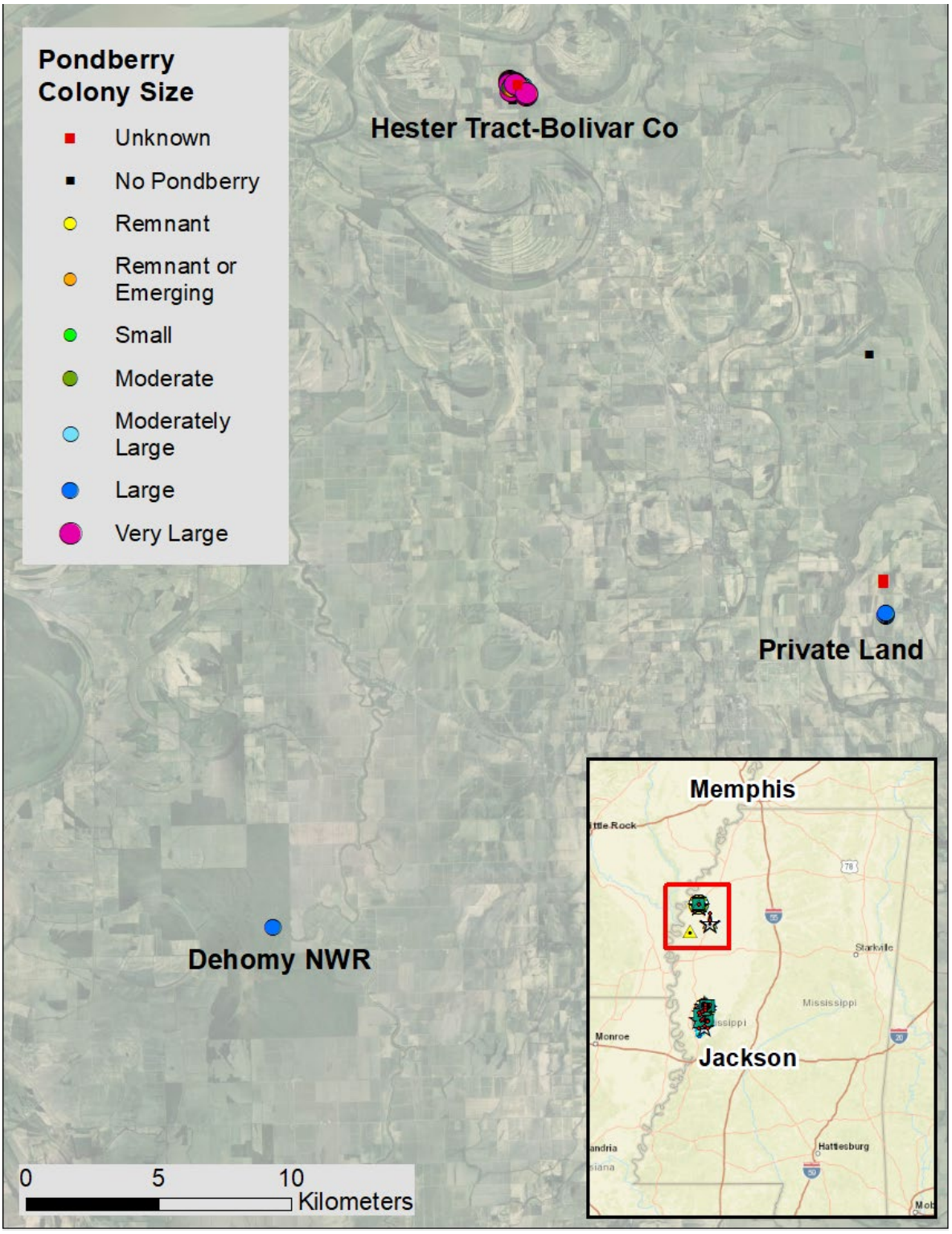


Figure 7. Map of pondberry colonies that occur within Mississippi, but outside of the YBA. These colonies are located on private lands except for one colony within the Dahomey National Wildlife Refuge.

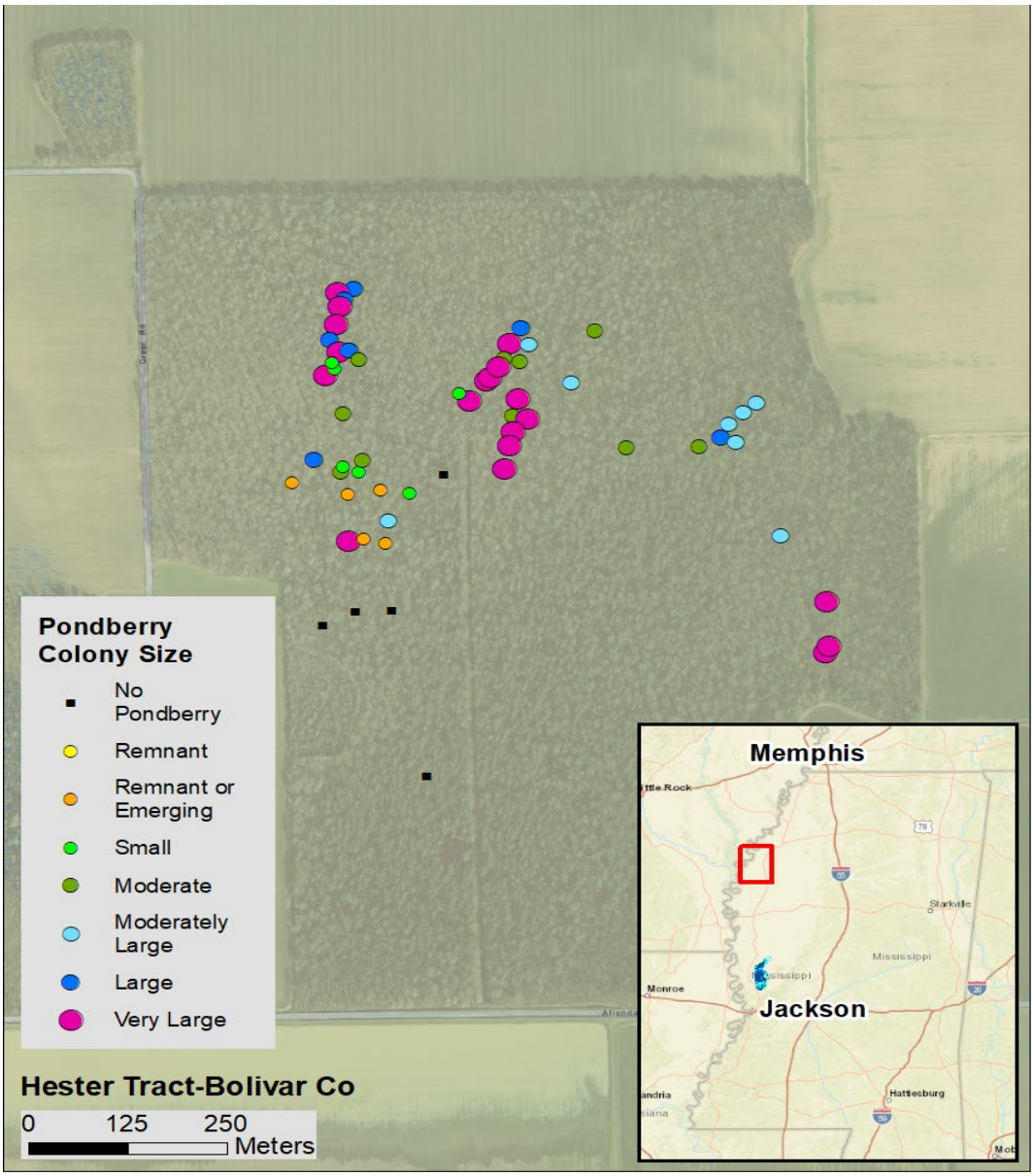


Figure 8. Pondberry colonies within the Hester Tract, Bolivar County, MS as of 2022. Table 2 defines pondberry colony size referenced within figures of this BA.

Hester Tract. During visits in 2021 and 2022, the ERDC-EL and USFWS visited the 71-acre Hester Tract (north of the Action Area) and conducted extensive systematic searches throughout nearly the entire tract. We revisited all prior GSRC plots (47, 48, 50-52, and 67) and those plots from Devall (2012). In total and with newly discovered colonies, there are 61 pondberry colony sites of which 55 were extant with 53,730 stems (Figures 6-8). Because of colony areal sizes (some of which have 1000s of stems) and colony shapes that include multiple "fingers" of pondberry stems that can extend for dozens of feet in multiple directions, it is feasible that stem counts from historical and current surveys differ based on whether these connecting pondberry "fingers" were found at the time of each survey. It would be very easy to miss these narrow bands of pondberry that connect larger clumps. This makes comparisons with 2005 GSRC (and

Devall 2012) colony stem counts difficult. It is noteworthy that GSRC (2005) counted 17,389 stems in the Hester Tract at their five permanent plots. Devall (2012), who conducted systematic and comprehensive searches of the Hester Tract in 2005, found 28 pondberry colonies and a minimum of 6,571 stems. The discrepancy between GSRC (2005) and Devall (2012; with counts made the same year as GSRC) is difficult to explain. However, it does provide compelling evidence that, based on recent ERDC-EL surveys in the conservation easement, stem counts have increased substantially (i.e., possibly by more than 36,000 stems).

Delta National Forest. Within the Action Area, **s**tem counts, and number of colonies sampled between 2000 and 2023 have varied dramatically (Table 3). Total stem counts in the DNF have ranged from 11,839 (from 48 extant colonies surveyed by GSRC) in 2000 to 19,095 in 2022 (54 extant colonies, with many colonies going extinct during this period, as well as new colonies discovered) when the most comprehensive surveys were conducted (Table 3). It is important to note that annual stem count numbers are significantly related to effort and the number and location of colonies sampled. From 2020-2023, the ERDC-EL discovered dozens of colonies not previously recorded in the comprehensive database, both in the DNF, and Hester Tract. These recent colony discoveries suggest that there may be more colonies to be discovered given additional search efforts. Despite visiting over 300 currently extant or extinct colonies in the DNF (Figure 9) and conducting some focused discovery surveys near areas where pondberry is prevalent, there are still vast areas that have not yet been visited or comprehensively searched in at least two decades. Because our data show that 95% of extant pondberry colonies in the DNF occur between elevations 91.0 and 96.0 ft NGVD, future DNF discovery surveys should focus on those elevations. A more precise 1-m resolution USGS 3D Elevation Program (3DEP) digital elevation model (DEM) also allows for depressional areas surrounded by higher elevations to be visually observed within GIS. Future surveys likely will be directed using this improved spatial layer. ERDC-EL characterized colonies as extirpated after thorough survey efforts in two successive years resulted in zero stems found.

Table 3. Stem counts by year, for Dahomey NWR, DNF, Hester Tract, and Private Lands in Mississippi, 2000-2023.

	2000	2001	2005	2010	2014	2017	2020	2021	2022	2023
Stem Counts										
Dahomey NWR	-	-	-	-	220	432	-	-	443	-
DNF	11,839	2,078	7,090	6,919	-	-	4,029	10,395	19,095	20,271
Hester	1,359	-	17,389	4,269	-	-	-	4,252	53,730	-
Private	866	-	496	-	-	-	-	-	1,597	-

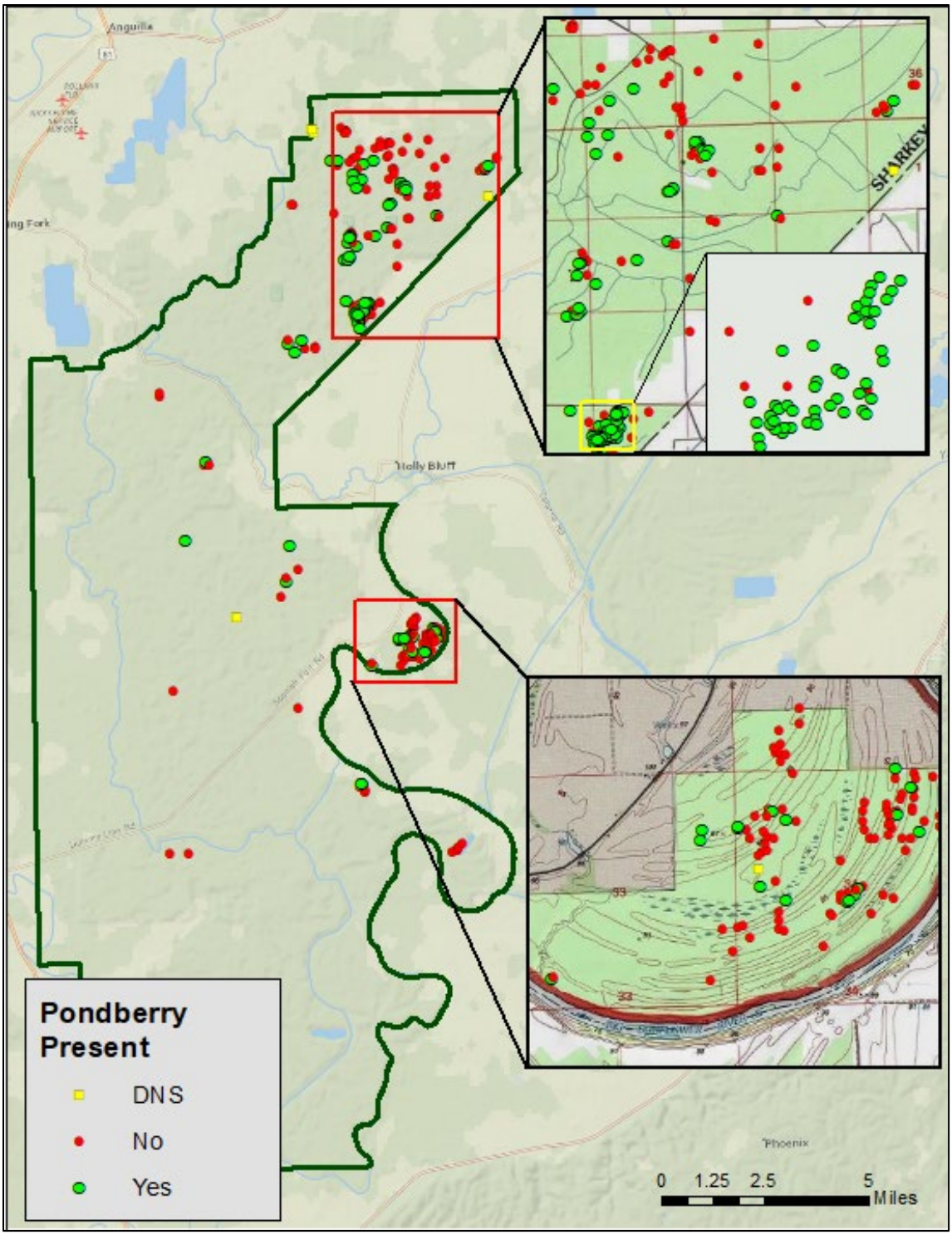


Figure 9. Historical and current pondberry colony locations within the YBA as of September 2023. Colonies that are "present" contained at least one stem during surveys since 2020. Colonies noted as not having pondberry present were surveyed at least twice since 2020.

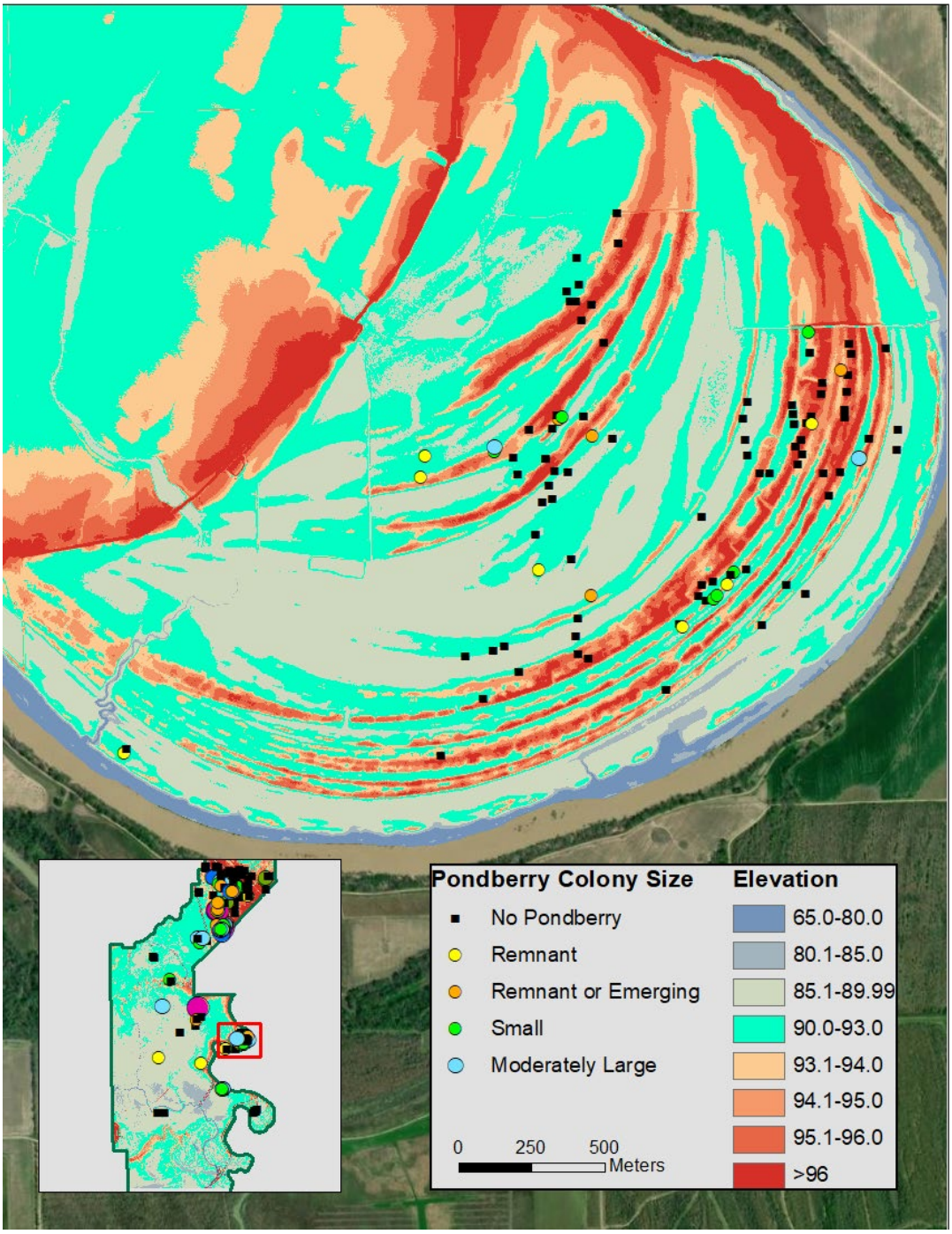


Figure 10. The Spanish Fort area within the Delta National Forest depicting the elevation zones and the relative size of pondberry colonies. Table 2 defines pondberry colony size referenced within figures of this BA.

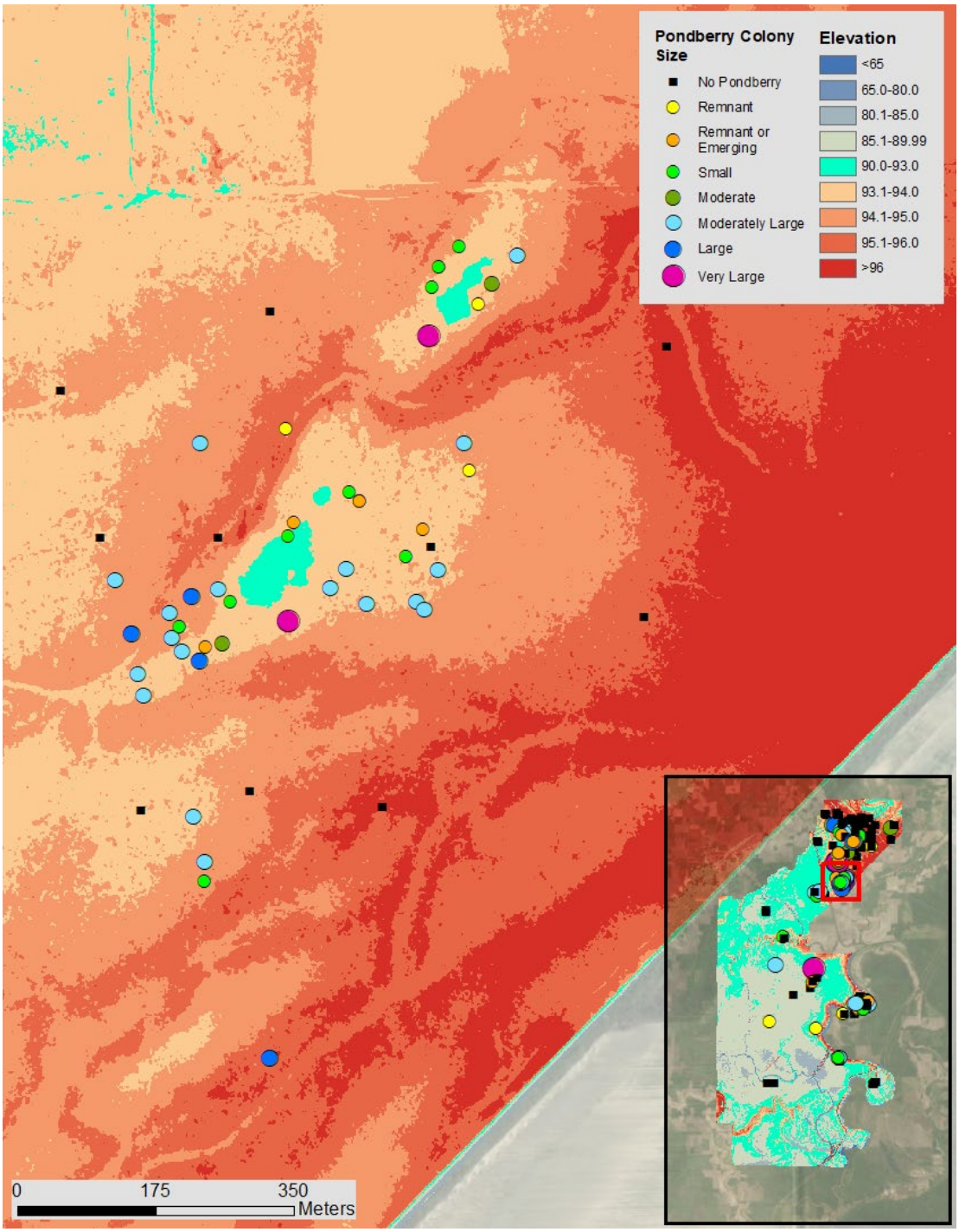


Figure 11. The area referenced as "Delta Depths" of the Delta National Forest depicting the elevation zones and the relative size of pondberry colonies. Table 2 defines pondberry colony size referenced within figures of report.

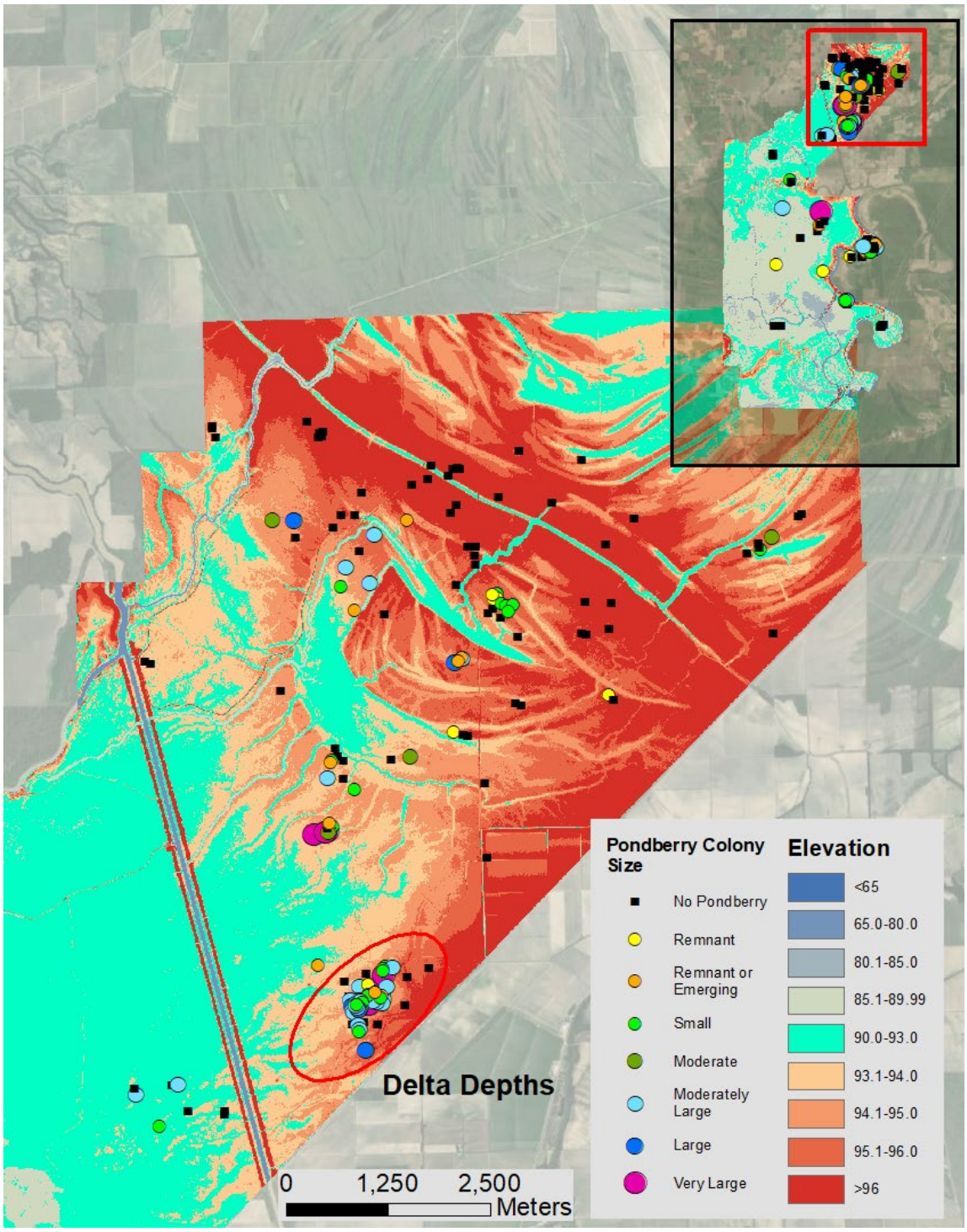


Figure 12. The northern section of the Delta National Forest depicting the elevation zones and the relative size of pondberry colonies. Table 2 defines pondberry colony size referenced within figures of this BA.

Pondberry is located within portions of the DNF, being mostly associated with the 5, 10, and 20-year floodplain areas (Figure 3). The Spanish Fort area (Figure 10) has 19 extant colonies, 79 colonies that appear to be extirpated, and one colony with an unknown status. The Delta Depths area (Figure 11), which contains colonies previously referenced as the McDearman survey colonies, appears to still support the most robust pondberry colonies in the DNF with 58 colonies still extant, 11 colonies extirpated, and 1 colony of unknown status. It is important to note that many of the original coordinates of pondberry colonies are now within "megacolonies" where previously independent colonies have appeared to coalesce into one large colony. Much of this coalescing of colonies was observed beginning in 2021, and continued through 2023, likely in response to recovery from the 2019 and 2020 deep and long-duration floods (as detailed further in other sections below). The vast majority of remaining colonies are distributed throughout the northern portion (north of Delta Depths) of the DNF (Figure 12) with 39 extant colonies, 74 extirpated colonies, and 2 colonies of unknown status.

4.7 Pondberry Life History

Pondberry populations are generally found in bottomland hardwoods under a partially shaded canopy of mature forest (Klomps 1980a, Tucker 1984). Colonies in Mississippi have historically been described as occurring in small dense clumps usually averaging less than 0.10 acre in size. ERDC-EL began quantifying colony areal sizes in 2022 by circumnavigating colonies with a high-precision Trimble® GPS unit. The intention is to measure temporal changes, not only in stem counts and colony health, but also spatial extent and colony shape (See Section 5.4.8 below). Numerous field investigations indicate that vigorous healthy colonies were found in homogeneous clumps with shrub associates growing adjacent to, but not within, the clumps. In less vigorous colonies, shrub/vine associates were usually growing within the clumps.

Individual stems within each colony are short-lived, generally dying by their seventh or eighth year. Young stems sprout from the rootstock and replace the dying stems. Over time, colonies may expand vegetatively, resulting in many vastly rooted stems typically within 20 cm of the ground surface (Wright 1989). Thus, a typical vigorous colony is composed of numerous relatively tall stems, dead and dying stems, as well as young leaf sprouts. Despite numerous studies attempting to identify seed dispersal agents (see Section 4.4), there is little information regarding new seedling establishment and growth; therefore, colony expansion is suspected to be almost exclusively vegetative (Tucker 1984, FWS 1990).

Individual stems of pondberry begin flowering by their second to fourth year of growth (Tucker, 1984). Flowering begins in late February to early March in Mississippi and generally lasts no longer than 2 weeks. Pondberry is dioecious (male and female flowers found on separate plants). A typical colony in Mississippi is composed primarily of male stems with few to several female stems. In many instances, the entire colony is composed of male plants. In general, seed production in relation to the total number of stems is low. Because flowering occurs in late February to early March, frost or near-freezing temperatures often damage flowers, further reducing fruit production. Rayner and Ferral (1988), in a study of 73 colonies from the Honey Hill region of South Carolina, reported that only 22 percent of all colonies surveyed produced fruit, with fruit production averaging only 22 fruits per colony. They also noted that fruit production did not seem to improve with plant health since sexual reproduction appeared to be

poor even in large healthy plants. ERDC-EL found fruiting stems at just 10 of 97 (10%) extant colonies (only one stem in five of the colonies) in the Delta National Forest that were surveyed in July and August 2023, with fruit observed on ≤ 5% of stems at these 10 colonies and in most instances very few fruits per stem. Clonal (vegetative) spread of pondberry may be an important component of its life history, and this is reviewed in more detail in USFWS (2014). Pondberry is suspected to be insect pollinated. Tucker (1984) noted small bees and flies on flowers in Arkansas. The fruit contains many oils and similar compounds, which are suspected to make the fruit unpalatable to most wildlife. Therefore, seed dispersal is likely accomplished by seeds merely falling to the ground or by animals (such as birds) picking the fruit and depositing it elsewhere (USFWS 1990). No plant species currently are known to hybridize with pondberry.

4.8 Pondberry Habitat Requirements

Habitat requirements of pondberry appear to be variable across its range. Pondberry is found within seasonally flooded wetlands that broadly include riverine bottomland hardwood forests and geographically isolated wetlands (i.e., Carolina bays, limestone or lime sink ponds, sand ponds, and lowland sand prairie depressions) in the Atlantic and Gulf Coastal Plains and Mississippi Alluvial Valley of the southeastern United States (USFWS 2014). In general, pondberry occupies wetland habitats that are normally flooded or saturated during the dormant season, but infrequently flooded during the growing season for extended periods (Tucker, 1984).

Hydrology at geographically isolated wetlands typically is maintained by precipitation, and in some cases, groundwater. Hydrology for pondberry colonies in bottomland hardwoods is maintained by overbank flooding, local precipitation, storage in depressions or at sites with soils that impede drainage independent of overbank flooding, or a combination of the previous two factors (USFWS 2014).

Tucker (1984) reported that pondberry populations in Mississippi are associated with “mature bottomland hardwood forests in low depressions.” The USACE (1991) reported that pondberry colonies in Mississippi are typically found on slight ridges in a ridge and swale community which is either frequently or periodically flooded or is in proximity to a permanent water body.

The extant populations in Mississippi are all associated with bottomland hardwoods at elevations where rainfall/local hydrology dominates the hydrologic conditions at the pondberry colony site (USACE 2005). Hawkins et al. (2009) provided a quantitative description of bottomland hardwood forests in the DNF that supported pondberry colonies. They analyzed extensive data and found that canopy and subcanopy trees were similar among sites, colonies were not associated with mean tree density or dbh, and forest composition and structure reflect hydrologic regime, topography, historical disturbance, and absence of any recent disturbance. In the Action Area, recent (2019 and 2020) deep and long-duration flooding (Table 6) inundated many pondberry colonies in the DNF for up to 203 days in 2019 and 154 days in 2020. The ERDC-EL has inventoried and quantified colony response (via stem counts, and measurement of stem heights and other plant metrics) in the DNF for the majority of known colonies subjected to this extensive flooding. Those data and associated narratives are reported in various sections of this BA, and all available data are provided in Excel spreadsheet format.

Mississippi pondberry populations are thought to occur on soils characterized by the Sharkey-Alligator-Dowling Association and less frequently on soils characterized as Alligator-Dowling-Forestdale Association as delineated by the Natural Resources Conservation Service 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 soils within these associations all have poor drainage, high water table, low permeability rates, and gleyed B and C horizons (Tucker 1984, Banker and Goetz 1989). The tight clay subsoils of these associations result 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). Impervious clay soils, especially in areas with depressions or ridges and swales, can result in temporary wetlands (i.e., vernal pools) in the bottomland hardwood forests of the Mississippi Delta after heavy rain events (Nichols et al.2020).

The USACE (1991) reported that of 44 pondberry colonies surveyed, 18 (41%) were located in surface soils classified as silty clay, 14 (32%) in silty clay loams, and 9 (21%) in silt loam soils. In addition, 62 pondberry sites surveyed in 2000 and 2005 contained clay loams or silty clay soils (Gulf South Research Corporation [GSRC] 2000, 2005). This indicates that pondberry colonies will not likely be found on strictly heavy Alligator, Sharkey, or Dowling clay soils.

4.9 Associated Species

Hawkins et al. (2009b) investigated the canopy and subcanopy composition of bottomland forests associated with pondberry populations in Mississippi, Arkansas, and Missouri, and found pondberry distribution was not associated with mean tree density or dbh, and no single indicator tree species could be identified. Their data did suggest that pondberry tended to be more associated with flood-tolerant than flood-intolerant species. Hawkins *et al*. (2010) conducted focused studies in bottomland hardwood forests of Mississippi on the vascular plants associated with pondberry colonies and found 69 species growing within 1 m of pondberry colonies in Bolivar and Sharkey Counties. Of these species, nine were identified as having weedy characteristics while eight species of vines (five *Smilax* spp. and three *Vitis* spp.) were identified that could strongly compete with pondberry for light.

Several early investigators from the 1980s studied tree species associated with Mississippi pondberry populations. Tree species most often associated with colonies included oaks *Quercus* spp.), Sugarberry (*Celtis laevigata)*, American Elm (*Ulmus americana)*, Green Ash (*Fraxinus pennsylvania*), and hickories (*Carya* spp.) (Morgan 1983, Tucker 1984). From the early 1990s to 2005, various investigators including USACE and GSRC continued to collect data on associated tree and shrub species, more clearly defining associates (GSRC 2000, 2005). The most common overstory tree species were oaks (*Q. phellos, Q. nuttallii, and Q. lyrata*), sweetgum (*Liquidambar styraciflua*), and elms (*U. crassifolia, U. americana, and U. alata*). In 2005, the most common overstory species were Sweetgum, Overcup Oak, and Pecan. Devall, et al. (2001), recorded the dominant trees inhabiting the 40-acre Red Gum Research Natural Area in Sharkey County. Dominant tree species observed included Sweetgum, Box Elder (*Acer negundo*), American Elm, and Sugarberry. Nordman (2002) conducted a botanical inventory of a 164x65-foot plot containing pondberry in Compartment 7 of DNF in 2002 and characterized the pondberry colony as an “Old growth sweetgum stand with canopy gaps containing Cedar Elm (*U. crassifolia*) trees up to 20-inch dbh in the subcanopy, with a slightly higher topography than most pondberry sites in DNF.”

4.10 Other Pondberry Research

In 2005, the U.S. Army Engineer District, Vicksburg (CEMVK) provided funding to the USFS, Southern Research Station, to conduct extensive pondberry research investigations. The CEMVK

entered into a $5 million, 6-year cooperative interagency agreement in 2001 (and later amended in 2002 with input from USFWS) with USFS to conduct experiments on pondberry that resulted in a multitude of reports and publications in the following areas-- the role of flooding and sunlight (e.g., Lockhart et al. 2006, Lockhart et al. 2015); silvicultural treatments (e.g., Lockhart 2016), impact of periodic flooding on competition; dynamics of native pondberry colonies; and stem dieback, population genetics (Echt et al. 2011), and seed ecology. This program also involved the propagation of over 80,000 pondberry plants to conduct genetic testing, pathogen and predation analyses, and flood regime requirements. The latter included both laboratory and field experiments involving 12 1-acre ponds (impoundment cells). Some of the resulting publications were included in the 2007 Final Yazoo Backwater Area Reformulation Study EIS (i.e., Pondberry Regional Habitat Requirements; Pondberry Profile; Re-evaluation of Pondberry (*Lindera melissifolia*) in the Big Sunflower River and Yazoo River Backwater Areas; Pondberry Biological Assessment; and Pondberry Final Biological Opinion), while others have been published subsequently in the peer-reviewed literature and summarized below.

The ERDC-EL has been collecting hourly imagery from 19 wildlife trail cameras strategically placed at or near pondberry colonies, at varying elevations, in the DNF. Imagery (>600,000 images) from these cameras (set to record one image per hour, and five images per motion trigger) are providing information and data and indices on (a) wild hog abundance, (b) deer browsing, (c) other disturbance events (e.g., hunters), and (d) visual reference for surface inundation by local precipitation events. A subset of those data is used in this BA to illustrate their utility for indexing disturbance and for visually characterizing surface water events from flooding.

4.11 Threats and Reasons for Decline

While there are no records in the literature of pondberry status before modern times (whether it was abundant or scarce), apparent reasons for the species' current endangered status are discussed below; and include land clearing operations for agricultural, commercial, and private development (USFWS 1990). Timber harvesting activities (and especially those that include the use of heavy equipment) can crush plants, fell trees into pondberry colonies, uproot trees near colonies, unfavorably modify forest canopy, and possibly change local hydrology. Kral (1983) reported that single-tree selection harvesting in hardwoods likely would 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 USFWS, 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 (Banker and Goetz, 1989). The ERDC-EL is uncertain at this time what best management practices currently are being used by the USFS to protect pondberry colonies.

Several investigators have made general statements about drainage activities and subsequent effects on pondberry such as ditching, which could alter 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 (Kral 1983, Wright 1989, USFWS 1990). The USACE, through extensive field studies of pondberry within Mississippi, determined that only drainage activities that significantly alter the local hydrologic regime of depressions, ponds, sinks, or other areas governed by localized hydrology would adversely affect pondberry colonies.

A third factor associated with the loss of habitat is land clearing due to agricultural interests and other developments. Throughout the pondberry range, bottomland hardwoods and similar habitat types have been extensively cleared. These wetlands provide a variety of functions (e.g., water storage; floral and faunal habitat) and values (e.g., flood risk reduction and recreation) within the Mississippi River Valley (Smith and Klimas 2002). However, historic landscape alteration has resulted in significant (>70 percent) declines in forested wetland acreage, and associated losses of wetland functional capacities in the region (King et al., 2006).

Anecdotal evidence in the DNF from surveys and trail camera imagery suggest that feral hogs are an increasing and significant stressor on pondberry colonies. Hog rooting, wallows, and trampling all have been observed at or near many colonies. Also, though we have not been able to find data on distribution and abundance of palmetto (*Sabal* spp.) in the DNF, it is a significant component of the understory of the DNF, especially in the northern half of the forest. We suspect that it has become increasingly dominant in the last two decades. There are many extinct pondberry colonies in the DNF that have been partially or completely overwhelmed with palmetto growth. There is an apparent, but yet unquantified, relationship between palmetto and feral hog distribution, with the latter likely using the dense palmetto understory for foraging, cover, and reproduction. These stressors, both individually and in combination, should be investigated in more detail to better understand how they might impact pondberry colonies in the DNF in the future.

4.11.1 Disease/predation. The literature indicates that nearly all colonies of pondberry are affected by stem dieback. Rayner and Ferral (1988) reported that stem dieback and predation were two factors that led to poor colony health in the Honey Hill region of South Carolina. Stem dieback has been hypothesized to be fungal and/or drought-related but could be characteristic of the species**.** Predation has been observed by deer and insects, mainly the spicebush swallowtail caterpillar (*Papilio troilus*) (Rayner and Ferral, 1988; USACE, 1991). Devall et al. (2000), found six insect species in association with pondberry, but none of them appear to be a limiting factor for the plant.

Through field studies of pondberry colonies in Mississippi, stem dieback and insect damage seem to influence the general health of many colonies (USACE 1991; GSRC 2000, 2005). Devall et al. (2000), reported dieback of 33 percent of the stems during June at a site in Shelby County, Mississippi. The best available information suggests that stem dieback is related to fungal pathogens, drought, and the interactions between pathogens and drought. In addition, Devall et al. (2000), noted that in unusual conditions, stem dieback may be caused by winter freezing. Monitoring and studies of plant growth and decline at colonies in DNF indicated most instances of stem dieback were accompanied by abnormal patterns of sudden leaf wilt and death during the growing season on plants of all size classes. This pattern was not indicative of senescence and dieback of old or large plants. Dead stems have been reported at various locations in different pondberry locations (e.g., GSRC 2000, 2005).

Wright (1989) first reported leaf senescence, summer leaf fall (facultatively deciduous), and twig dieback on pondberry plants in response to summer drought conditions in Arkansas. In DNF, the pathological symptoms of active dieback were directly observed and monitored by McDearman at 10 pondberry colonies (USFWS 2000b). The first symptoms were characterized by rapid leafwilt and sudden death of leaves and stems during a late summer dry period, without leaf abscission. Stem, branch (more than one stem), or whole plant death followed during the subsequent fall and winter. Since leaves died rapidly in the summer without abscission at DNF

sites, additional investigations by Dr. Douglass Boyette (USDA Agricultural Research Service) revealed several potential pathogens, including *Diaporthe* sp., the cause of stem-canker.

Browsing by vertebrates appears to occur only occasionally. Some stems were reported to have been eaten by rabbits during the winter (Wright, 1989). The USACE (1991) reported evidence of herbivory at only one of 44 pondberry colonies in DNF. ERDC-EL wildlife trail camera imagery from 2021-2023 confirms that deer do occasionally browse on pondberry leaves.

Pondberry also is susceptible to a fungal pathogen (*Raffaelea lauricola*) that causes laurel wilt, which is a lethal disease for the species. Several researchers have investigated the impacts of this pathogen on pondberry (e.g., Best and Fraedrich 2018, Fraedrich et al. 2011). The USFWS (2021) cited laurel wilt disease as an emerging threat of mostly unknown long-term consequence to extant pondberry colonies that needs much more investigation. The disease was not discovered in the U.S. until after the Recovery Plan was finalized, but the pathogen now is known from all states but Missouri within the full current and historic range of the species. The distribution map for laurel wilt in the United States is tracked by The Southern Regional Extension Forestry (SREF) Forest Health Program (http://southernforesthealth.net/news.updated-laurel-wilt-map), and the current online map does not show the pathogen present within the Action Area (latest update 23 July 2021). Nonetheless, laurel wilt disease is of significant concern, particularly if it spreads within the distribution of Mississippi pondberry populations.

4.11.2 Lack of reproduction. Most recent accounts and studies of pondberry list poor sexual reproductive success as another important reason in the decline of pondberry colonies. Many of the colonies studied in Mississippi consisted mainly of male plants. Some entire colonies contained only male stems. Consequently, colony expansion is suspected to occur primarily vegetatively. Sexual reproduction can be accomplished in a controlled environment (such as a nursery) as reported by USFWS (1990), which indicated successful seed germination when seeds were depressed below the soil surface. During field surveys from 2020-2023 by ERDC-EL of the Mississippi population on DNF and Hester Tract, fruits (which are single-seeded) were infrequently observed on plants, particularly in the DNF. Also, there was regrowth observed at many DNF colonies, and it was common to observe what appeared to be emerging seedlings, though these all could have been sprouts from existing underground stolons. It should also be noted that seedlings can be difficult to distinguish from other species (Aleric and Kirkman 2005; Hawkins et al. 2010) and easily overlooked. With the abundance of suitable habitat within DNF, it is likely that if germination and sexual reproduction can occur in the wild, it could be occurring here. However, reports by Tucker (1984) and Morgan (1983) suggested some uncertainty about germination and new seedling establishment in the wild. Nonetheless, USFWS (2021) stated that despite progress on understanding reproductive ecology, "more studies are needed to determine the minimum number of self-sustaining (viable), protected populations required to maintain adequate genetic diversity and continued survival of pondberry into the foreseeable future."

4.11.3 Competition. Hawkins et al. (2010) investigated three disjunct pondberry populations in Mississippi over three years and found that most associated species do not appear to have direct competitive impacts on pondberry, except for those that are invasive, become weedy, or have vining growth forms. For the latter, *Smilax* spp. and *Vitis* spp. have the greatest potential as strong competitors to pondberry. Additionally, recent ERDC-EL surveys in the DNF noted some colonies with dense trumpet creeper (*Campsis radicans*) and peppervine (*Ampelopsis*

spp.) encroachment. Additionally, dwarf palmetto (*Sabal minor*) forms dense stands in the DNF that may be constricting the areal extent of pondberry colonies or prohibiting their expansion.

Hydrology may play an important role in regulating interspecific competition with pondberry. As discussed in more detail in USFWS (2007) and USFWS (2014), and references included therein (e.g., Lockhart et al. 2013), competition with pondberry, particularly from less flood-tolerant plant species, can be increased in the absence of regular floods. More recently, Hawkins et al. (2016) found increased interspecific competition between pondberry and *Brunnichia ovata*, which has been identified as a potentially aggressive competitor, increased in non-flooded conditions compared to experimentally flooded conditions. However, both pondberry and *Brunnichia ovata* are considered facultative wetland species, consequently, competition might be due to other environmental factors such as light availability, and not changes in hydric regime (or an interaction between light availability and flooding regime [as discussed in UWFWS 2014]). Such interactions warrant further study and analysis, which are proposed below (see Section 6) as should be included as part of any Monitoring and Adaptive Management Plan for the Action Area (USACE 2020c).

5 Environmental Baseline

The purpose of this section is to describe the current condition and local terrestrial environment of pondberry within the Action Area. The Yazoo Backwater Action Area lies in the alluvial valley of the Mississippi River. The topography is characterized by relatively flat, poorly drained land with slopes of 0.3 to 0.9 foot per mile. Elevations range from 120.0 to 75.0 feet, NGVD, from north to south.

5.1 Land Use

The Action Area is comprised primarily of woody wetlands (bottomland hardwood forests) interspersed with agricultural fields (Figure 13). Within the DNF, pondberry is found exclusively within woody wetlands (Figure 14). Most of the known pondberry colonies that occur in the Action Area are within the DNF. Additional colonies occur on private lands and in the Hester Tract but are outside of the Action Area. We include metrics on these other colonies in this BA to provide a comprehensive data set for all known pondberry colonies in Mississippi. Within the Action Area there has been an overall increase in forested acres between 1980 and 2010 (following a decreasing trend between 1950 and 1980) in Humphreys, Issaquena, Sharkey, and Warren counties (Table 4; Oswalt 2013). These net increases in bottomland hardwood forest may benefit pondberry since it is the primary habitat type for which it is known to occur, provided that other important habitat conditions (e.g., seasonal inundation) within portions of the reforested areas exist. Land cover is summarized for the Action Area in Figure 13 and Table 5, and the DNF in Figure 14.

Table 4. The total land a forested area estimates in Mississippi counties within the Lower Mississippi Alluvial Valley for the reference period 1950-2010. Original data obtained from Oswalt 2013.

		Forested Area (Acres in Thousands)				
County	Total Land Area	1950	1970	1980	1990	2010
Bolivar	591.3	108	96.3	66.3	84.8	128.6
Coahoma	362.2	94	69.8	56.6	67.9	70.4
Holmes	491.2	223	220.1	255.9	269.7	342.2
Humphreys	279.8	101	38.4	41.8	36.3	53.1
Issaquena	269.9	161	120.5	98.4	116.5	117.2
Leflore	362.2	94	69.2	57.9	63.5	75.7
Quitman	262	64	35.3	32.5	26.5	38
Sharkey	290.5	132	82.6	72.7	92.8	115.9
Sunflower	436.3	49	30.2	32.3	38.1	13.9
Tallahatchie	406.8	151	127.6	97.2	114	136.5
Tunica	279.6	91	52.4	57.8	44.6	68.8
Warren	360	233.2	235.8	215.5	253.6	253.7

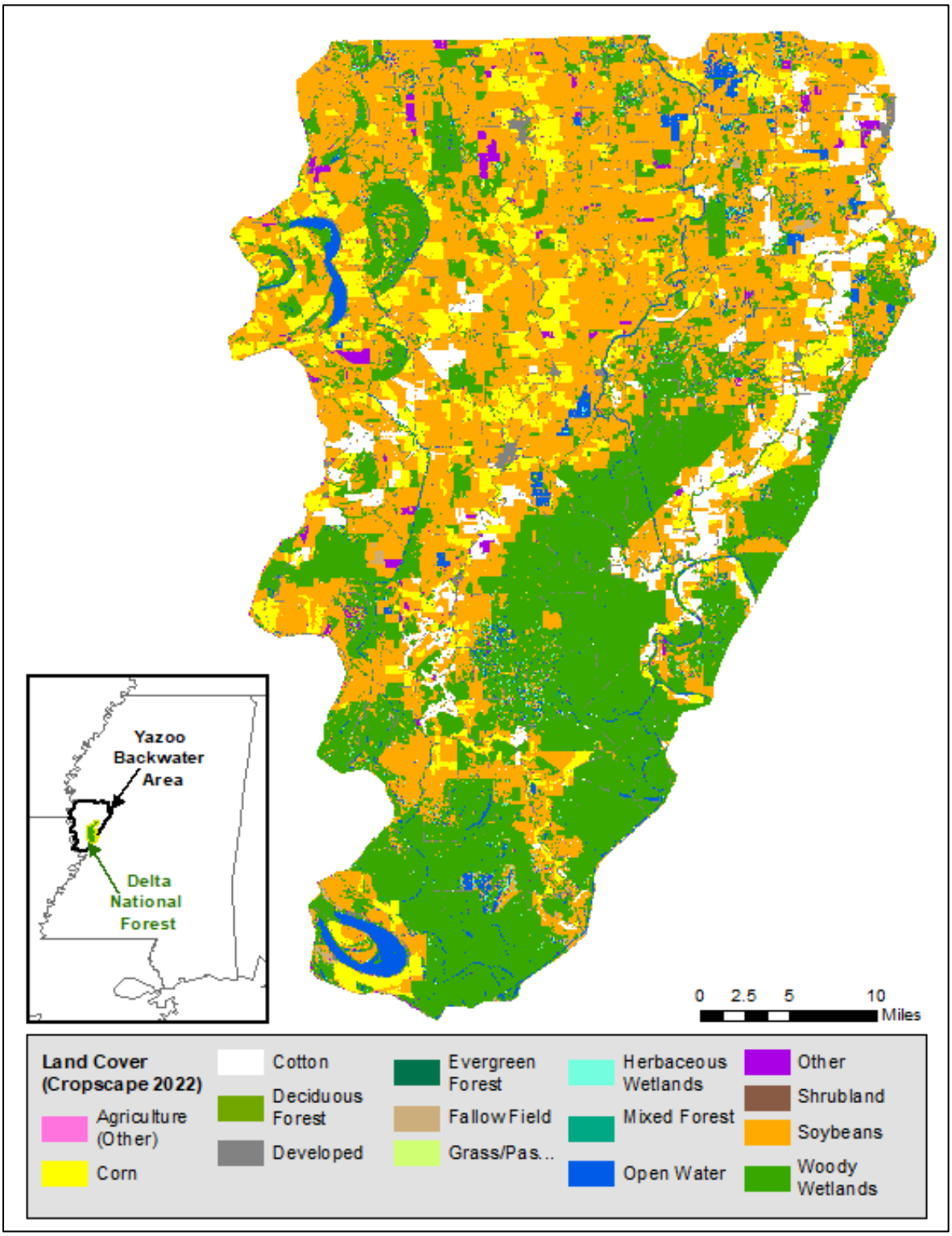


Figure 13. Land cover according to the 2022 USDA National Agriculture Statistics Service (NASS) Cropscape within the Yazoo Backwater Area. Of the forested areas, >99% is classified as Woody Wetland.

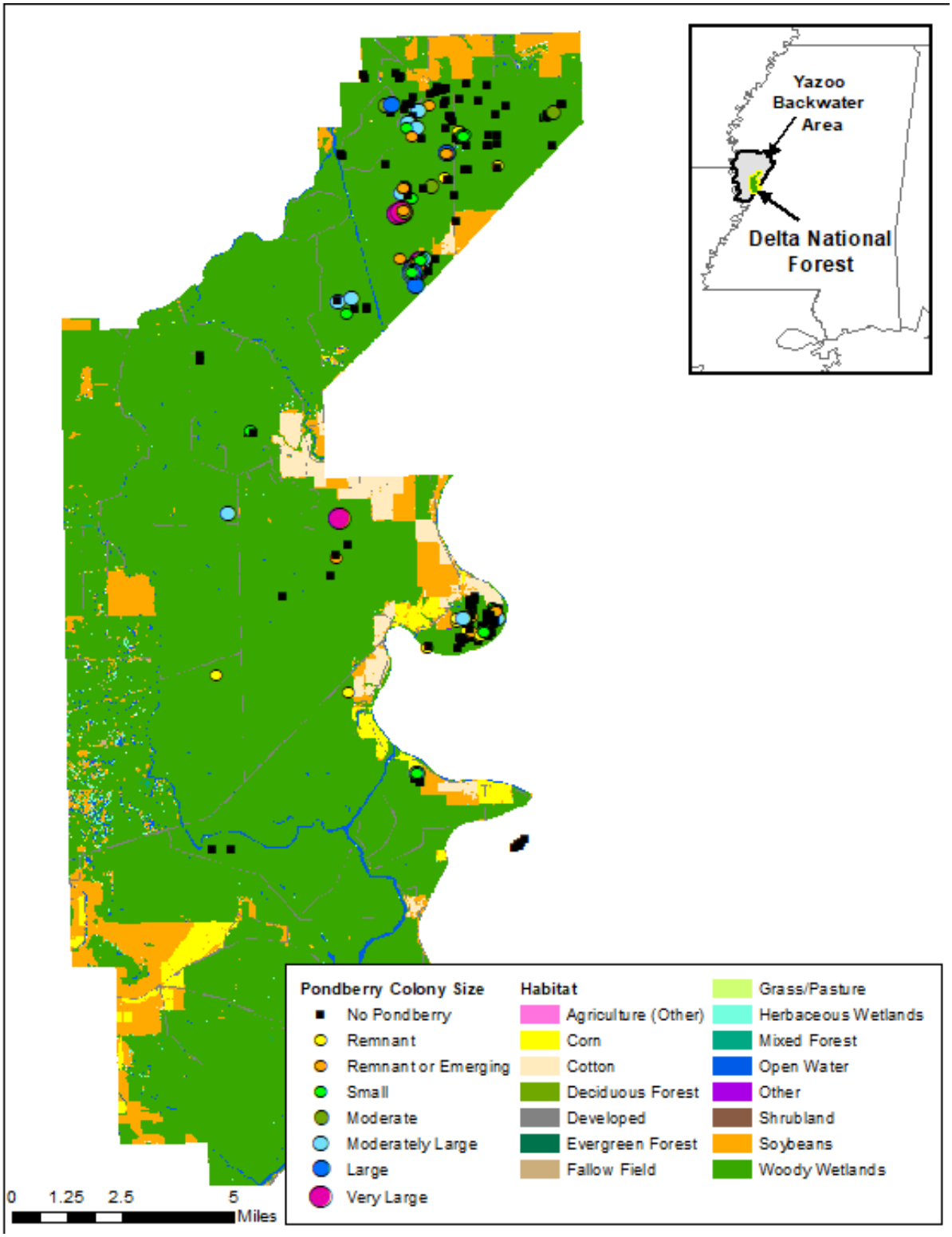


Figure 14. Land cover within the DNF according to the 2022 NASS database with extirpated and extant pondberry colonies. Of these 313 colonies, all are located within woody wetlands with the exception of 3 extirpated colonies where coordinates are located in agricultural fields near the forest edge. Table 2 defines pondberry colony size referenced within figures of this BA.

Table 5. Land cover within the Yazoo Action Area according to the 2022 NASS database.		
2022 USDA NASS Land Cover Classification	**Habitat**	**Acres**
Aquaculture	Other	151
Barren	Other	461
Corn	Corn	90,554
Cotton	Agriculture	51,938
Dbl Crop Soybeans/Oats	Agriculture	8
Dbl Crop WinWht/Cotton	Agriculture	1
Dbl Crop WinWht/Soybeans	Agriculture	3,021
Deciduous Forest	Deciduous Forest	240
Developed/High Intensity	Developed	644
Developed/Low Intensity	Developed	7,370
Developed/Med Intensity	Developed	4,855
Developed/Open Space	Developed	15,587
Evergreen Forest	Evergreen Forest	233
Fallow/Idle Cropland	Fallow Field	4,269
Grassland/Pasture	Grass/Pasture	636
Herbaceous Wetlands	Herbaceous Wetlands	6,275
Mixed Forest	Mixed Forest	106
Oats	Agriculture	24
Open Water	Open Water	30,052
Other Hay/Non-Alfalfa	Agriculture	185
Peanuts	Agriculture	2
Peas	Agriculture	0
Pecans	Agriculture	2,392
Rice	Agriculture	3,442
Shrubland	Shrubland	127
Sod/Grass Seed	Agriculture	0
Soybeans	Soybeans	382,117
Sunflower	Agriculture	11
Sweet Potatoes	Agriculture	646
Winter Wheat	Agriculture	2,827
Woody Wetlands	Woody Wetlands	317,320

5.2 Hydrology

The hydrology of the study area is affected by both internal and external sources. Both sources have been altered by features of the Mississippi River and Tributaries (MR&T) Project. The frequency and duration of flooding due to the Mississippi River have been reduced by the mainline levees and the channel cutoffs (external sources). The levees keep floodwaters of the Mississippi River out of the Yazoo Study Area. The channel cutoffs lowered Mississippi River stages which in turn reduced backwater flooding. The maximum reduction of backwater flooding due to the channel cutoffs occurred in the 1950s. Aggradation of the Mississippi River channel bed has eliminated most of this reduction. Reservoirs constructed in the hill area of the Yazoo Basin and channel improvements to the Yazoo River also had an effect on stages within the Yazoo Backwater Area and have reduced flooding in the Yazoo River, but high stages on the

Yazoo River do not necessarily induce significant backwater flooding in the YBA. For example, during the April 1991 Flood, there was significant flooding in the Coldwater and Tallahatchie River Basin, which amounted to a 50-year flood event. However, the stage at the SBWCS was equivalent to a 5-year flood, and the Steele Bayou and Little Sunflower River gates only closed very briefly at the beginning of this headwater flood event because the interior water elevation was greater than the riverside elevation. The YBA has also benefited from other flood damage reduction features of the MR&T project that have been completed inside the study area (internal sources). A more detailed description of the hydrologic setting is included in Appendix 6 of the Yazoo Backwater SEIS II (USACE 2020a), and the Engineering Appendix A in the 2024 draft EIS.

- Yazoo Backwater levee extending from the end of the east bank mainline Mississippi River levee to the downstream end of the west side of the Will M. Whittington Channel levee along the Yazoo River.
- Water control structures at Steele Bayou and the Little Sunflower River. These structures allow interior runoff to be released when the ponding area stages are higher than the river stages and prevent backwater flooding from the Mississippi and Yazoo Rivers when the river is higher than the ponding areas.
- A 200-foot bottom width connecting channel between the Big Sunflower and Little Sunflower Rivers and an enlarged Little Sunflower River channel between this connecting channel and the Little Sunflower drainage structure.
- A 200-foot bottom width connecting channel between the Little Sunflower River and Steele Bayou, which also intercepts Deer Creek flow.
- A water control structure in Muddy Bayou which controls Eagle Lake inflows and outflows for environmental purposes.
- The inlet-outlet channel and the cofferdam around the pump station site.

The mainline Mississippi River levees are designed to protect the alluvial valley from the Project Design Flood (PDF) by confining flood flows within the leveed floodway, except where it enters the backwater areas or is diverted intentionally into the floodway areas. The mainline levee system is comprised of levees, floodwalls, and various control structures. When major floods occur and the carrying capacity of the Mississippi River leveed channel is threatened, additional conveyance through the Bird's Point-New Madrid Floodway, and relief outlets through the Atchafalaya Basin, Morganza, and Bonnet Carre Floodways are utilized as well as the storage capacity of flat lowlands at the confluences of tributaries with the Mississippi River. These tributary areas are commonly referred to as "backwater areas." These areas are protected from lesser floods by backwater levee systems that are designed to be overtopped near the crest of the PDF in order to reduce the peak flow of the PDF and allow safe passage within the mainline levee system. The system design which utilizes backwater storage at appropriate times in the PDF hydrograph has significantly reduced the need for even higher mainline levees. The Yazoo Backwater levees are designed to overtop by the PDF.

Ponding of runoff from the Big Sunflower River, Little Sunflower River, Deer Creek, and Steele Bayou is provided by two ponding areas connected by a 200-foot bottom width channel. The lower ponding area, formerly referred to as the Steele Bayou ponding area, lies in the lower end

of the Steele Bayou Basin while the upper ponding area, formerly called the Sunflower River ponding area, is located in the lower portion of the Little Sunflower River Basin.

The interior area is protected from high stages of the Mississippi and Yazoo Rivers by levees; however, the area is subject to flooding resulting from interior drainage from Steele Bayou, Deer Creek, and Big and Little Sunflower Rivers. Under present conditions, the flooding in the Yazoo Action Area primarily results from interior ponding behind the Yazoo Backwater levee when the Steele Bayou and Little Sunflower structures are closed due to high Mississippi River stages. The interior ponding areas consist primarily of agricultural and forested lands with several developed areas. Interior flooding begins at approximately 80.0 feet, NGVD.

During the rising and falling stages of a flood hydrograph, the water surface elevations in the upper ponding area are generally higher than the water surface elevations in the lower ponding area. This difference is due to the difference in elevation between the two sumps. Near the peak of the flood event, there is little difference in water surface elevations between the two ponding areas.

The Muddy Bayou water control structure was constructed as a means of controlling inflows to and discharge from Eagle Lake during non-flood conditions to enhance the lake's water quality. However, due to the topography surrounding the lake, flood protection is provided as well.

During flood conditions, the Muddy Bayou structure is opened to allow water to pass from the lower ponding area into Eagle Lake only if it becomes apparent that this line of protection will be overtopped (about elevation 96.0 feet, NGVD).

Eagle Lake was formed from an abandoned Mississippi River channel and has been cut off from the Mississippi River by the Mississippi levee. Without the two low-level levees (privately owned) in conjunction with the Muddy Bayou water control structure, the area would see significant backwater flooding.

The Steele Bayou water control structure is the principal drainage structure for the Yazoo Backwater Project. Any time the stage on the landside of the Steele Bayou and Little Sunflower water control structures is higher than the riverside and above 70.0 feet, NGVD, the gates are opened. With a rising river, the interior ponding areas are normally allowed to rise to an elevation of 75.0 feet, NGVD. The floodgates are closed when the river elevation is higher than the interior ponding levels. The Little Sunflower structure generally remains closed. It is opened during flood events when the riverside water surface elevation is less than the landside elevation and the Steele Bayou water control structure is closed.

The Steele Bayou water control structure is operated to control minimum water levels in the Steele Bayou and Little Sunflower ponding areas. The current operation plan calls for holding minimum water levels in the ponding areas between 68.5 feet, NGVD, and 70.0 feet, NGVD.

As was mentioned earlier, there were several FDR features that affected internal stages that were constructed between 1950 and 1978. These included clearing and snagging of the Big Sunflower River and the construction of the Holly Bluff cut-off. These features reduced flooding above the upper end of the Holly Bluff cut-off (Anguilla and Little Callao gauges), but increased stages at Holly Bluff by approximately 1 foot. The 2007 SEIS included a comparison of the 14-day duration flood extents for four periods from 1900 to 1997. That study was updated using the 10-meter LIDAR DEM used in the USACE (2020a) SEIS II.

5.2.1 Importance of Local Hydrology to Pondberry Colonies

Forested wetlands within the Action Area receive both local precipitation and backwater flooding as major hydrologic influences (Smith and Klimas 2002). Backwater flooding in the Action Area is a result of inundation resulting from impeded drainage when water control structures are closed due to high flood stages in the Mississippi River. Impeded drainage leads to increasing water tables and surface inundation on the landscape. Over the POR, backwater flooding events at colonies above elevation 93.0 ft (87% of known extant colonies in the Action Area) have not been a frequent occurrence (7 of 43 years), though in 2019 and 2020 backwater events were especially deep and of long duration (Table 6). In 2019, more than 550,000 acres of the Action Area were subject to flooding that lasted more than five months. Flooding was exacerbated by very high local precipitation in combination with the closure of multiple water control structures (NOAA 2020).

Price and Berkowitz (2020) studied impacts on wetland functions following long flood inundations in the lower Mississippi River valley and found functional wetland impairment, (with some wetland functions declining as much as 23%) and suggested these decreases in functional capacity likely would persist for many years. Importantly, Berkowitz et al. (2020) studied wetland hydrology drivers in the Yazoo Basin and found that in most wetlands the dominant hydrologic driver is local precipitation rather than flooding. Furthermore, they suggested that the proposed Water Management Plan for the Action Area is unlikely to convert wetlands to non-wetlands despite any anticipated changes from the project on duration of flooding (See 2024 Draft EIS Wetlands Appendix).

Deep and Long-duration Flooding. Throughout this BA, the ERDC-EL frequently refers to the potential effects on pondberry of deep and long-duration flooding. To provide some context to this phrase, we summarized data from YBA backwater flood events from 2005 to 2024 using the Steele Bayou gauge landside water levels (backwater flooding events have a “flat or nearly flat surface” across the YBA basin, which acts as a “dry dam reservoir” as described in the draft EIS Appendix A-Engineering Report). The most extensive flooding occurred in 2019 and 2020, when water levels reached 98.22 and 96.84 ft NGVD, respectively (Table 6). In 2022, the ERDC-EL measured maximum stem height at 48 pondberry colonies in the DNF. The median value of all 48 maximum stem height values 29.5 inches. For a colony with a 30-inch stem length maximum located at elevation 92.5’ NGVD in the YBA, the entire colony would be fully inundated at 95.0’ NGVD and would have been inundated with turbid water for at least 146 days (durations may have been longer in depressions or where additional headwater flooding may have occurred) in 2019, and at least 57 days in 2020. Similar calculations for any length stem in any DNF colony can be made using Table 6.

To assist in better understanding the role of local precipitation on pondberry colonies in the Action Area, the CEMVK deployed 149 groundwater monitoring wells throughout the Action Area in 2021 and 2022 (Figure 15). Of those, 58 were intentionally placed immediately adjacent to pondberry colonies. The ERDC-EL has initiated preliminary analyses in July 2024 as part of a proposed long-term effort to measure groundwater and surface water inundation levels at these colonies. Examples of hydrologic data from 14 different groundwater monitoring wells from the DNF are shown in appendices A, B, and C. As an added measure to monitor surface water at a subset of these monitoring wells, we analyzed wildlife trail camera data where imagery provided

Table 6. Backwater flood events 2005-2024 – Steele Bayou Landside Pool Levels

Year	2008	2009	2013	2015	2016	2018	2019	2020	2021
Date start	10 Apr	13 May	18 May	28 Mar	23 Jan	03 Mar	25 Feb	17 Jan	03 Apr
Date end	27 May	11 Jun	31 May	06 Apr	31 Mar	07 May	06 Aug	18 Jun	22 Apr
Max (ft)	92.18	93.74	90.91	90.67	91.98	95.11	98.22	96.84	91.81
Days ≥90 ft	48	30	14	10	27	66	203	154	20
Days ≥91 ft	23	26	0	0	17	55	183	136	10
Days ≥92 ft	4	20	0	0	0	46	161	117	0
Days ≥93 ft	0	12	0	0	0	20	159	97	0
Days ≥94 ft	0	0	0	0	0	14	153	81	0
Days ≥95 ft	0	0	0	0	0	4	146	57	0
Days ≥96 ft	0	0	0	0	0	0	104	31	0
Days ≥97 ft	0	0	0	0	0	0	79	0	0
Days ≥98 ft	0	0	0	0	0	0	8	0	0

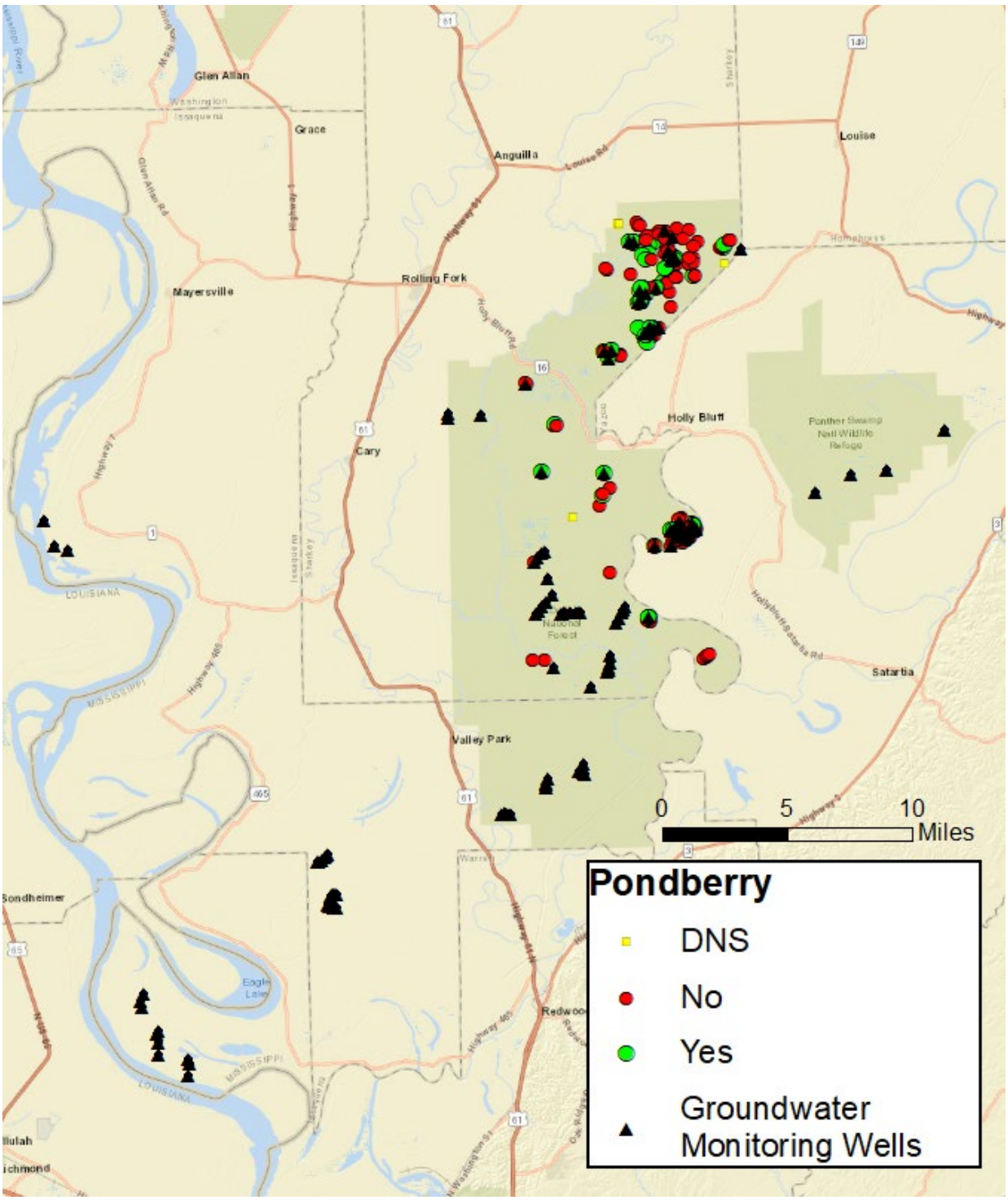


Figure 15. Distribution of 149 groundwater monitoring wells in the Yazoo Backwater Area installed during 2021-2022 by CEMVK. DNS = Did Not Survey.

a clear view of the ground. We also downloaded river gauge and precipitation data for both the Holly Bluff and Steele Bayou gauges for the same period of record as groundwater monitoring well data.

There is significant correspondence among local precipitation, river gauges, and monitoring well data (Figure 26). Over the period of record for monitoring well data (September 2021 to late-March 2023), surface water as a result of local precipitation events was frequent but variable across pondberry colonies. This is undoubtedly influenced by a variety of factors such as topography, soil type, and localized drainage patterns.

Recognizing that historical pulse flooding from the Mississippi River into the current DNF ended many decades ago with the installation of levees and water control structures, and that forested wetlands in the DNF have persisted despite this hydrologic change, it is important to investigate the long-term hydrologic patterns associated with historical and current pondberry colonies. It has been well-documented that pondberry requires at least occasional inundation to meet life-history needs (see Section 4.8 Life-history). To characterize the frequency of historical backwater flooding events relative to currently extant pondberry colonies, we took a retrospective look at long-term hydrologic data provided by CEMVK for the POR (1979-2020) as well as more recent gauge data through July 2024 We selected two river gauges nearest to the DNF that included the majority of pondberry colonies (Little Sunflower [LS] and Holly Bluff) HB], as well as at the SBWCS that (when closed during flood events) backs up water into the Action Area at a relatively flat elevation surface. It is uncertain if all currently extant pondberry colonies existed at the start of the POR, and this analysis examines hydrologic conditions at the locations of extant colonies regardless of how long the colonies have been present. Since 1979, backwater flooding to elevation 95.0 ft NGVD only occurred during five [LS and SB, 1979, 1983, 2018, 2019, and 2020] and seven years [HB, 1979, 1982, 1983, 1991, 2018, 2019, and 2020], respectively. These data suggest that the 17 extant pondberry colonies above 95.0 ft NGVD in the DNF, over the POR, did not experience backwater inundation for many years, and in some cases, decades. Backwater flood events above 93.0 ft NGVD were also relatively uncommon over the POR (7/46 years at SB), and thus the 106 extant colonies occurring above 93.0 ft NGVD (out of 122 known extant colonies in the Action Area) would not have been subjected to backwater flooding in 39 out of the past 46 years. The infrequency of backwater events at the vast majority of known extant pondberry colonies in the Action Area, and the emerging information on local hydrographs associated with individual pondberry colonies, provide increasing evidence for the importance and role of local precipitation as a leading driver in maintaining suitable growing conditions for pondberry in the Action Area.

5.3 Habitat

Land and water resources within the 926,000-acre Yazoo Action Area are comprised mainly of agricultural land or woody wetlands (i.e., primarily bottomland hardwoods), with numerous river and stream systems interspersed across the landscape. Bottomland hardwoods containing Cottonwood *(Populus deltoides),* Sycamore *(Platanus occidentalis),* Black Willow (*Salix nigra),* Pecan (Carya spp.), Green Ash *(Fraxinus pennsylvanica),* Sugarberry *(Celtis laevigata),* Hackberry *(C. occidentalis),* Oaks *(Quercus* spp.), and Elm *(Ulmus* spp.) are dynamic and productive systems that depend on intermittent flooding for maintenance of structure and numerous functions provided (e.g., wildlife habitat, sediment retention). They are the most

important ecological landscape component subject to impacts by the construction and operation of the proposed Water Management Plan within the Action Area.

5.4 History of Pondberry Surveys in the DNF

Pondberry has been one primary focus of the potential impacts of the Pump Project to native flora and fauna for more than two decades (Table 7). In the 1990's and early 2000's, the USFS, USFWS (McDearman, Unpublished Data), Gulf South Biological (1991), Gulf South Research Corporation (GSRC; 2000, 2005), and others, completed a variety of pondberry surveys and site assessments in the Yazoo Basin across both the DNF and adjacent private and public lands, with a goal of documenting distribution and abundance, and to measure a variety of colony and associated forest and hydrologic metrics as a means to characterize optimal pondberry habitat in the Mississippi Alluvial Valley.

In the 1990's the USFS surveyed approximately 32% of the DNF (19,783) acres for pondberry. Also, in the 1990's, the Corps surveyed all rights-of-ways for the Yazoo Backwater Project, 2,000 acres of bottomland hardwood forest with high potential for pondberry occurrence, and 3,600 acres associated with the Upper Steele Bayou Project. These efforts combined yielded a minimum of 182 pondberry colony sites within the DNF (USACE 2005b). In 2000, GSRC documented and georeferenced via global positioning system (GPS) 62 distinct pondberry colonies, including detailed metrics assessing general forest and colony characteristics (Gulf South Research Corporation 2001). Of those, 50 colonies were located in the DNF (primarily Sharkey County) and 12 were located on private lands in Bolivar and Sunflower Counties. In 2001, the USFWS contracted with Gulf South Biological Surveys, Inc. (2001) to investigate a subset of DNF colonies and their locations relative to hydrology associated with ponded depressions. During this work, Gulf South Biological also conducted stem counts at GSRC points 1-46 and 53-56 in the DNF (Table 7). In 2005, GSRC relocated 57 of the original 62 DNF colonies and again assessed site characteristics similar to those measured in 2000. The

The ERDC-EL compiled stem count data collected from 2000-2023 at GSRC plots[2] and summarized in Table 8. Of those colonies in the DNF, mean number of stems per colony appeared to have declined from 2000 (n=240) to 2005 (n=147) and 2010 (n=129). The USFWS (2007) did a similar analysis on 177 known colonies/sites (removing the 5 colonies that occur outside of the Yazoo Backwater Area) and stated, "The available data reveals a declining trend during this 5-year period. In 2000, the Corps counted 11,839 plants at profiled colonies/sites, which declined in the 2005 census to 7,083 plants, a loss of 40 percent." Subsequently, no assessments of these same colonies have been completed to our knowledge until 2020.

5.4.2 Yazoo Backwater Reformulation Project (1994). During the period September-October 1994, field surveys for pondberry were conducted for the Yazoo Backwater Reformulation Project. The surveys included the entire direct rights-of-way for the project and a 5 percent survey (2,000 acres) of forested tracts, with a high potential for pondberry occurrence, south and west of the DNF. In addition to pondberry profile report information, flood frequency data and professional judgment were utilized to select forested tracts to survey. Also, the Mississippi Natural Heritage Program (MNHP) was asked to review its records for reported pondberry colonies within the Yazoo Backwater Project Area. In 2005, the USACE also updated

[2] Naming conventions for pondberry colonies have varied widely since at least 2000. . The ERDC-EL renamed all known historic and new (whether extinct or extant) colonies in Mississippi with "Pondberry" followed by a sequential numeric descriptor.

Table 7. Survey dates for pondberry assessments, 2000-2023, Delta National Forest, Mississippi	
Survey	**Dates**
GSRC 2000	11 May to 20 June, 2000
Gulf South Biological, Inc.	3-18 April, 2001
GSRC 2005	7 June to 13 July, 2005
GSRC 2010	13 April – 16 June, 2010
ERDC-EL[1]	6-17 July, 2020
ERDC-EL[2]	12-22 September, 2020
ERDC-EL	2 August - 29 September, 2021
ERDC-EL	15-26 August, 2022
ERDC-EL	31 July to 31 August, 2023

[1] Initial sampling effort conducted just after floodwaters receded. Point locations were erroneous

[2] The resampling effort occurred during September to provide ample time for regrowth following extensive flood inundation.

its comprehensive Geographic Information System (GIS) database of known pondberry sites on DNF. This database includes 182 sites and was compiled from several sources, including compartment maps provided by DNF.

No pondberry colonies or evidence of pondberry presence was noted within either the rights-of-way or the 2,000 acres surveyed in 1994. In a 31 January 2000 letter with an accompanying site map, MNHP noted only 22 sites where pondberry colonies occurred within the proposed project area. None of the MNHP sites were located in areas of direct impact.

5.4.3 Survey Report – Reevaluation of Pondberry in Mississippi (2000). In May-June 2000, GSRC collected data from 62 colonies. Fifty colonies were in DNF, and 12 colonies were in Bolivar and Sunflower Counties, Mississippi. A range of data was collected on pondberry colony characteristics, surrounding stand characteristics, and site characteristics and elevation.

The purpose of this study was to update the 1991 pondberry profile and collect data on additional locations discovered since CEMVK conducted pondberry surveys in the early 1990s. The study area for this project included the DNF in Sharkey County, Mississippi; several parcels of private land in Bolivar County; and a 32-acre plot south of the DNF. Data were collected on 62 colonies (50 in DNF and 12 on private land). Data collected included physical characteristics of the colony, colony health, forest stand conditions, soil characteristics, and evidence of localized depressions. Importantly, the elevation of each colony and surrounding area was determined

using a professional land survey crew. These elevations were used to establish the flood frequency of the site. The flood frequency of the sites was used to analyze relationships among pondberry colony characteristics and flood frequency.

The analysis found that common associate species were similar to previous studies on the Mississippi pondberry populations. Common associate tree species were sweetgum, oaks, and elms, while associate shrub species were sugarberry, swamp dogwood, and deciduous holly. The study concluded there was no correlation between colony health, measured by stem density, stem diameter, stem height, and elevation (used to determine flood frequency of the site). In other words, there appeared to be no relationship between the variation in pondberry characteristics and variation in flood frequency (as determined from surveyed elevations of each pondberry colony). There was also no correlation between stem density and percent canopy cover or diameter at breast height. Therefore, it was difficult to predict where pondberry might be successful by using these quantifiable variables. Instead, evidence from this and the 1991 pondberry profile suggests that, in general, pondberry was successful in areas of high percent canopy cover, in a ridge and swale community, and in areas that are mostly affected by local precipitation and hydrology. The analysis documented that 94 percent of the colonies had evidence of localized depressions (defined as an area greater than 10 square feet that is slightly lower than the surrounding area and contains ponded water or evidence of ponded water [e.g., water-stained leaves] at some time).

5.4.4 Hydrology and Habitat Evaluation of 51 Selected Colonies of Pondberry in DNF, Mississippi (2001). In April 2001, FWS contracted Gulf Coast Biological Surveys, Inc., to examine selected sites of pondberry in DNF and to determine if these colonies were located in ponded depressions mostly influenced by rainwater accumulation or on alluvial ridges mostly influenced by overbank flooding. This report documents these findings.

5.4.5 Survey Report – Reevaluation of Pondberry (*Lindera melissifolia*) in the Big Sunflower and Yazoo Rivers Backwater Areas (2005, 2010). In June-July 2005, GSRC collected data from the same 62 colonies sampled in 2000. In 2010, GSRC repeated this effort.

5.4.6 USFS Pondberry Surveys in Delta National Forest. The USFS DNF conducted intermittent pondberry surveys as part of their pre-action evaluation of management activities in stands and compiled a database of pondberry colony data incorporating surveys from 1988 to 2005 (USFWS 2007). We have been unable to locate any actual count data for these specific references to a database, other than those data in GSRC (2000, 2005, 2010) reports. Many of these colonies were not included in 2000, 2001, 2005, 2010, or 2020 pondberry surveys, so it is not known whether pondberry may still be extant at these sites. From DNF data, the USFS noted most known pondberry colonies occurred in the northeast portion and Compartment 39 of DNF, and that this spatial distribution did not appear to be the result of entering and surveying a disproportionate number of stands in these areas of DNF. At that time, approximately 32 percent of DNF had been surveyed for pondberry (USFWS 2007), and the surveyed stands appeared to be well-distributed across DNF. From prior hydrologic analyses, approximately 60 percent of DNF was considered below the 1-year frequency elevation, with the remaining 40 percent of DNF above the 1-year frequency elevation. Twenty-four percent of the area below the 1-year frequency had been surveyed, with 23 colonies being located. Forty-three percent of the area above the 1-year frequency had been surveyed, with 159 colonies being located. Prior assessment suggested that there is a low probability of locating additional pondberry colonies in

areas below the 1-year frequency, and the lack of pondberry colonies discovered on the majority of DNF was not the result of limited or disproportionate surveys.

5.4.7 Re-evaluation of Pondberry in the Delta National Forest (2020-2023).

Surveys in 2020. During June 2020 and following the long and deep-duration flooding in 2019 and 2020 in the YBA, the ERDC-EL, CEMVK, USFWS, and USFS met virtually to discuss pondberry sampling in the DNF. All parties agreed that given the timeframe available to conduct fieldwork for the 2020 SEIS, that ERDC-EL discovery survey efforts would initially only focus on GSRC colony sites. In July 2020, the ERDC-EL revisited and assessed DNF GSRC colony sites within a 2-week timeframe. Pondberry was not found at any of the colony sites, but in the course of those surveys, 12 new colonies were identified and described. Subsequent to the July 2020 effort, the ERDC-EL determined that coordinates used for these surveys included a historical GIS projection error that resulted in all GSRC points being shifted 200m from their original location.

On 11 September, 2020, six ERDC-EL biologists met in the DNF for a one-day training effort to (a) enhance skills associated with pondberry identification, (b) finalize the protocol being used to assess a variety of pondberry colony and individual plant metrics, and (c) develop a consensus on how to assess metrics (e.g., canopy and understory cover). From 11-22 September 2020, two ERDC-EL teams deployed daily, with corrected GIS data, to visit sampling plots. The teams visited all GSRC plots, along with the 12 newly discovered ERDC-EL colonies, and 10 additional historical colony sites (McDearman Sites) provided by the USFWS. Williamson et al. (2019) documented pondberry in 2019 at three U.S. Forest Service (USFS) plots within DNF Compartments 9 and 25, and subsequently provided coordinates for these plots to facilitate assessments. Each team navigated to coordinates of previously documented pondberry locations in the DNF using a handheld GPS unit. Plot center was marked with flagging (but was not monumented in any other fashion) and a $1/5^{th}$ acre circular plot (52.7-foot radius) was established by stretching a forester's tape along cardinal directions. The teams searched each plot for pondberry, as well as the PVC pipes used in 2005 to mark prior colony locations and survey points. At each point ERDC-EL conducted a meander search for pondberry within each of four quadrants for a minimum of five minutes; plots with dense groundcover components were allotted additional time per quadrant. As time allowed, ERDC-EL also conducted rapid, untimed searches for pondberry in adjacent areas outside of plots. In addition, ERDC-EL generally searched for pondberry while walking between plots and to and from forest access points. When pondberry was found, colored flagging was used to mark individual plants at small colonies, and the perimeter of large colonies, for colony and associated habitat assessments. We defined distinct pondberry colonies as any occurrences separated by a distance >15 feet. We established a $1/10^{th}$ acre circular plot (37.2 ft radius) at the center of each colony, and assessed each colony using the metrics described below.

For plots where pondberry was not found, pondberry was also not detected adjacent to any of these plots. For GSRC plots containing pondberry, some plots had stems outside of the 37.2-foot radius plot, and this usually was noted on the data sheet. If pondberry stems occurred outside of the 37.2-ft radius plot, the entire colony area was measured regardless of whether it occurred wholly within the plot or extended beyond the plot boundary (except for GSRC 42 and GSRC 43 which occurred within the very large cluster of ~2,500 stems over at least an acre now referenced as Pondberry 082). In cases where stems were noted outside of the plot and more than 15 ft from

the nearest stem, these were noted as separate colonies (and in some cases, measured metrics in a new 37.2-foot radius plot). The presence of PVC pipe at many of these sites with zero stems lends credence to the possibility that 29 colonies were extirpated between 2000 and 2020 (Table 8). The extensive inundation depth and duration of the 2019 and 2020 floods could have impacted many of these colonies such that some colonies were still viable and extant but did not have above-ground growth at the time of the 2020 surveys. However, in 2023, ERDC-EL revisited nearly 100% of pondberry colonies in the DNF to ensure that each colony was visited at least twice between 2020 and 2023. Since pondberry colonies would have had three years in which to recover from the 2019 and 2020 floods, it is likely that those colonies without any above-ground stems present in 2023 are now truly extirpated.

5.4.7.1 Assessment metrics used by the ERDC-EL from 2020-2023 (note, not all metrics were recorded each year. The supplemental spreadsheet provided with this BA provides a comprehensive data set for all information collected by year and colony)

(1) Describe site type
   a. Ridge – Highest elevations in the DNF, typically dominated by less water-tolerant vegetation, and often surrounded by lower elevation flats and depressions.
   b. High flat – higher elevation sites than the surrounding landscape, but below ridges.
   c. Low flat- lower elevation sites than surrounding landscape with evidence of recent flooding, often adjacent to a depression.
   d. Depression – obvious wetland depression in locally low-elevation sites that either held water at the time of surveys or recently were inundated.

(2) Conduct a qualitative assessment of site wetness at the soil surface
   a. Measurable standing water
   b. Saturated soil, but no measurable water depth
   c. Moist but not saturated soil
   d. Dry soil

(3) Record existing water depth (centimeters; cm) at plot with one representative measurement.

(4) Record the maximum height (cm) of any water marks or moss trim lines present on trees within the assessment plot.

(5) Record any evidence of current or prior disturbance including cut stumps, beaver activity, feral pig activity, large tree-fall gaps, etc. within a 50-foot radius of the plot center.

(6) Record the distance and azimuth from the center of the colony to the nearest upper-canopy tree.

(7) Record the number, height, and diameter at soil surface (with small calipers) of pondberry stems in each colony. For small colonies (e.g., < 50 stems), measure each individual plant. For medium-sized colonies (e.g., 50-150 stems), measure every

other plant. For large colonies, measure a representative number of plants such that at least 50 stems are measured (e.g., every 5th stem in a colony of 250 plants).

(8) Colony Photo Documentation: Take digital image from each cardinal direction from outside of colony facing inward toward colony, such that the entire colony is in view for each image. Images captured in the following sequence: N, E, S, W.

(9) Record number of fruiting pondberry stems, if fruit present.

(10) Qualitative assessment of colony Health:

a. Note presence and severity of (a) stem dieback/damage, (b) herbivory, (c) chlorotic leaf tissue, and (d) necrotic leaf tissue.

0 — absent or negligible (present on ≤10% of stems; if colony is comprised of a single stem then affecting ≤10% of approximate total leaf area affected, dieback/damage on no more than one primary or secondary branch).

-1 — moderate (present on >10% but ≤25% of stems; if colony is comprised of a single stem, affecting ≥10% but ≤25% of the approximate total leaf area, dieback/damage on more than one primary or secondary branch but ≤25% of total primary and secondary branches).

-2 — major (>50% of stems; if the colony is comprised of a single stem, ≥50% of the approximate total leaf area, dieback/damage on ≥25% of primary or secondary branches.

b. Overall health rating of colony based on deductions from prevalence of stem dieback/damage, herbivory, chlorotic and necrotic foliage. (0 = excellent, -1 = good, -2 = fair, and ≤-3 = poor)

(11) Measure canopy cover with a spherical, convex mirror densiometer at the end of each 37.2-foot azimuth (cardinal directions) and obtain an average canopy cover value for the plot.

(12) Determine basal area by measuring diameter at breast height (DBH) of all trees within the plot. Record tree species for each measurement.

(13) Assess stand maturity class based on DBH: most trees approximately 6", 6-18", >18", or Mixed sizes.

(14) Record distance to nearest water body if visible, or determine remotely from aerial imagery.

(15) Measure basic colony dimensions (length x width) with a meter tape or by using a rangefinder.

2**020 Surveys.** ERDC-EL revisited 50 prior-documented GSRC pondberry colonies within the DNF (Figure 16) and found above-ground growth of pondberry at 17 (34%) of these sites. At most locations, PVC pipe(s) in the immediate vicinity indicated that coordinates were accurate. The mean and median number of stems at these 17 colonies was 7 and 34.6, respectively (range 1-319 stems). For these 50 GSRC plots ERDC-EL was able to visit and assess within DNF, the total number of pondberry stems within plots in 2020 (n=589) declined by 95.0% and 90.7%

from 2001 (n=11,839) and 2005 (n=6,302), respectively. Only one colony (GSRC 39; now Pondberry 079) had more pondberry than previously documented in 2000 or 2005. Measures of herbivory, chlorosis, dieback/damage, necrosis, and fungal pathogens were noted at multiple colonies, though most colonies appeared relatively healthy.

We found a total of 41 distinct extant colonies at all sites, plus one very large colony (or groups of colonies) encompassing McDearman plots. This latter site and associated colonies were extremely large with pondberry distributed over approximately one acre. We visually estimated this plot containing multiple colonies collectively with several thousand stems. The site was too large to completely characterize given time constraints of conducting detailed habitat sampling at all DNF sites with and without colonies. However, two GSRC plots (GSRC 42, GSRC 43 now Pondberry 082 and 083) fell within the boundaries of this area and metrics from these two points should sufficiently characterize overall habitat characteristics for the larger site.

For all plots combined, mean canopy closure at pondberry colonies (96.8%, n=42) was similar to historical colony locations without stems (95.3%, n=38). Likewise, understory cover at pondberry colonies (42.5%, n=38) was also similar to plots without pondberry (47.8%, n=38). Disturbances documented at 18 colony sites included presence of large tree-fall gaps, beavers, and evidence of moderate to heavy rooting by feral pigs.

Surveys from 2021-2023. During late summer of each year, 2021-2023, the ERDC-EL and USFWS visited every known extant and extinct pondberry colony in western Mississippi. These sites include the DNF (Sharkey County), Dahomey NWR (Bolivar County), Hester Tract (Bolivar County), and two private lands sites (Sunflower County). We have summarized those data in various portions of this BA. Because of the extensive size of the data set, we refer the USFWS to the supplemental Excel spreadsheet for all data. This spreadsheet includes pondberry colony ID (with cross-references to all former naming conventions), updated UTM coordinates collected with a Trimble R2 unit at cm-level accuracy, comprehensive stem count data, plant and colony metrics, disturbance scores and descriptions, elevations from analyses using a 2024 1-m DEM, and notes from colony visits. Should the USFWS request specific summaries of these data, the ERDC-EL will work with them to provide any requested information, or additional tables and figures.

In an attempt to better understand long-term trends of pondberry colonies in the Action Area, the ERDC-EL investigated all available stem count data from GSRC pondberry colony plots. Historic counts occurred in 2000, 2005, and 2010. Contemporary counts included annual counts between 2020 and 2023. During the last count of GSRC colonies in the DNF (late summer 2023), the ERDC-EL noted a significant decline from 2000 to 2023 in the number of known pondberry colonies in the DNF (Figure 16). Only 25 of 63 (40%) GSRC colony sites had detectable stems (note this is an increase in six extant colonies from count data from the same sites in 2020) indicating that ~60% of colonies went extinct. Of 62 colonies that were measured in both 2000 and 2023, the mean change in colony size (stem count) from 2000-2023 was -42.4%, the median change was -100% (Figure 16).

During course of surveys between 2020-2023, ERDC-EL documented 97 additional colonies or "clumps" within the YBA, of which 56 occurred in the DNF and 41 within the Hester Tract.

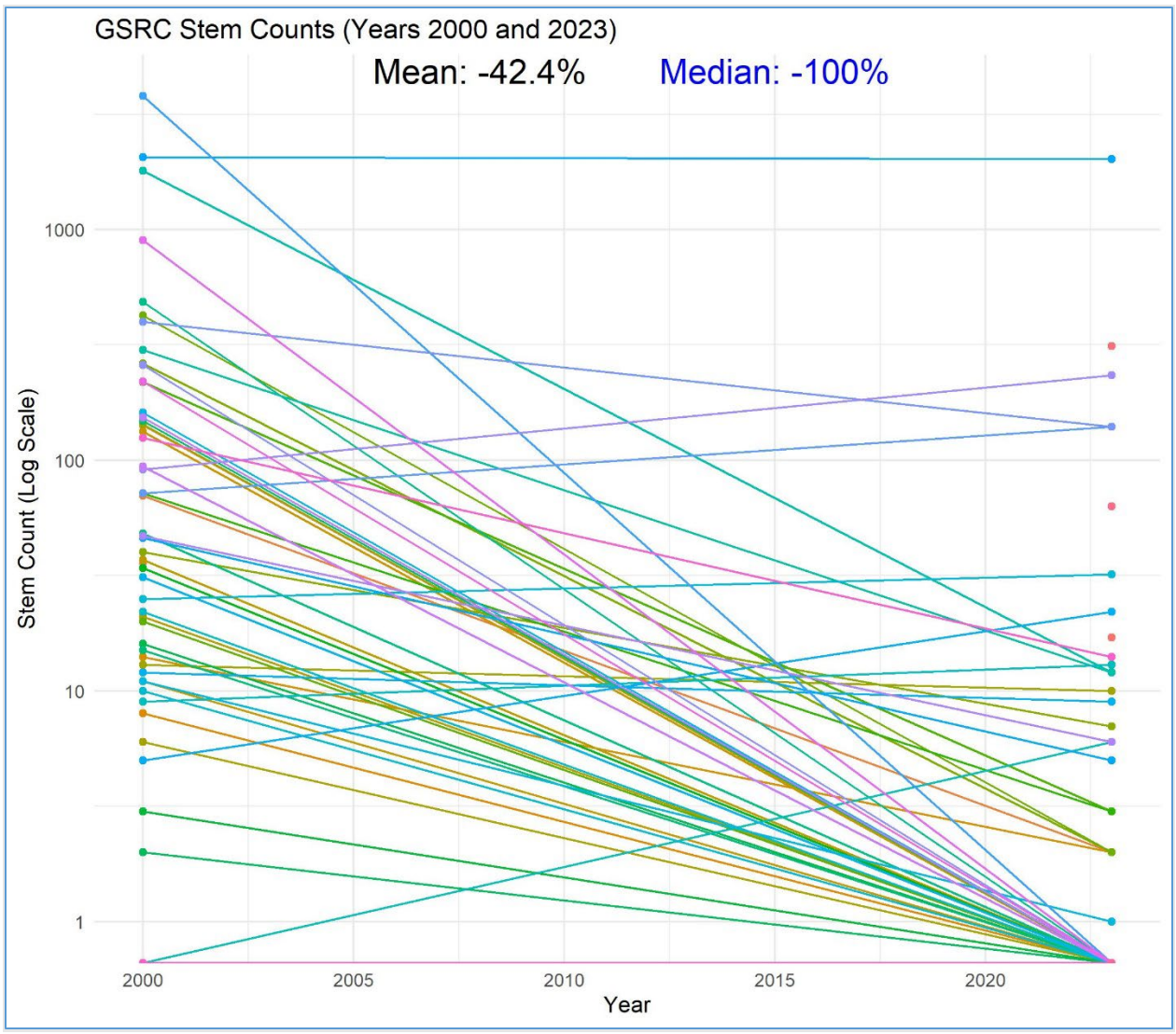


Figure 16. Plot of stem counts at 62 "GSRC" pondberry colonies between 2000 and 2023. The Y-axis has been log-transformed for ease of data visualization. Mean percent change in colony stem count between colonies measured in both 2000 and 2023 was -42.4%. Median change was 0%.

Because surveys occurred in late-summer and well into the growing season (post-flood), ERDC-EL believes colony conditions were representative of current colony stem count and health. Such a dramatic decline in colony numbers and size is concerning, though it is prudent to consider the depth and duration of floodwater inundation within the Action Area during both 2019 and 2020 before drawing any conclusions about the overall status of pondberry in the DNF. From 2020-2023, we discovered at least 27 new pondberry colonies in the DNF. Because the ERDC-EL discovered new colonies during fieldwork within limited portions of the DNF, we believe that the distribution and abundance of pondberry are higher than currently documented. Future additional and more extensive discovery surveys are highly recommended.

We summarized stem count data from 85 extant pondberry colonies assessed from 2020-2023 in the DNF to determine changes in counts from immediately post-flood through 2023 (Figures 17 and 18). Within this time frame, for colonies existing above 93.0 feet elevation, the median inter-

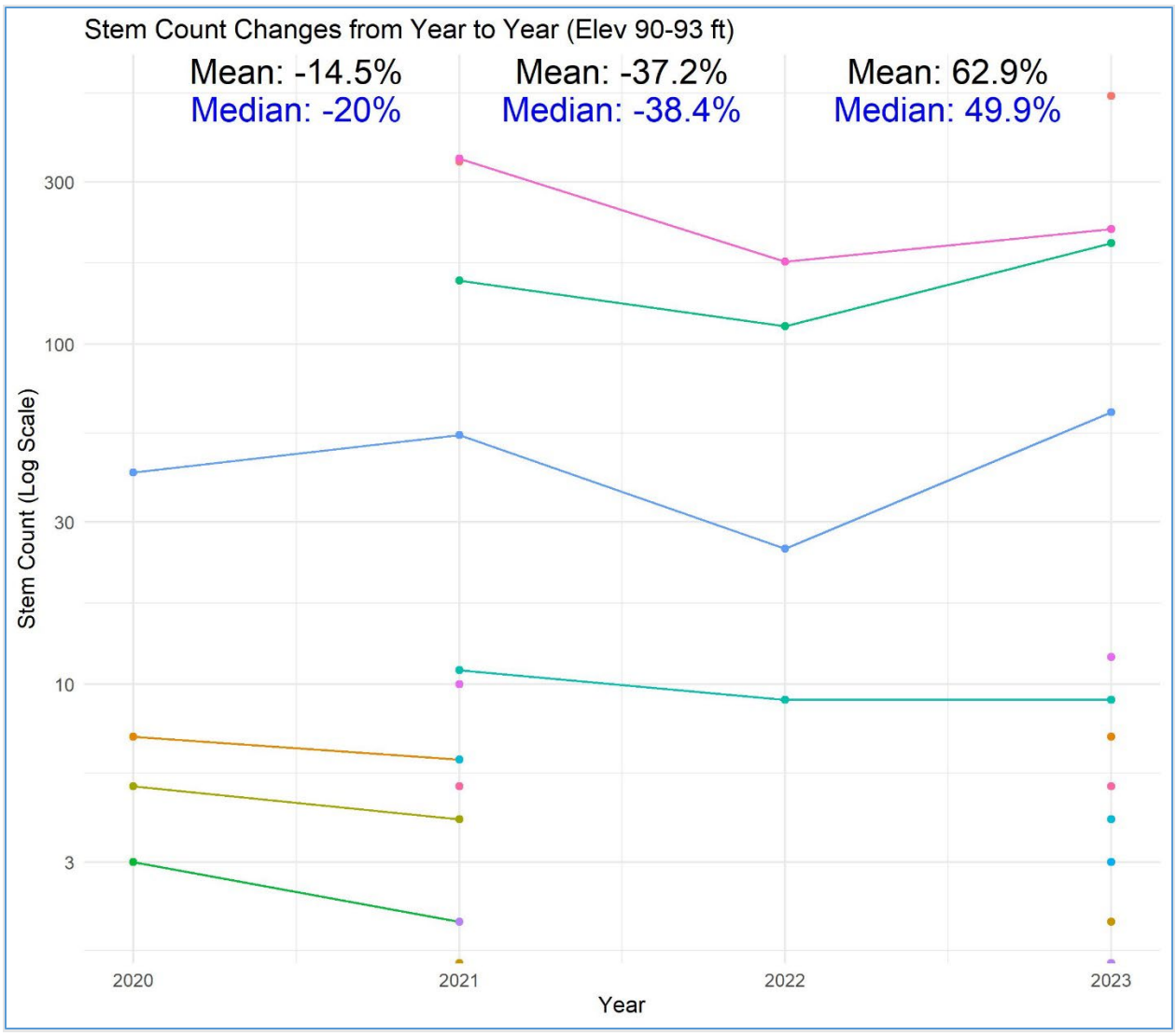


Figure 17. Plot of stem counts at 15 pondberry colonies that exist between 90.0 and 93.0 ft elevation within the DNF from 2020-2023. The y-axis been log-transformed for ease of data visualization.

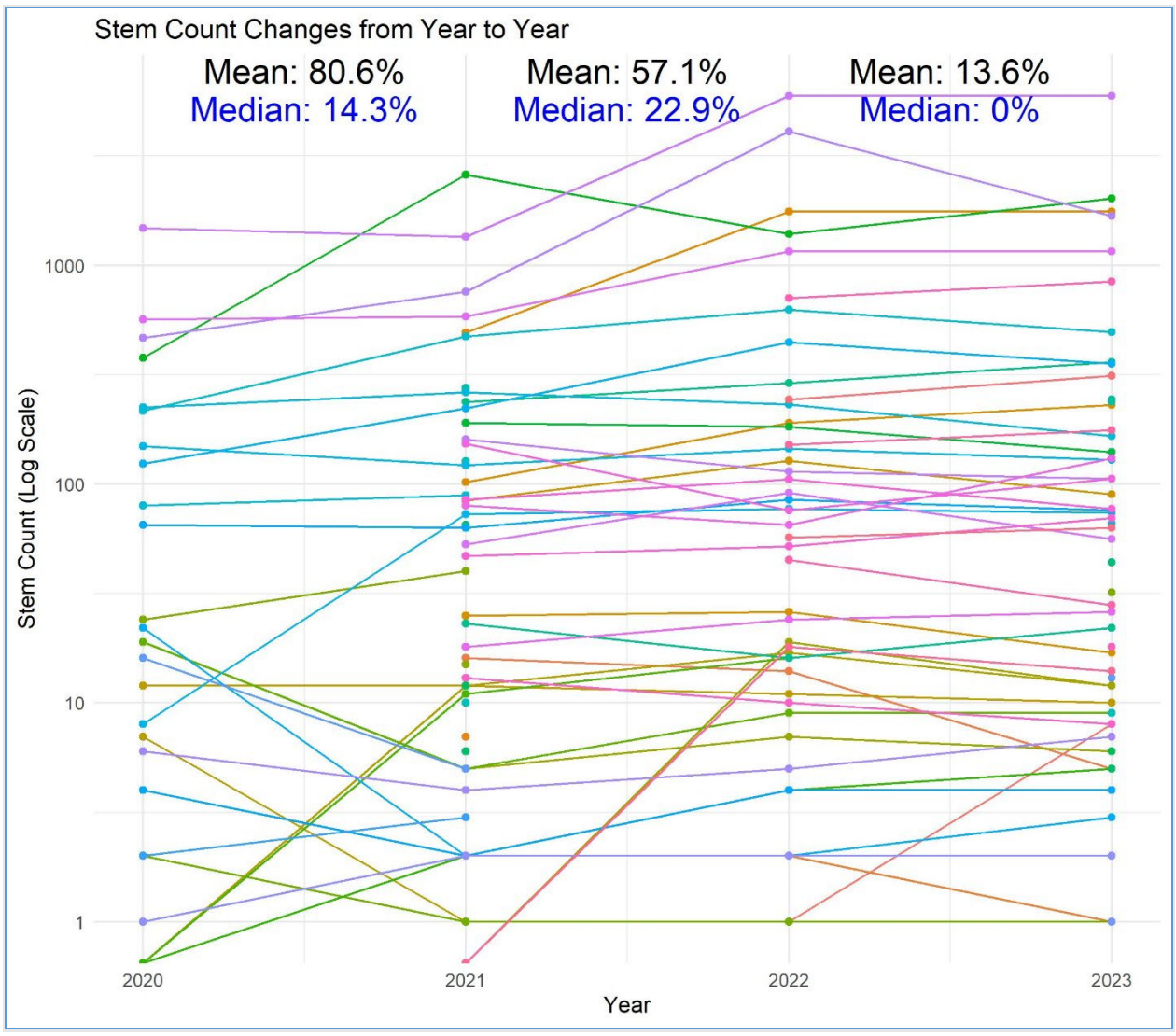


Figure 18. Plot of stem counts at 66 pondberry colonies that exist above 93.0 ft elevation within the DNF from 2020-2023. The y-axis been log-transformed for ease of data visualization. Labels indicate the mean and median change in colony stem counts between years.

annual change in stem count was +12.4% (Figure 18), suggesting that colonies were increasing in size over this time-period as they recovered from the extensively deep and long-duration floods. For colonies existing between elevations 90.0 and 93.0 ft NGVD elevation, the median interannual change in stem count was –2.83%, suggesting a relatively stable colony trajectory during this time period.

Table 8. Comparison of number of pondberry stems counted at GSRC plots during colony surveys in the Delta National Forest, 2000-2023.

		Number of Pondberry Stems							
Colony ID	**Pondberry ID**	**GSRC 2000[1]**	**GCBS 2001[2]**	**GSRC 2005[3]**	**GSRC 2010[4]**	**USACE 2020[5]**	**USACE 2021[5]**	**USACE 2022[5]**	**USACE 2023[5]**
PB039	39	2	0	2	0	- [6]	0	-	0
PB040	40	36	22	14	3	0	0	-	-
PB041	41	70	42	4	1	0	0	-	2
PB042	42	142	60	-	31	3	0	-	0
PB043	43	8	3	4	1	0	0	-	0
PB044	44	10	4	3	1	0	0	-	0
PB045	45	14	9	12	7	0	2	2	2
PB046	46	6	5	3	0	-	0	-	0
PB047	47	133	35+	-	14	0	0	-	0
PB048	48	11	4	6	0	-	0	-	0
PB049	49	37	29	19	28	-	0	-	0
PB050	50	21	21	12	6	-	0	-	0
PB051	51	6	1	6	14	-	0	-	0
PB052	52	13	15	27	32	12	12	11	10
PB053	53	143	50+	39	19	7	0	-	0
PB054	54	40	25	40	16	7	6	-	7
PB055	55	262	75	133	23	7	1	-	2
PB056	56	424	~ 100	-	15	-	0	-	2
PB057	57	20	15	-	5	-	0	-	0
PB058	58	218	60	57	5	5	4	-	3
PB059	59	72	37	45	3	3	2	-	3
PB060	60	34	12	0	0	-	0	-	-
PB061	61	3	3	0	0	0	0	-	-
PB062	62	16	7	8	1	0	0	-	-
PB063	63	2	2	13	8	0	0	-	-
PB064	64	148	73	-	13	-	0	-	-
PB065	65	15	12	-	2	0	0	-	-
PB066	66	48	16	43	12	0	0	-	-
PB067	67	485	> 200	148	33	-	0	-	-
PB068	68	-	-	-	-	-	0	-	-
PB069	69	300	> 100	113	6	0	12	17	12
PB070	70	1,800	150	565	151	9	0	19	12
PB071	71	-	-	-	-	-	5	7	6
PB072	72	9	6	97	34	-	15	-	13
PB073	73	22	27	16	0	-	0	-	0
PB074	74	10	11	11	9	-	0	-	0
PB075	75	25	24	63	33	24	40	-	32
PB076	76	11	1000's	10	7	2	1	1	1
PB077	77	161	-	43	12	0	0	-	0

PB078	78	31	-	29	8	-	0	-	0
PB079	79	12	"Few emergent stems at 39-41 to hundreds of stems at 42-43"	14	13	19	5	9	9
PB080	80	5		-	-	0	11	16	22
PB081	81	46		41	-	0	2	4	5
PB082	82	5855[8]		1993[8]	4132[8]	378[8]	2602[8]	1392[8]	2016[8]
PB083	83	Lumped into GSRC 42		Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42
PB084	84	72	25	40	-	3	2	-	0
PB085	85	656[9]	291[9]	667[9]	-	-	190[9]	183[9]	280[9]
PB086	86	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45
PB0223[7]	233	125	-	-	-	-	35	70	-
PB324[7]	324	115	-	-	-	-	-	-	-
GSRC 49[7]	NA	212	-	-	-	-	-	-	-
PB234[7]	234	-	-	-	-	-	-	7	-
PB228[7]	228	900	-	-	-	-	-	-	-
PB230[7]	230	219	***	-	-	-	-	105	-
PB087	87	91	40	-	-	-	0	-	0
PB088	88	47	150	558	236	87	154	108	234
PB089	89	153	10	130	36	-	12	-	6
PB090	90	94	300	1,280	823	-	3	-	0
GSRC 57[7]	NA	199	-	-	-	-	-	-	-
GSRC 58[7]	NA	177	-	-	-	-	-	-	-
PB248[7]	248	500	-	-	-	-	-	0	-
PB251[7]	251	37	-	-	-	-	-	0	-
PB249[7]	249	79	-	-	-	-	-	0	-
PB250[7]	250	250	-	-	-	-	-	0	-
PB332	332	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42
PB325	325	-	-	-	1	-	-	-	0
PB331	331	-	-	-	13	-	-	-	1
PB127	127	-	-	-	51	-	-	-	0
PB279	279	-	-	-	-	-	-	147	-
GSRC 70	23	-	-	-	83	-	-	26	17
PB338	338	-	-	-	243	-	-	-	12

Sources: [1]GSRC (2001); [2]Gulf Coast Biological Surveys, Inc. (2001); [3]GSRC (2005); [4]GSRC (2010); [5]USACE-ERDC (2020-2023)
[6] Dashes indicate missing data
[X] Plot falls inside of USFWS McDearman Plots 1-4 containing approximately 8,000 stems as estimated in September 2020
[7] Plots occur outside of the DNF and Action Area and were not included 2005 or 2020 assessments
[8]GSRC 42 and GSRC 43 combined in 2021 due to a physical merger of the colonies
[9]GSRC 45 and GSRC 46 combined in 2021 due to a physical merger of the colonies
It should be noted that stem counts during each year were completed using plots of varying sizes, making comparisons of stem counts among years difficult to compare.
*** This colony had 16,638 stems according to the GSRC 2005 survey

5.4.8 Spatial Metrics of Pondberry Colonies in the DNF. From 2022-2023, the ERDC-EL began quantifying the aerial sizes of select pondberry colonies in the DNF by circumnavigating colonies with a high-precision Trimble® R2 GNSS receiver. During stem counts, the perimeter of colonies was temporarily marked with colored flagging. Subsequently, an observer with the R2 unit slowly walked the marked perimeter. These data were then uploaded to ArcGIS for viewing and analyses. ERDC-EL intends to continue collecting these data in future years to measure temporal changes, not only in stem counts and colony health, but areal acreage measurements and colony shape. Pondberry perimeters for numerous colonies in and near the "McDearman" colonies illustrate some initial change between years in aerial extent (Figure 19). While colony expansion and contraction between years is apparent in Figure 19, some of those changes were actual changes in spatial stem coverage, while others reflect some minor alterations in survey protocol between years. The ERDC-EL will continue to develop a written protocol and refine this technique to provide careful consistency in all future years of this effort.

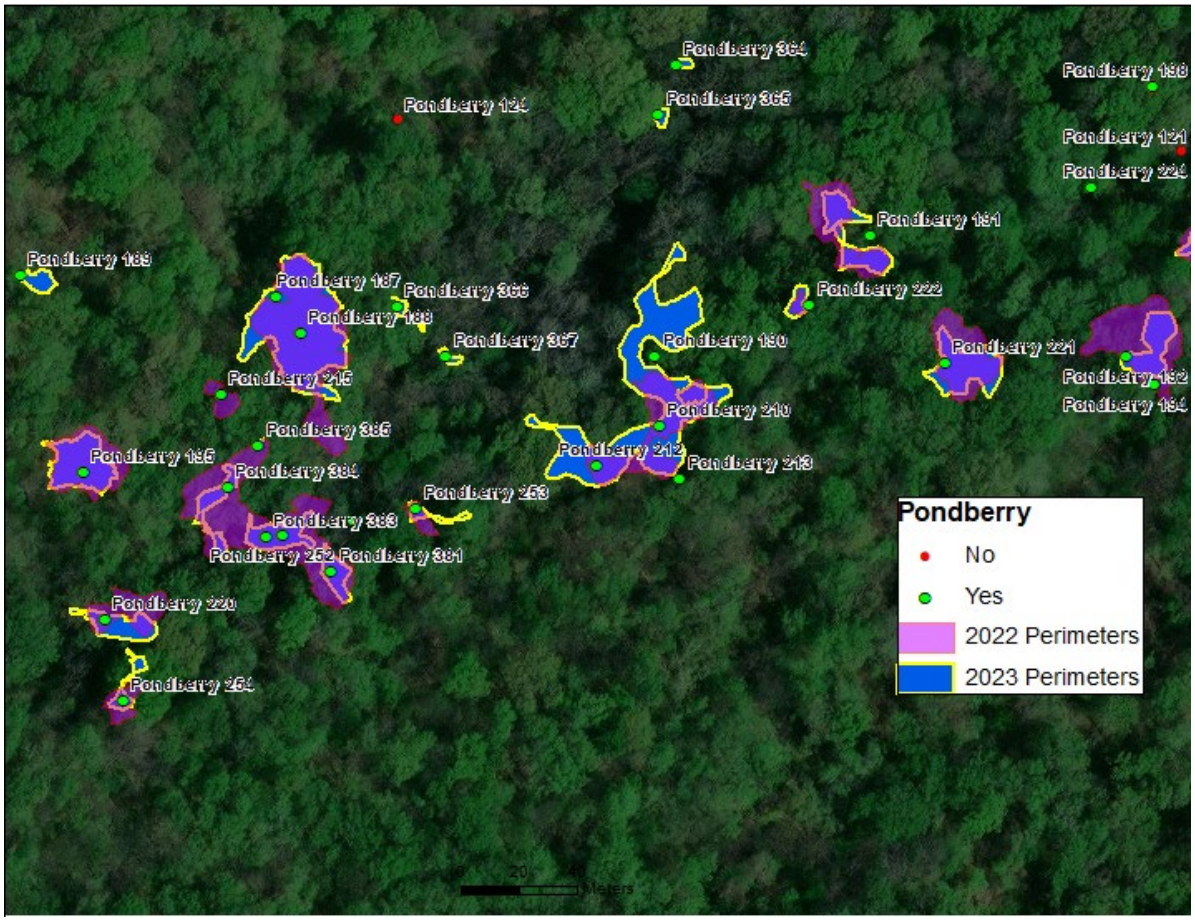


Figure 19. Perimeter surveys via high-precision Trimble R2 GNSS receiver of Pondberry colonies associated with the “McDearman” and nearby Pondberry colonies in the DNF. Colony sizes ranged from 0.01 acres (Pondberry colonies 364 and 365) to 0.37 acres (Pondberry colony 210).

Pondberry Summary

The ERDC-EL has put significant focus on identifying and addressing those pondberry colonies that occur within the "effect zone" of the YBA Water Management Plan, and we define the effect zone as the land area in the YBA encompassing all elevations between 90.0 and 93.0 ft NGVD that are most likely to be affected (and would most frequently be affected) by the Water Management Plan. In this BA, the ERDC-EL has noted there are 122 known extant pondberry colonies within the YBA (Table 9). Of those, 12 (9.8%) initially were identified as being in the effect zone using an elevation layer provided by the MVK hydrologist in 2020. Because we are uncertain what elevation bins the hydrologist used to derive elevation intervals and assign pondberry colonies to each, we assumed that all colonies in the 90 to 93 ft NGVD categories occurred in the effect zone, providing the total of 12 colonies (orange shading in Table 9). Subsequently, in July 2024, the ERDC-EL obtained a 1-m resolution USGS 3DEP DEM and overlayed that with GPS coordinates of all known extant and extinct pondberry colonies in the YBA. We were able to assign elevations to each pondberry colony in the YBA with a higher degree of precision and then summed all colonies within elevations of 90.0 to 93.0 ft NGVD, as noted in the green shading of Table 9. The elevation values extracted from the DEM raster layer are based on a single point location, generally in the center of the colony.

Stems within a colony are various distances from the centroid for which the GPS location was taken; therefore, we calculated the average distance to the most distant portion of the colony across 52 of our extant pondberry colonies in the DNF for which perimeter polygons were obtained using a Trimble R2 unit. The mean distance from centroid to the most distant point of colony perimeter was 14.1 m; therefore, we created a 15-m buffer around elevation 93.0 NGVD to include any additional pondberry colony centroids that occurred in this zone. As noted previously, areas that were depressions in the landscape surrounded by higher elevations were not included as these areas might not have hydrologic connectivity until backwater events reached the higher elevation (see Figure 11 at Delta Depths colonies as example). This resulted in an increase from 12 to 22 extant pondberry colonies in the current "effect zone" (Table 9), a net increase of 10 colonies. Of the 22 colonies, 16 occur in the Spanish Fort population, which is an historical oxbow feature with significant ridge and swale topography along the eastern edge of the Delta National Forest (Figure 10). The Spanish Fort population occurs within an area of approximately 73 ha (with one outlier approximately 1.5 km away from the main cluster of colonies).

There is a single colony below elevation 90.0 ft NGVD (noted with a light blue square in Figure 21) that had 234 stems in 2023. This colony had previously been classified to be within the 91 ft elevation zone and remains within the 1-year flood frequency. In addition to the 22 extant colonies below (or within 15 m of) elevation 93.0 ft, three colonies had previous surveys after 2020 during which stems were observed; however, during 2023 surveys no stems were found. Two colonies below elevation 93.0 are thought to be extirpated according to stem counts before 2023. These sites were not visited in 2023 to confirm; therefore, their status remains "unknown" along with the other three colonies mentioned to be absent in 2023 (Figure 21; Table 10). Six of 22 extant colonies had colony centroid elevations above 93.0 ft NGVD but were still included within the 90.0 to 93.0 ft "effect zone" as they had elevations within their 15-m buffer at or below 93.0 NGVD.

Table 9. Number of pondberry colonies at each elevation (87 to 98 feet NGVD) for 301 current and historical colonies in the Action Area, Yazoo Backwater Area, Mississippi based on data collected through September 2023.

	Original Analysis[1]		New Analysis[2]		
Elevation (ft. NGVD)	**Total # Extant Pondberry Colonies**	**Total # of Extirpated Pondberry Colonies**	**Elevation (ft. NGVD)**	**Total # Extant Pondberry Colonies**	**Total # of Extirpated Pondberry Colonies**
86	0	1	86.01 - 87.0	0	1
87	0	1	87.01 - 88.0	0	4
88	0	0	88.01 - 89.0	0	4
89	0	9	89.01 - 90.0	1[3]	11
90	1	8	90.01 - 91.0	2	6
91	2	7	91.01 - 92.0	4	11
92	3	7	92.01 - 93.0	9	12
93	6	15	93.01 - 94.0	58[4]	28
94	10	25	94.01 - 95.0	31	21
95	79	21	95.01 - 96.0	14	31
96	17	36	96.01 - 97.0	2	28
97	3	29	97.01 - 98.0	1	22
98	1	21	98.10 - 99.0	0	0
Total	122	179		122	179

[1] Original analysis was conducted with 2020 elevation data obtained from CEMVK hydrologist

[2] New analysis was conducted with the 3DEP 1-m resolution DEM raster obtained from the USGS.

[3] Extant pondberry colony previously above elevation 90 in the original analysis. The colony falls within the 90.0-93.0 elevation zone according to the 15-m buffer described in section “Pondberry Summary’.

[4] Six of the 58 colonies within this elevation range occur within the 15-m buffer of elevation 93.0 and are included as part of the 22 extant colonies within the 90.0-93.0 elevation zone.

Table 10. Pondberry colonies in the DNF within the 90.0 to 93.0 ft NGVD elevation zone that include a 15-m buffer and that are extant or have a status of "unknown." The determination of "Likely to Adversely Affect" by USACE applies to these 27 pondberry colonies. DNS = Did Not Survey.

Pondberry ID	Status	Pondberry Present in 2023	Pondberry Present in Past (2020-2023)	Stem Count 2023	Stem Count Category	Flood Frequency Base (2023)	Flood Frequency Alt (2023)	Flood Frequency Base (2020)	Elevation (2020)	DEM 1-m Range (2024)	Elevation (ft) 1-m DEM 2024
027	Extant	Yes	yes	537	Very Large	2	2	2	92	91	91.26
041	Extant	Yes	yes	2	Remnant	2	2	2	92	91	91.88
052	Extant	Yes	yes	10	Small	5	5	5	94	93	93.20
054	Extant	Yes	yes	7	Small	5	5	5	93	91	91.98
055	Extant	Yes	yes	2	Remnant	5	10	5	94	94	94.69
056	Extant	Yes	yes	2	Remnant	5	5	5	93	92	92.24
058	Extant	Yes	yes	3	Remnant	5	5	5	94	92	92.68
059	Extant	Yes	yes	3	Remnant	2	2	5	92	92	92.07
084	Unknown	No	yes	0	Remnant	5	10	10	94	92	92.78
088	Extant	Yes	yes	234	Moderately Large	1	1	1	91	89	89.65
090	Unknown	No	yes	0	Remnant	1	1	1	89	88	88.21
119	Extant	Yes	yes	198	Moderately Large	1	1	2	94	92	92.64
130	Extant	Yes	yes	9	Small	1	1	2	93	92	92.31
131	Extant	Yes	yes	4	Remnant	2	2	2	91	90	90.23
151	Extant	Yes	yes	3	Remnant	1	1	2	90	90	90.68
200	Extant	Yes	yes	63	Moderately Large	2	2	5	93	92	92.50
202	Unknown	No	yes	0	Remnant	5	5	5	94	92	92.01
203	Extant	Yes	yes	7	Small	10	10	10	95	93	93.75
204	Extant	Yes	yes	13	Small	5	5	5	94	94	94.03
205	Extant	Yes	yes	1	Remnant	10	10	10	95	93	93.84
207	Extant	Yes	yes	12	Small	5	5	10	94	91	91.69
216	Extant	Yes	yes	218	Moderately Large	1	1	1	93	92	92.25
223	Extant	Yes	yes	5	Remnant	5	5	5	94	92	92.71
226	Unknown	No	unknown	0	Unknown	1	1	1	89	87	87.72
257	Unknown	DNS	unknown	0	No Pondberry	1	1	1	89	88	88.04
338	Extant	Yes	yes	12	Small	10	10	10	95	94	94.33
375	Extant	Yes	yes	72	Moderately Large	5	5	5	93	92	92.71

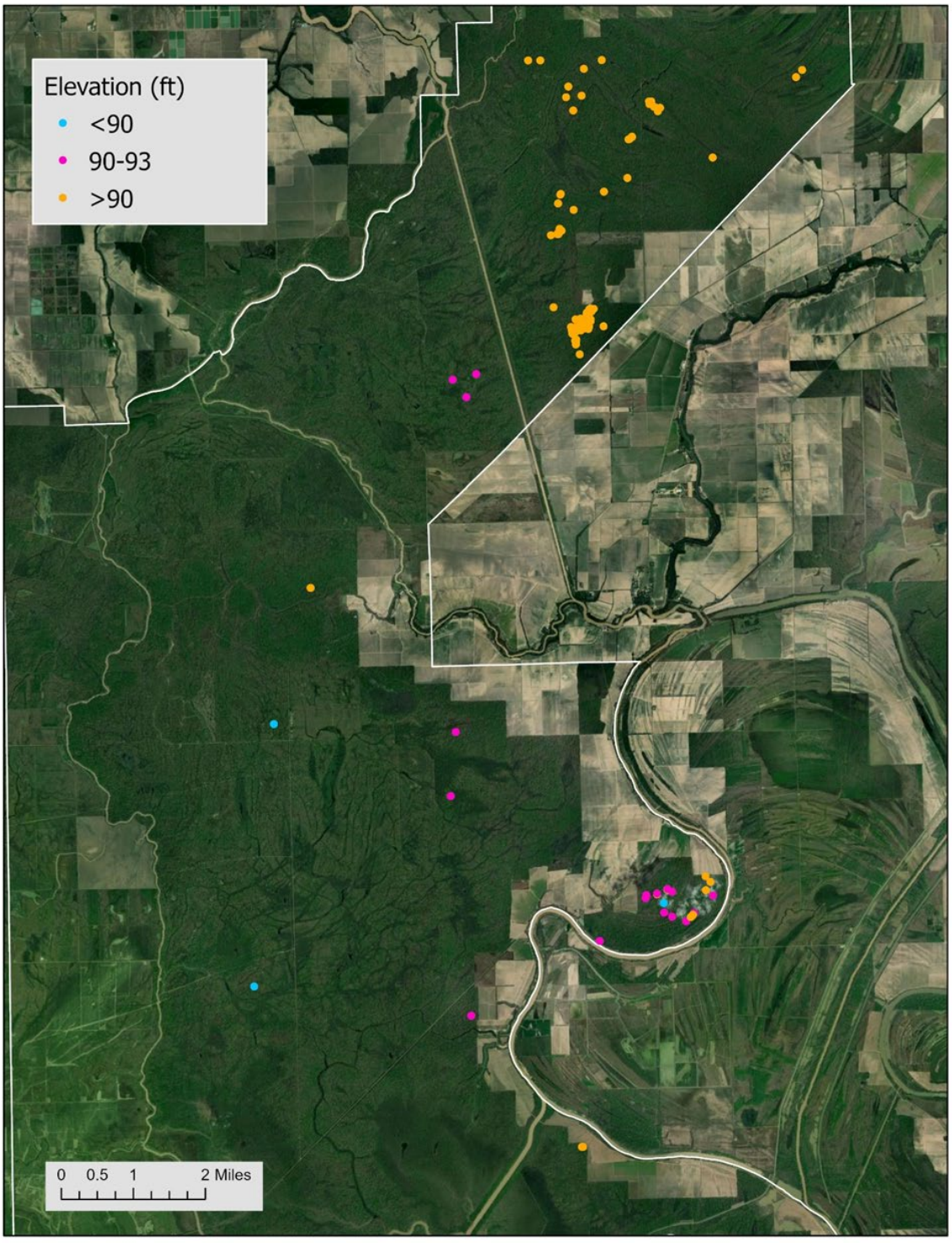


Figure 20. Known extant pondberry colonies as of 2021-2023. Of the three <90 ft NGVD colonies (Pondberry 88, 90, and 226) that were extant during this period, Pondberry 89 and 226 are now likely extirpated, as no stems were detected during the most recent survey (2023).

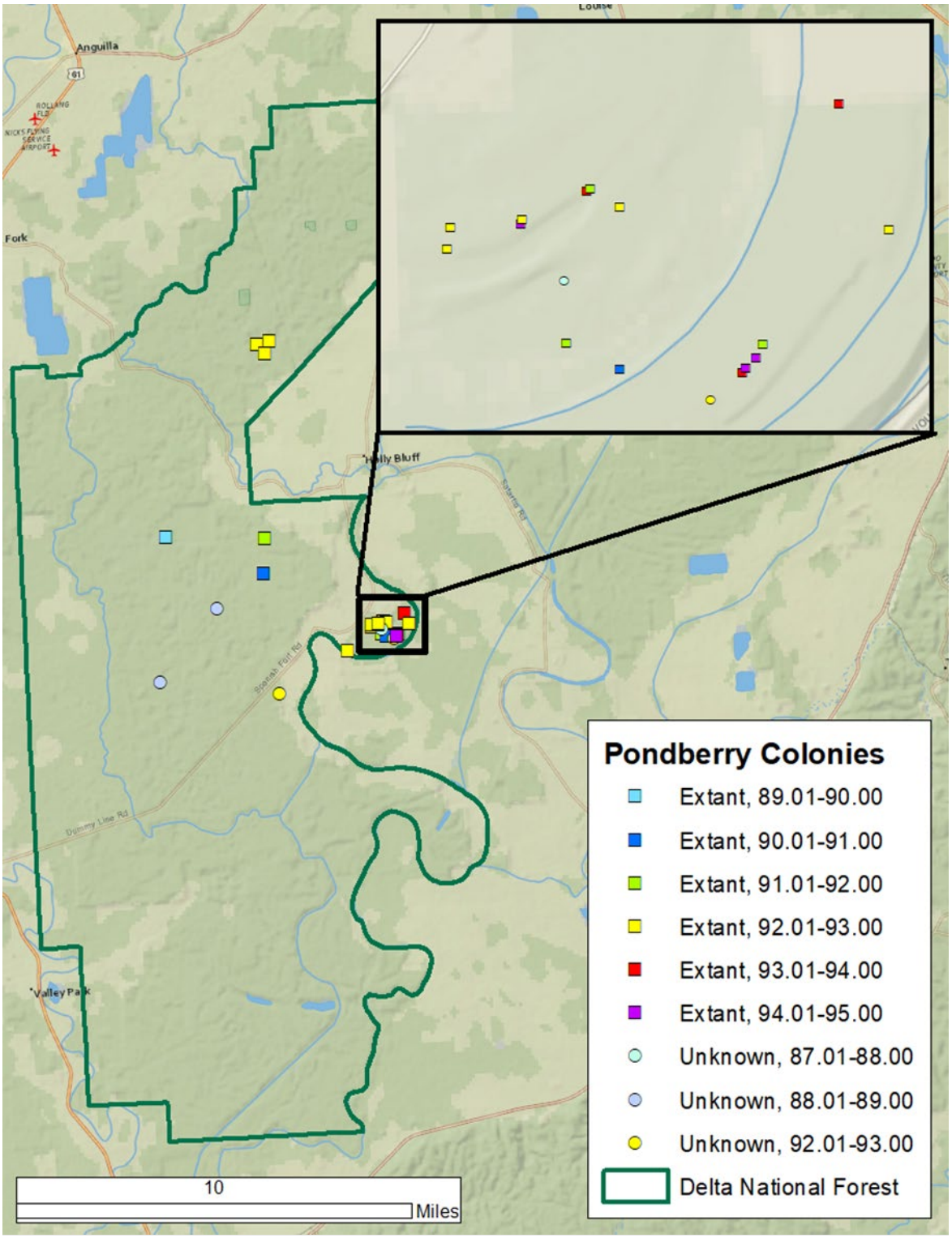


Figure 21. Map of the 27 pondberry colonies with the Delta National Forest that either occur at or below elevation 93 or that are within 15 meters of the 90.0-93.0 elevation zone.

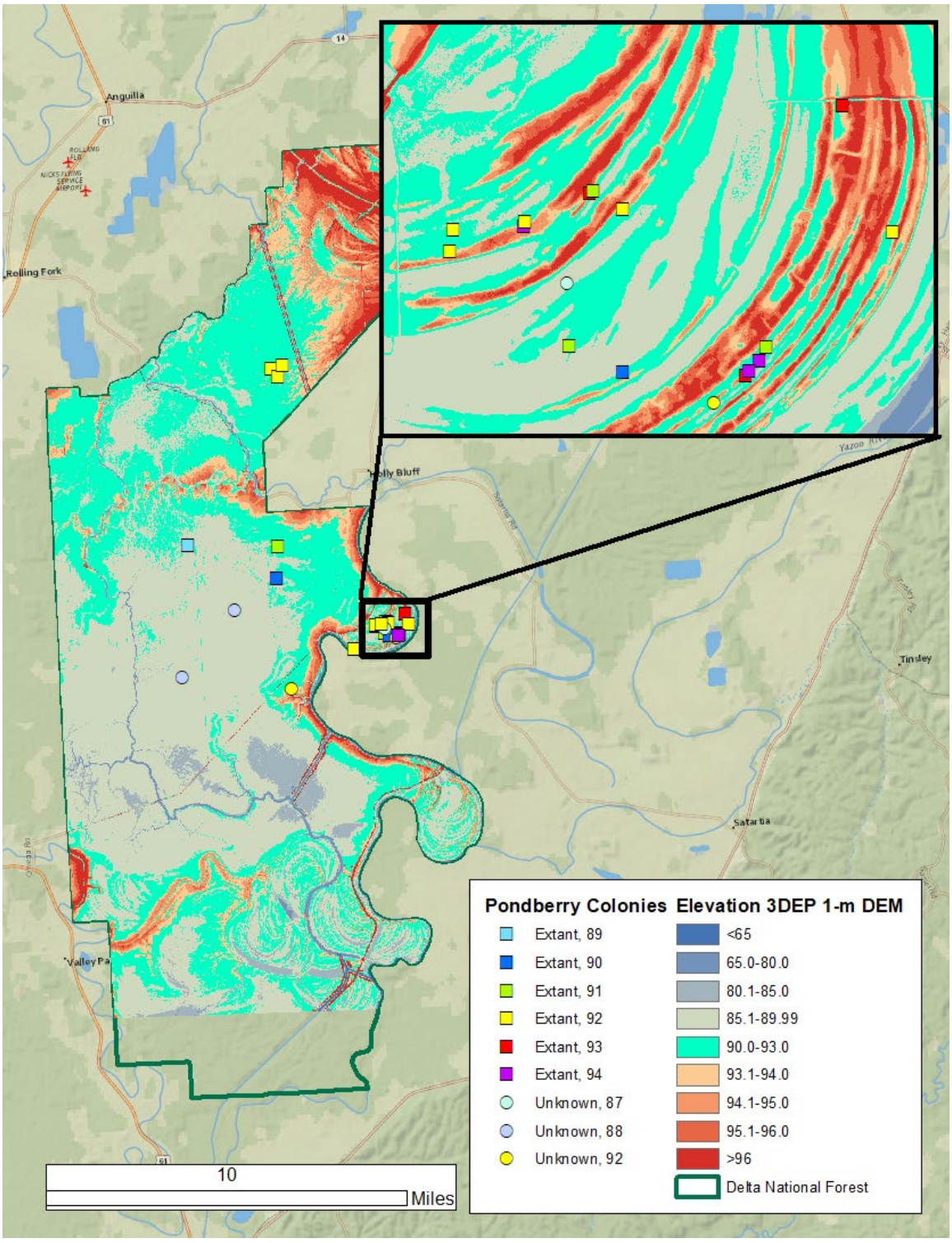


Figure 22. Map of the 27 pondberry colonies with the Delta National Forest that either occur at or below elevation 93 or that are within 15 meters of the 90.0-93.0 elevation zone.

5.4.9. Assessment of Pondberry Colonies by Elevation

Pondberry Colonies at or below the elevation 93 ft NGVD zone

Groundwater Monitoring Wells. To initiate a better understanding of local hydrologic influences on pondberry colonies, the ERDC-EL has analyzed groundwater monitoring well data (primarily fall 2021 through summer 2024) for eight colonies in the YBA at or below elevation 93.0 ft NGVD (Appendix A, Figures A1-A8), and for comparison, three colonies in the YBA from 93.5 to 93.6 ft NGVD (Appendix B; Figures B1-B3), and three colonies at much higher elevations from 155.0 ft to 155.1 ft (north of the YBA in the Hester Tract) in Shelby County (Appendix C; Figures C1-C3). During this period, many colonies in the DNF at or below elevation 93.0 ft NGVD showed cyclic annual spring surface water inundation (e.g., Figures A1, A2, A5, and A8). All other colonies at or below 93.1 ft NGVD, except for Pondberry 027 (for which only one season of data was obtained), either show surface water inundation, or an increase in groundwater saturation within the root zone (typically up to ~8-inch depth; Devall 2013), also in a cyclic annual pattern (Figures A2 – A8). During this same period, the water level at the Steele Bayou gauge (Figure 23) never exceeded 90 ft NGVD suggesting (a) that backwater events, which did occur in 2022, 2023, and 2024 when water elevation 80 ft NGVD was surpassed at Steele Bayou Landside WCS and was less than the Riverside elevation, never reached elevations in the YBA where pondberry colonies occur, and (b) had the pumps been available for operation during this timeframe they would not have been turned on. Therefore, the hydrographs in each of these figures represent local hydrologic events at or near each pondberry colony. We fully recognize that, in the future, backwater events are almost certain to occur within this elevation zone, and hydroperiod and depth of inundation would be altered by pump operation under the proposed Water Management Plan.

It is also compelling to note that three colonies above elevation 93 ft NGVD (Pondberry 23, 214, and 217 all between 93.0 and 93.9 ft NGVD; Figures B1-B3), and three colonies in the Hester Tract (Pondberry 244, 316, and 318; Figures C1-C3) at approximately 155 ft NGVD, each with a proximal groundwater monitoring well, all showed hydroperiods (e.g., cyclic annual surface water inundation) similar to those colonies below elevation 93 ft NGVD. While we do need additional data on potential riverine overbank (or distributary) flooding near these colonies outside of the YBA, these data provide an even stronger inference for the role of local hydrology (we assume primarily precipitation events) on pondberry colonies at all elevations where they occur in Mississippi. Furthermore, the Hester Tract pondberry colonies (as well as a colony in Dahomey National Wildlife Refuge and six private land colonies north of the YBA), which are not subjected to backwater flooding, are comprised of statistically significant larger-diameter and taller stems compared with the DNF colonies in the YBA (Figure 24). Thus, while it is possible that the proposed Water Management Plan may adversely affect colonies within the effect zone in some years, it is also possible that reducing the frequency of deep and long-duration backwater events could create hydrological conditions that are more similar to what the large, robust colonies north of the YBA experience.

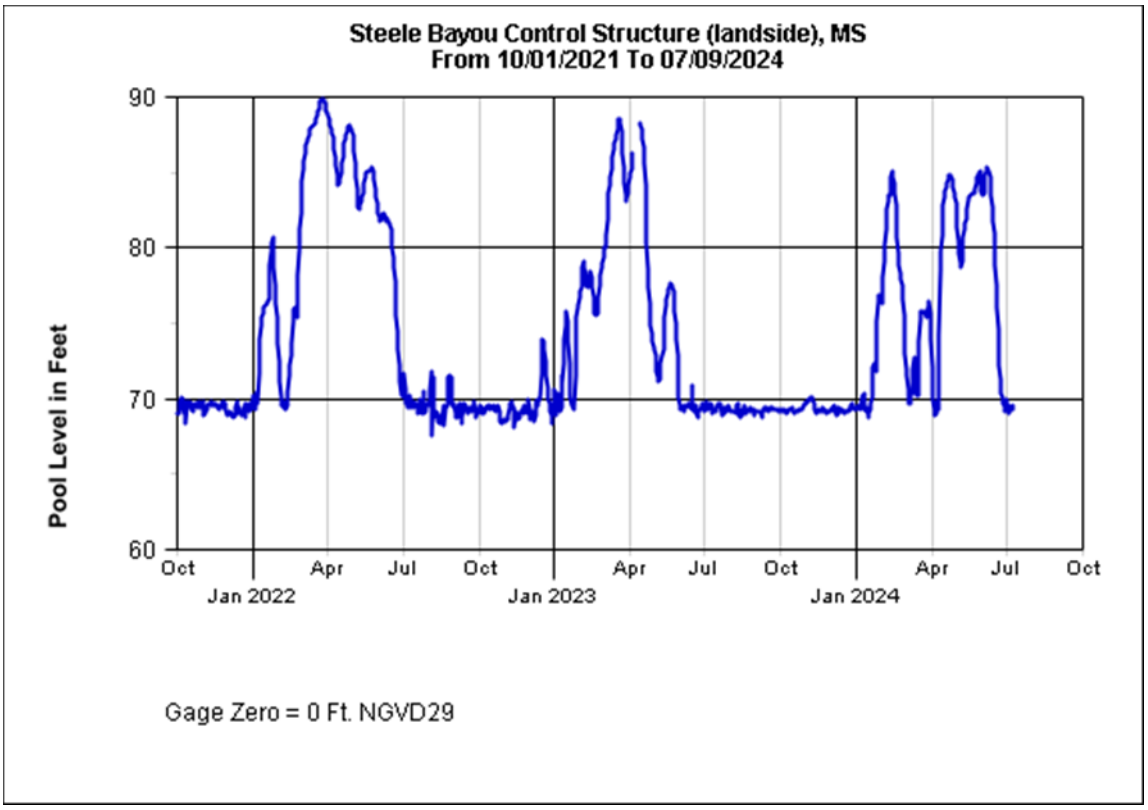


Figure 23. Steele Bayou Control Structure (landside) pool level since Oct 2021. Pumps would not have operated from 1 Oct 2021 through 9 July 2024 and thus the inundation periods shown from the groundwater well data in Appendices A and B would not have been affected by pump operations under the proposed alternatives. Chart generated at

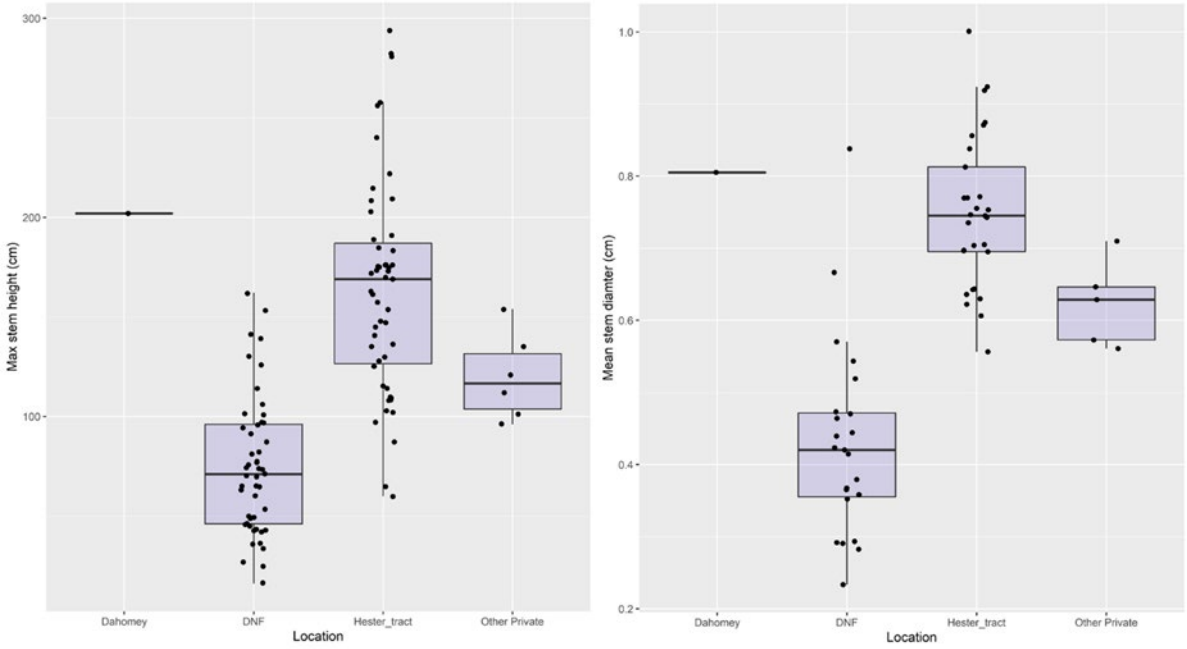


Figure 24. Maximum stem height and mean stem diameter per pondberry colony in the Dahomey National Wildlife Refuge, Delta National Forest (DNF), and private lands in the Mississippi Delta, measured in 2022. Only the DNF colonies are within the YBA and (especially DNF colonies up to 93.0 ft) subjected to periodic backwater flooding.

Wildlife Trail Cameras. We also investigated extensive wildlife trail camera imagery available from a collection of 19 Reconyx trail cameras placed at or near pondberry colonies within the DNF in 2020. These cameras were programmed to capture images hourly (24-hr cycle), as well as during the detection of movement. For many of our cameras, images clearly show hourly and daily surface water inundation (Figure 25). Figure 26 provides an example, from September 2021 to March 2023, of local precipitation (dashed purple), river gauge data from Steele Bayou landside (blue) and Holly Bluff (green), and groundwater monitoring well data (red). The light gray polygon overlays are dates when an example trail camera showed surface water at a pondberry colony (Figure 26). These data are intended to corroborate those data collected at groundwater monitoring wells.

Extinction Rates. Only one known extant colony occurs below elevation 90, and that colony had 234 stems recorded during 2023 surveys. We also note a disproportional number of colonies that now are extinct below elevation 90.0 ft NGVD (95.2%), and at or above elevation 96.01 ft NGVD (94.3%) compared with colonies between elevations 90.01 – 93.0 (65.9%) and 93.01 – 96.0 (60.4%) (Table 11). We hypothesize that the high rate of colony extinction at and below elevation 90.0 ft NGVD (21 of 22 colonies, or 95.2%, have gone extinct) has been influenced by the frequency, depth, and duration of historical inundation (Table 11).

Table 11. Elevation range and extinction rates for pondberry colonies in the Delta National Forest, 2001-2023.		
Elevation (ft. NGVD)	**Percent Extinct**	**Total # of Colonies**
86.01 - 90.0	95.2%	21
90.01 - 93.0	65.9%	44
93.01 - 96.0	60.4%	134
96.01 - 99.0	94.3%	53

Figure 25. Example of surface water inundation on 23 March 2022 at a pondberry colony in the DNF. This photo is from Cam_11 at PB217 (93.38 ft NGVD). The surface inundation in this shallow depression was not caused by backwater flooding, as the Steele Bayou landside pool level on this date was 89.67 ft NGVD and had not surpassed 93.0 ft since May 2020.

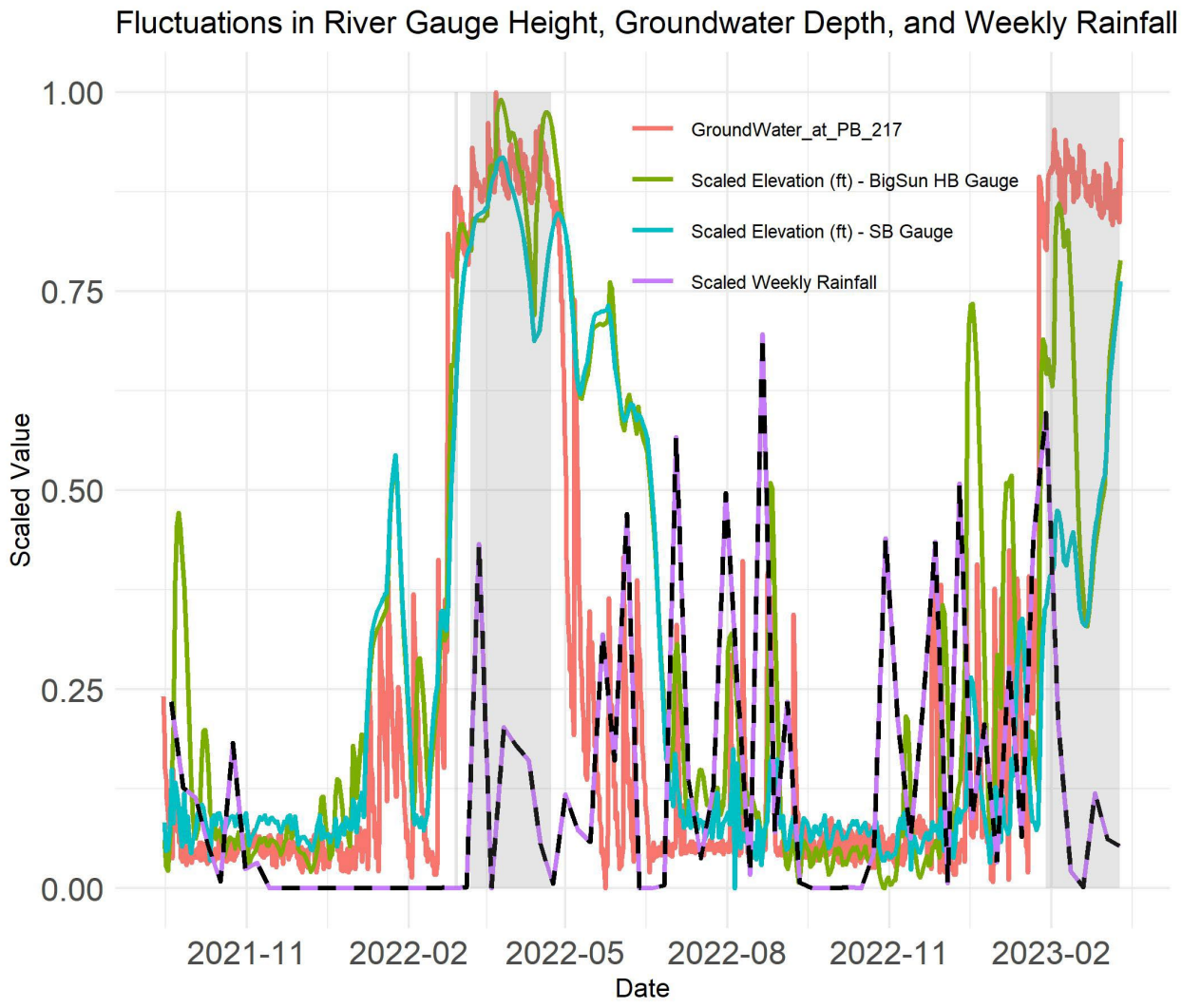


Figure 26. River gauge, groundwater monitoring well, and rainfall data overlayed with dates a single wildlife trail camera imagery showed surface water inundation at pondberry colony PB217 (93.38 m NGVD). Gray rectangles indicate the appearance of inundation on trail camera imagery (Cam_11). River gauges are Big Sunflower River at Holly Bluff and Steel Bayou landside gauge. Precipitation was measured at Holly Bluff.

We believe a "Likely to Adversely Affect" determination for the 22 known extant colonies within the elevation 90.0 - 93.0 ft NGVD effect zone which includes the 15-m buffer is appropriate, based on potential unknown or adverse effects, which may include the following:

1. When SBWCS is closed, and water levels reach an elevation between 90 and 93 ft NGVD, the effects on pondberry colonies may be related to inundation depth, and the duration that flood waters remain on colonies. Our data suggest that post-2019 and post-2020 flood response by pondberry included reductions in stem counts, stem diameters, and in some cases, colony extinction. However, it should be noted that much of those effects are hypotheses given the lack of colony data between 2010 and the ERDC-EL assessments initiated in 2020. For a variety of reasons detailed in this

BA, we cannot conclusively attribute 2019 and 2020 flooding effects to status of pondberry in the YBA. We believe that continued extensive colony monitoring is necessary, particularly as flood pulses occur from the proposed Water Management Plan between 90 and 93 ft NGVD.

2. During any future backwater events under the proposed Water Management Plan, there is significant uncertainty regarding hydroperiod and effects on pondberry colonies within the 90 to 93 ft NGVD effect zone. For example, during the non-crop season, the Plan specifies that the pumps will begin operating once water levels reach 93 ft NGVD (or possibly sooner if headwater inflows are projected to lead to an exceedance of 93 ft NGVD) with the goal of allowing water to touch elevation 93 ft NGVD and then pumping water levels back down to elevation 90 ft NGVD. If water level is predicted to not go above 92.5 ft NGVD (and thus, not triggering activation of the pumps) then water could potentially remain at some level within the effect zone until the crop season or the SBWCS is opened. Thus, should backwater events occur, and water levels do not reach elevation 93 ft NGVD, that water feasibly could remain on some pondberry colonies for extended periods, at least until the SBWCS is reopened, or the crop season date begins. It should be noted here that much of this potential and unknown hydroperiod, during the non-crop season, falls mostly outside of the pondberry growing season. Conversely, during the crop season (beginning in mid-March and ending in mid-October), the proposed Water Management Plan specifies that water be pumped from the YBA when the SBWCS is closed and backwater events occur, such that water elevations remain at or below 90 ft NGVD. Thus, future backwater events that occur under the proposed Water Management Plan during the crop season, which is also the pondberry growing season, likely would result in a reduction in potential inundation events.
3. Altered hydroperiods potentially provide conditions for vines to either overcome or outcompete pondberry colonies, leading to potentially detrimental effects on colony persistence. *Smilax* spp. and *Vitis* spp. have the greatest potential as strong competitors to pondberry. Recent ERDC-EL surveys in the DNF noted many colonies with dense trumpet creeper (*Campsis radicans*) and peppervine (*Ampelopsis* spp.) encroachment. Additionally, Dwarf Palmetto (*Sabal minor*) forms dense stands, particularly in the northern third of the DNF, that appear to have either overcome some pondberry colonies, or have prohibited pondberry colony areal expansion. Dwarf palmetto may benefit (i.e., expand its distribution and abundance) with less frequent inundation.

Pondberry Colonies above elevation 93’

Of the 122 extant pondberry colonies in the YBA, 106 colony centroids (86.9%) occur above elevation 93.0 NGVD. We believe that the proposed Water Management Plan will have no (or very insignificant) negative impacts or influence on pondberry colonies above elevation 93.0 NGVD. To better understand the potential changes in hydrology to colonies with project (Alternative 2) above elevation 93.0 NGVD, we investigated the number of colonies that occur in each flood frequency (1, 2, 5, 10, 20, 50, and 100-year floodplains) (Figure 27) for both the

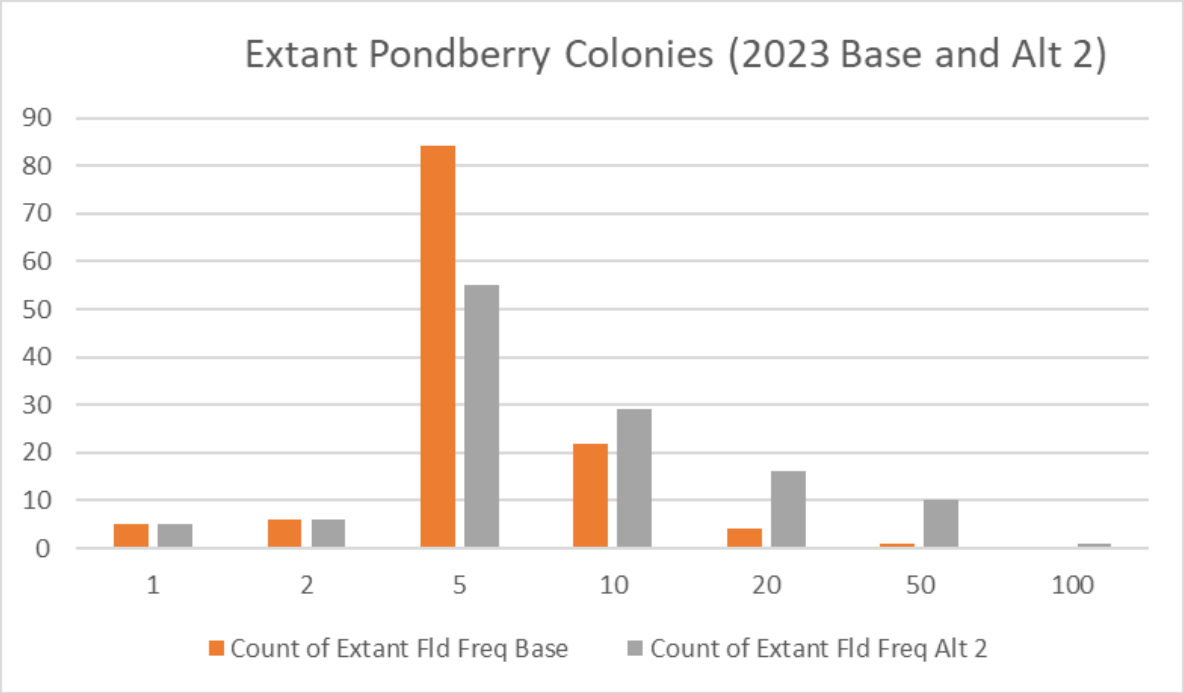


Figure 27. Graphical comparison between extant pondberry colonies under the No-Action and Action Alternative 2 condition according to each flood frequency within the DNF, Mississippi as of September 2023.

base (without project), and then for Alternative 2. As expected, there is a noticeable shift between Base and Alternative to less frequent flooding for 29 colonies (out of the 5-year flood frequency) and 53 colonies at the 5-year frequency and greater (Figure 27). However, the significance of this shift needs to also consider the following:

Because historic backwater levels infrequently have exceeded elevation 93.0 ft NGVD at the SBWCS during the 43-year POR (7 years [1979, 1983, 1997, 2009, 2018, 2019, and 2020]), it is not likely that pumping operations will have a significant influence on inundation of colonies above elevation 93.0 ft NGVD except in years with significant and extensive backwater events. Should hydrologic inflows from rivers and tributaries contribute and maintain water at or above elevation 93.0 ft well into the growing season (as happened in 2019 and 2020), pondberry colonies could experience significant stress. This stress was noted during pondberry colony assessments post-2020 after pondberry colonies were subjected to deep and long-duration flooding with turbid water. In the future, if flooding events occur that are similar in scale to the historic 2019 and 2020 floods, we would expect the pumps to continue lowering water levels and alleviate persistent floodwater effects. Furthermore, there could be net positive effects of pumping during extreme flooding events, if floodwaters reach colonies above elevation 93 NGVD, but with subsequent and immediate pumping to reduce the depth and duration of flooding on these colonies as well as those below 93 ft. Between 1983 and 2018, a 35-year period, the gauge at the SBWCS never exceeded elevation 95.0 ft, and during the entire 43-year POR, elevation 95.0 NGVD was surpassed in just 5 years (1979, 1983, 2018, 2019, and 2020, with max elevation 98.62 ft in 2019). Engineering Appendix A, Figure 2-112 outlines when the SBWCS would have opened and closed during the 43-year POR along with associated pumping

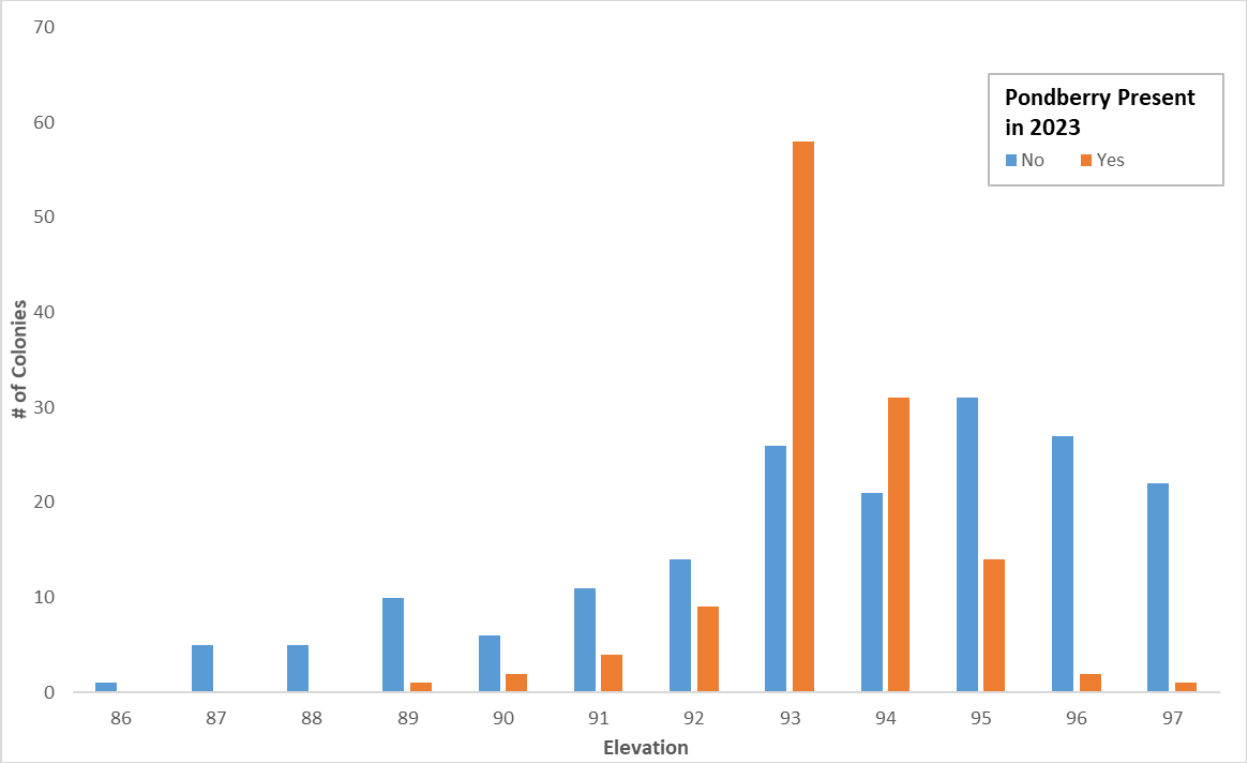


Figure 28. Graphical comparison between extant and extirpated pondberry colonies, by elevation, within the DNF, Mississippi as of September 2023. Elevation ranges associated with values on X-axis are consistent with the example 93 = 93.01-94.00 ft.

dates during that period. In total, only 5.4% of the time would the pumps have been in operation with Alternative 2 over the 43-year POR (and only 3.7% from 1978 to 2018). Based on this historical analysis, with >85% of all known extant colonies above elevation 93.0 NGVD, we suggest that the overwhelming contributor to annual pondberry colony hydrology above elevation 93.0' has been (and will continue to be under the proposed Water Management Plan) local hydrologic events. In years in which backwater flooding >93.0 ft might possibly occur, even if pumps were to reduce the extent and duration of backwater flooding, it is also likely that an above-average combination of local precipitation and headwater flooding would also exist at pondberry colonies in the YBA.

Conclusion

Because of the potential for unknown impacts due to changes in hydrology in some future years and corresponding changes in competing vegetation and other factors on pondberry colonies between the 90.0 to 93.0 ft NGVD flood zone, we conclude that the YBA Water Management Plan is Likely to Adversely Affect the 27 pondberry colonies (22 extant, 5 unknown status) in this elevation "effect zone." For the remaining 100 (82%) extant pondberry colonies above elevation 93.0 NGVD, we conclude that the YBA Water Management Plan is Not Likely to Adversely Affect these colonies. While the proposed Yazoo Pumps Project may adversely affect the 22 extant colonies and the 5 colonies of unknown status within the 90.0 to 93.0 ft elevation zone, these 22 extant colonies represent only 18% of known extant colonies (containing

approximately 10.4% of all pondberry stems) in the YBA. Furthermore, in years with extreme and prolonged flooding during the growing season, it is possible that these 22 extant (and other at higher elevation) colonies could benefit from the pumps and this could be scientifically evaluated if the pumps are implemented and future monitoring efforts are funded for continuation.

The infrequency of backwater events, and the emerging information on local hydrographs associated with individual pondberry colonies, provide increasing evidence for the importance and role of local precipitation as a leading driver in maintaining suitable growing conditions for pondberry in the Action Area. We suggest that, within the YBA, and especially at higher elevations (i.e., above ~ elevation 95 NGVD), encroachment of palmetto into pondberry colonies, the apparent increase in wild hogs resulting in significant damage (and likely, extirpation) to many colonies, and the potential for laurel wilt disease to impact pondberry colonies in the future (at any elevation), are likely to represent more significant single and/or interacting threats and stressors to persistence of pondberry colonies than the proposed changes in hydrology in the YBA from operation of a pump station given the proposed alternatives. We reiterate the need for continued frequent monitoring of all pondberry colonies in the YBA, as well as those on private lands outside of the YBA, to monitor colony and population status, and to assess the relative impacts of identified threats. The goal should be to continue building a robust data set that, when paired with continued extensive collection of groundwater monitoring well data, will provide significant opportunities for hypotheses testing relative to the effects of annual hydrologic changes over time on pondberry colony health and persistence in the YBA.

6 Avoidance, Minimization, and Conservation Measures

The primary mitigation associated with the overall proposed Water Management Plan includes the acquisition and reforestation/conservation of agricultural lands through perpetual easements from willing sellers. Because there are no known extant pondberry colonies at or below 89.0 ft. NGVD in the Action Area, any acquisition of lands as mitigation for the preferred alternative under the Water Management Plan that occur below 89.0 ft. NGVD would have little to no value for potential future pondberry colonization. Mitigation within the Action area in the 91.0 to 96.0 ft NGVD elevation range (95% of known extant colonies are within this range) would be most likely to benefit pondberry. Because backwater flooding events in the 91.0 to 96.0 ft range have been infrequent over the POR (especially above 93.0 ft), the ERDC-EL believes that, with or without potential changes in hydrology from the preferred alternative for the YBA, there is sufficient and extensive pondberry habitat across broad swaths of the DNF that will continue to be maintained by frequent to intermittent local precipitation events. Because limited discovery surveys by ERDC-EL were yielding previously undiscovered colonies within this elevation range as recently as 2023, future extensive discovery surveys, especially within elevations 91.0-96.0 ft NGVD within the DNF, should continue to yield extant and yet unknown pondberry colonies.

Future conservation actions, by both the USACE and USFS within the DNF, should provide significant benefits to multiple pondberry populations. The best administrative approach to ensuring proper delivery of appropriate monitoring, research, and management is through Section 7(a)(1) of the ESA. Below, we provide some detail on Section 7(a)(1), followed by proposed actions and activities we believe will further increase the baseline of pondberry in the Action Area. Further details are provided separately in a Section 7(a)(1) Conservation Plan for Pondberry. This Plan should help streamline Section 7(a)(2) consultations between the USACE and USFWS and provide some assurances that proactive work by USACE will continue so long as there are appropriated funds and recommended actions fall within USACE authorities.

6.1 Endangered Species Act Section 7(a)(1) Conservation Planning

The CEMVK believes that the most beneficial means of promoting pondberry populations in the DNF is through proactive conservation planning and implementation. Section 7 of the Endangered Species Act provides that federal agencies consult with either the USFWS or NMFS (collectively, the Services) to ensure that their actions do not jeopardize the continued existence of threatened or endangered species, or adversely modify their critical habitats. Section 7 is split into multiple parts that relate to how action agencies cooperate with the Services to protect species. The USACE works with the Services primarily via formal and informal consultations under Section 7(a)(2) of the Endangered Species Act, which typically leads to the issuance of Biological Opinions by the Services that mandate special measures action agencies must follow to protect threatened and endangered species in the course of their actions.

There is significantly less familiarity with, and utilization of, the preceding Section 7(a)(1). In 2017, the USFWS Jackson, Mississippi Ecological Services Office, and the ERDC-EL collaborated on a publication (Hartfield et al. 2017) to describe the benefits of interagency cooperation through Section 7(a)(1). This approach proved successful in contributing to the delisting of the interior population of the Least Tern (*Sternula antillarum athalassos*). Many of

the proactive conservation activities that have been implemented during the past several decades on USACE lands pertain directly to this section which describes voluntary conservation measures by federal agencies for federally listed species. This section specifies that agencies' duties to conserve threatened and endangered species can apply widely to programs and is not limited to individual actions. Thus, agencies can distribute conservation obligations program-wide, as well as achieve conservation opportunities outside of defined action areas to attain compliance with the ESA in a way that promotes efficiency, cost effectiveness, ingenuity, and improved conservation outcomes through increases in species baselines. Thus, a more proactive use of Section 7(a)(1) conservation actions provides a way USACE can gain improved operational efficiency and flexibility in executing mission requirements (Hartfield et al. 2017).

In addition, the flexibility that can be gained through 7(a)(1) conservation programs enables greater synergy with stakeholder initiatives and promotes strategic collaboration and resource leveraging which can significantly increase objectives achievement and program sustainability. It also allows opportunistic mitigation of past, present, or future adverse effects of agency actions by raising the species population and/or habitat baselines, which may reduce the potential of future interagency conflicts under Section 7(a)(2) and increase operational flexibility and mission sustainability (Hartfield et al. 2017).

6.1.2 Components of Section 7(a)(1) Conservation Programs. There is no formal template for Section 7(a)(1) conservation programs, and their design is currently flexible and adaptable. Important components would include relating the federal agencies' roles and contributions to the species baseline within their regulatory footprints, identification of research and monitoring needs relative to agency actions, and management strategies under its authorities to minimize adverse impacts ***and*** benefit (i.e., conserve) the species (Hartfield et al. 2017). The obvious intent of section 7(a)(1) is to raise the species status baseline within the scope of the federal agency mission program footprint. In general, a Section 7(a)(1) conservation program links the authorized purpose of the mandated mission program with the status of listed species potentially benefitted or adversely affected by the mission program and presents a general and defined strategy for the conservation of the species and their habitats.

6.2 Historical and Recommended Potential Conservation Actions by USACE

In 2001, the CEMVK entered into a 7-year, $5 million interagency agreement (IA) with the USFS, to initiate various biological and ecological investigations on pondberry. The Agreement was entered into pursuant to Section 7(a)(l) of the ESA. That IA was supplemented with an updated IA in 2002. These research activities were specifically designed to address recovery tasks described in the USFWS (1993) Pondberry Recovery Plan. Attachment A of the USFWS (2007) Biological Opinion addressed tasks in the Recovery Plan and are also being conducted in accordance with Section 7(a)(l) of the ESA.

At that time, the Corps proposed to conduct the following activities:

> (1) Propagation and stocking of approximately 40,000 pondberry plants at Mahannah Wildlife Management Area and Panther Swamp National Wildlife Refuge, at or below the 1-year Backwater flood frequency.
>
> (2) Establishment of field experiments within experimental plots in DNF, Sharkey County, MS, to evaluate the effects of flood frequency, sunlight, competition, and

pathogens on pondberry. Proposed treatments included (a) flood frequencies at 1, 2, 5, 10, and 15 years; (b) stand sunlight manipulated through light thinning, heavy thinning and control; and (c) competition investigated with herbicide treatment and control.

During the approximate timeframe between 2001 and 2015, the USFS conducted a wide variety of research investigations under the Agreement resulting in a multitude of reports and peer-reviewed publications. To our knowledge, the majority of these investigations occurred in the laboratory, or in limited field settings. These research investigations yielded significant insight on the biology and ecology of pondberry relative to flooding and light requirements, much of which can now be transferred to field settings for direct management treatments that could be monitored over time in an experimental framework. The interagency agreement (both 2001 and 2002) between the CEMVK and USFS has been fulfilled. The 2007 MOA, to include CEMVK, USFS, the USFWS, is no longer in effect because the project was halted due to the Environmental Protection Agency project veto. All resources/publications that were produced as a result of the interagency agreement were coordinated and shared with the USFWS upon completion. There are a variety of management opportunities that would assist in increasing the baseline of pondberry in the DNF. The management practices listed below could provide opportunities to better understand how pondberry responds to changes in stressor levels, which ultimately could provide insight into ways to both conserve and recovery the species. At this time, the CEMVK does not plan on establishing a new interagency agreement for additional research, but instead plans to establish a new MOA to establish monitoring efforts, and where and when feasible additional research, to implement specific conservation actions for Pondberry in the DNF. The conservation measures proposed below are intended to occur on lands under USFS jurisdiction. The CEMVK has communicated with the USFS DNF staff, and as of the date on this draft, a verbal agreement is in place that would allow the USACE (CEMVK, ERDC-EL) to work with the USFS to implement the proposed conservation measures. The CEMVK is planning to coordinate all conservation actions with the USFWS and USFS and proposes to establish a new MOA including the monitoring efforts for specific conservation actions (see below) and how and who will complete each. The written agreement would provide assurance that the proposed conservation measures can and will be implemented. We also believe it appropriate and beneficial to coordinate all proposed conservation measures, research projects, and otherwise, in an interagency context that would allow CEMVK, ERDC-EL, USFS, and the USFWS an opportunity to each assist in the design and (as appropriate) implementation of all below activities. The USFWS was instrumental in the design phase of the studies referenced in the interagency agreement (both 2001 and 2002) along with the USFS and CEMVK. The CEMVK should continue this coordination with ERDC-EL, USFS, and USFWS for the design of the monitoring efforts for specific conservation actions in a new MOA.

Agency conservation programs developed under section 7(a)(1) of the Endangered Species Act are intended to assist Federal Agencies and their potential partners in planning and implementing actions to protect and recover endangered or threatened species potentially affected by the agency's activities. The proposed conservation measures below are a guide for meeting the goal and objective outlined above, and do not obligate any party, including the USACE to undertake specific actions at specific times. Implementation of the actions outlined below is contingent upon opportunity and annual appropriations and other budgetary constraints.

Several factors were identified herein that affect distribution, growth, and development of pondberry colonies:

1. In the 2007 Biological Opinion, the USFWS identified that hydroperiod affects the distribution, growth, and development of pondberry. In addition, the USFWS recognized the need to improve our understanding on the life-history of pondberry.
2. The USACE not only recognized the importance of hydroperiod, but also the effects of light availability which is influenced by canopy and midstory cover.
3. The USFWS has not proposed establishing pondberry critical habitat in either Mississippi or in other states in which the species is known to inhabit. However, the BA identified habitat characteristics associated with pondberry colonies found in Mississippi including mature bottomland hardwoods, low depressions dominated by vertical hydrology (rainfall and evapotranspiration), and soils with surface horizon characterized with silty clay to silt loam textures.
4. Competition from other plant species were reported in the BA including "weedy" species and vines (*Smilax* and *Vitus* spp.).
5. Within the DNF in Mississippi, the BA reported that the U.S. Forest Service determined 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.
6. Stem dieback, feral hog activity, palmetto encroachment, and herbivory all are potential stressors that may contribute to poor or declining colony health in the DNF. Herbivory has been observed by deer and insects (e.g., spicebush swallowtail caterpillar)**.** The best available information suggests that stem dieback is related to fungal pathogens, drought, and the interactions between pathogens and drought. See below for feral hogs.

We propose Strategies and Actions, as conservation measures, provided separately in an ESA Section 7(a)(1) Conservation Plan. Those Strategies relevant to long-term monitoring, and backwater and local hydrology, are introduced below:

Strategy 1: Design and Implement a Long-term Pondberry Monitoring Plan. Pondberry monitoring in the DNF has been ongoing but very intermittent in the DNF for at least three decades. In the 2020 BA, the ERDC-EL noted that there were 182 historically known pondberry colonies within the DNF. From 2020-2023, the ERDC-EL conducted a thorough investigation of nearly every known pondberry colony location as determined from multiple sources of information from CEMVK, USFWS, USFS, and others. We now believe that this 4-year effort provides a significant broad and thorough geographical assessment of the status of pondberry in the DNF.

Strategy 2: Continue Assessing the Role of Backwater Hydrology and Hydroperiod on Pondberry. A main focus (and disagreement between USFWS and USACE) of the 2007 BO (USFWS 2007) was on the effects of flood frequency on pondberry colonies. The metric used to test hypotheses regarding potential impacts of hydroperiod on pondberry colonies was number of stems per colony. Stem counts between 2000 and 2005 showed at least a short-term, yet apparent decline at most colonies. In reviewing GSRC (2000, 2005) reports, it was not clear exactly how

those investigators defined plot sizes for stem counts, and no raw data were available in GSRC (2005) for which to adequately determine whether 2000 and 2005 techniques were identical. To further this confusion, Gulf South Biological (2001) also visited GSRC pondberry colonies and counted stems, noting "at almost all sites the number of stems counted….were less than the number of stems counted by Gulf South Research Corporation. In certain instances, the flagged area where pondberry plants were concentrated was smaller than GSRC's original plot census." Pages 261-272 of 2007 BO (USFWS 2007) describe in detail and argue how various parties (including USACE, USFWS, and Applied Research and Analysis, Inc.) analyzed and interpreted data, and used estimates of statistical power to facilitate inference. Without sufficient detail on how plot sizes and stem counts were made among years, much of the prior analyses, interpretations, and disagreements are exceptionally difficult to interpret and assess. USFWS (2007) stated there was a clear decline in stems from 2000 to 2005, but ERDC-EL cannot determine if the same methods were used between years to fully analyze count data for declines.

Though a decline from 2005 to 2020 is readily apparent, these issues also make it exceptionally difficult to compare prior monitoring data with those collected from 2020-2023.There is significant need to more fully address impacts of hydrology (flood frequency, inundation depth and duration) on pondberry colony health and persistence, not only in the DNF but also in the Hester Tract. Future monitoring coordinated with USFS and USFWS, will assist in filling this knowledge gap. Specific details on improved and more consistent surveys and monitoring of Pondberry will be coordinated with the USFS and USFWS and documented in a proposed MOA.

Strategy 3. Conduct a Long-term Assessment of the Role of Local Hydrology on Pondberry. We believe that a more thorough investigation of the role of local hydrology (precipitation and flooding of local drainages via overbank or distributary flooding) on pondberry colonies is needed. We suggest using the Berkowitz et al. (2019) methodology as a starting point, conducted at extant and historic pondberry sites, and with associated research to investigate methods to spatially evaluate the role of local landform, elevation, contours, soils and other attributes at sites with precipitation driven wetland hydrology for a wider and accurate spatial application of such conditions elsewhere in the backwater area. This should be accompanied by investigations into how to appropriately and accurately spatially extrapolate results from localized well study sites, such as those reported in Berkowitz et al. (2019), to relate local hydrology to broader landscapes (where local wells have not been deployed) in a scientifically sound manner. To support this investigation, ERDC-EL also proposes to monitor existing and new groundwater wells relative to pondberry colony sites (see 6.2.4 below).

The Berkowitz et al. (2019) study represents the best available scientific data on wetland hydrology sources within the Yazoo Basin. They stated, "All monitoring locations were distributed based upon access to public lands, mapped flood frequency and duration (where available), and site condition to include analyses of mature second growth forest and reforested farmed wetlands." Their monitoring locations were not determined randomly or based on a probabilistic distribution approach. In addition, their 56 sites represented a large number of monitoring locations for this type of study; the study incorporated analysis of precipitation and

stream flow normality into the analysis to place the results in a larger context (this is the standard approach used to evaluate wetland hydrology when <10 years of data are available); and a number of wells were maintained for periods up to 8 years (which is also rare in these types of studies). Across all the available data, the period of soil saturation far exceeded (~10x) the period of flooding. These findings align with the conceptual hydropattern of bottomland hardwood forests.

The location of all the pondberry colonies was not anticipated prior to installation of shallow groundwater wells. However, well data can be extrapolated by identification and mapping of drainage features and local ground surface elevations, soil classification and hydric soil properties, and the expression of hydrophytic vegetation local to groundwater wells and pondberry colonies. Intensive studies to address these and other ecological factors affecting the growth, development and sustainability will be included in the Adaptive Monitoring and Management Plan (AM&M Plan; see USACE 2020c for similar from the 2020 SEIS). The AM&M Plan allows the Corps to make operational management decisions, develop benchmarks, and make adjustments in the face of uncertainties as outcomes from management actions and other events become better understood in regard to the effects on pondberry colonies. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Currently, a complete understanding of the regional ecology of pondberry is unknown, and even less is known in regard to local colonies. However, prior to pump construction (baseline conditions), ERDC-EL will continue to conduct intensive spatial and temporal studies on existing pondberry communities and establish seasonal trends including a range of environmental conditions beyond hydroperiod including available light, soil properties, herbivory, forest habitat metrics (competition), and stem dieback. Performance measures will include those related to growth, development, vigor and spatial distribution pre- and post-project. During future proposed efforts, as outlined in the ESA Section 7(a)(1) Plan, monitoring will be “adaptively” adjusted as key elements of regional and local pondberry ecology are identified.

7 IMPACT ASSESSMENT

The following section includes a status description of how pondberry will be potentially affected by elements of the proposed Water Management Plan as well as the determination of effects for pondberry. The effects determination took into account implementation of the conservation measures listed above, and specific proposed actions in the ESA Section 7(a)(1) Conservation Plan provided with this BA.

7.1 Effects Determination

7.1.1 Direct Effects of Pump Station and Borrow Site Construction

The ERDC-EL did not conduct any discovery surveys for pondberry at either site proposed for the pump station or borrow site. We used the USFWS Environmental Conservation Online System (ECOS: https://ecos.fws.gov/ecp/) range map for pondberry, which clearly showed both proposed construction sites being outside of the current range map for pondberry. However, the ECOS system does advise users to consult the USFWS Information for Planning and Consultation (IPaC) system to run a query on both sites. We did use IPaC to query both sites, which did list pondberry as a potential federally listed species. A thorough survey of the proposed pump station, and borrow areas, can rapidly be completed if the USFWS believes this is a critical action to fill the knowledge gap. ERDC-EL can add both sites to any future pondberry survey efforts to conduct a walking survey throughout all areas within all construction footprints.

We do not anticipate adverse effects on pondberry from the construction of the pumps, access to the pump system, the construction staging area, and any borrow areas. The majority of lands impacted by construction and deposition of fill material will be isolated from neighboring water bodies by dikes and existing levees. Any unavoidable impacts will be further minimized by the implementation of BMPs, such as silt screens, buffer zones, containment dikes, and erosion reduction techniques, in accordance with the State of Mississippi laws and regulations. A Stormwater Pollution Prevention Plan will be completed and submitted to MDEQ for approval before initiation of construction. All required environmental permits for construction and operation will be obtained prior to construction and all construction activities will adhere to state, federal, and local laws. Similarly, no secondary effects outside of the project footprint are anticipated due to a comprehensive Stormwater Pollution Prevention Plan and associated BMPs.

7.1.2 Impact of Preferred Alternative

For the dates throughout the POR (1978-2020) that the SBWCS was closed, and reopened, and the estimated number of days pumping would have occurred if the Preferred Alternative had been implemented in 1978 and continued across the entire period, refer to Engineering Appendix A in the 2024 Draft EIS (Figure 2-110 and 2-112 in Appendix A-Engineering Report, pages 133 and 135). In total, only 5.4% of the time would the pumps have been in operation over the 43-

year POR. During the crop season (which is also the pondberry growing season), backwater levels have exceeded elevation 90.0 ft in 20/43 (46.5%) years. Therefore, due to the proposed 90.0 ft water management threshold during the crop season, it is likely that pumping activities would lessen the frequency of backwater flooding within the elevation zone of 90.0 to 93.0 ft. This could potentially negatively affect the 22 pondberry colonies within this elevation range (e.g., by enabling increased competition with less flood-tolerant plant species). However, these colonies could also potentially benefit if the pumps prevent detrimental inundation effects during prolonged and deep flooding events such as those that occurred in 2019 and 2020, well into the growing seasons. Because of this uncertainty regarding the long-term effects of reduced backwater frequency, we suggest that the proposed preferred alternative is likely to adversely affect colonies within the action area between 90 and 93 ft elevation, although further monitoring would be required to determine whether potential benefits may offset any adverse effects.

Of all known extant colonies in the DNF, 95% occur between 91.0 and 96.0 ft NGVD elevation and would have experienced prolonged backwater flooding in 2019 and 2020, and 60% occur in the 5- and 10-year floodplain (Figure 3, Table 10). Furthermore, only 11 out of 48 colonies (23%) historically known below the 5-year floodplain still survive (Table 12). Since approximately 2000, pondberry populations appear to be in a decline in the Action Area, both in terms of number of stems and number of colonies. During post-2019 and 2020 flood survey efforts, the ERDC-EL found more than 50% of GSRC plots that were extant in 2000 went extinct at some point over that time interval. However, without any stem count data between 2010 and 2020 it is not possible to determine year(s) of extinction. Though sparse monitoring data are available between 2005 and 2020 (i.e., limited data from 2010), we believe that the 2019-2020 deep and long-duration flooding likely had significant negative effects on pondberry colonies that experienced extended periods of floodwater, particularly those within and below elevation 96.0 ft (Table 6). Those colonies in the DNF that did remain extant after the floods are currently in recovery as evidenced by the positive trend in stem counts between 2020 and 2023 (Figures 17 and 18). Some compelling evidence for this apparent detrimental effect of extreme backwater flooding can be observed in the comparison of stem heights and diameters between pondberry colonies in the DNF and colonies in the Hester Tract (north of the Yazoo Backwater Action Area and not subjected to backwater flooding). Many stems in the Hester Tract, especially in larger colonies approach 0.75 in in diameter and have a significant woody component. These types of robust stems in the DNF are currently almost non-existent.

With the no-action alternative, few extant colonies are expected to receive backwater flood inundation more frequently than every 5 years (Table 12). However, this does not take into account frequent local precipitation events, or other hydrologic inputs (e.g., overbank or distributary flooding), which were not addressed in any significant manner in prior analyses of pondberry in the DNF. The work by Berkowitz et al. (2019), along with 2021-2024 groundwater monitoring well data from the DNF (and partially analyzed and presented in this BA; see Appendix A), strongly suggest that precipitation inputs are the dominant driver of wetland hydrology at pondberry colonies in the Action Area, rather than backwater flooding. The Action Alternative 2 (Preferred Alternative) does indicate a shift in flood frequency zone for some colonies (Table 12, Figure 27). However, since backwater levels rarely have exceeded elevation 93.0 ft at the Steel Bayou WCS during the 43-year POR (7 years [1979, 1983, 1997, 2009, 2018, 2019, and 2020]), it is not likely that pumping operations will negatively impact colonies above 93.0 ft. Colonies above 95.0 ft are especially unlikely to be negatively affected. Between 1983

Table 12. Number of pondberry extant and extinct pondberry colonies (September 2023) within each flood frequency interval, without (base) and with (pump) project.										
		Flood Frequency Interval (years)								
	Pondberry Present	**1**	**2**	**5**	**10**	**20**	**50**	**100**	**>100**	**Total**
Base	No	25	12	46	31	43	22	0	5	184
	Yes	5	6	84	22	4	1	0	0	122
	Total	30	18	130	53	47	23	0	5	306
Pump	No	25	14	35	13	19	38	19	21	184
	Yes	5	6	55	29	16	10	1	0	122
	Total	30	20	90	42	35	48	20	21	306

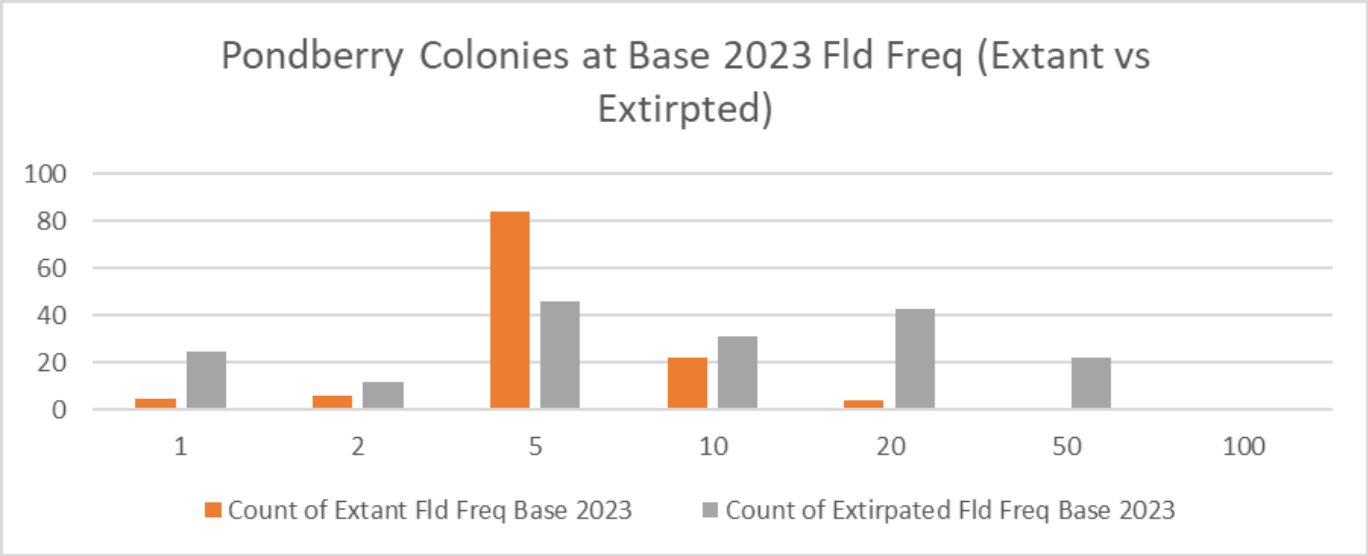


Figure 29. Graphical comparison between extant and extirpated pondberry colonies according to each flood frequency within the DNF, Mississippi as of September 2023.

and 2018, a 35-year period, (and from 2020 through 15 July 2024), the gauge at the SBWCS never exceeded elevation 95.0 ft.

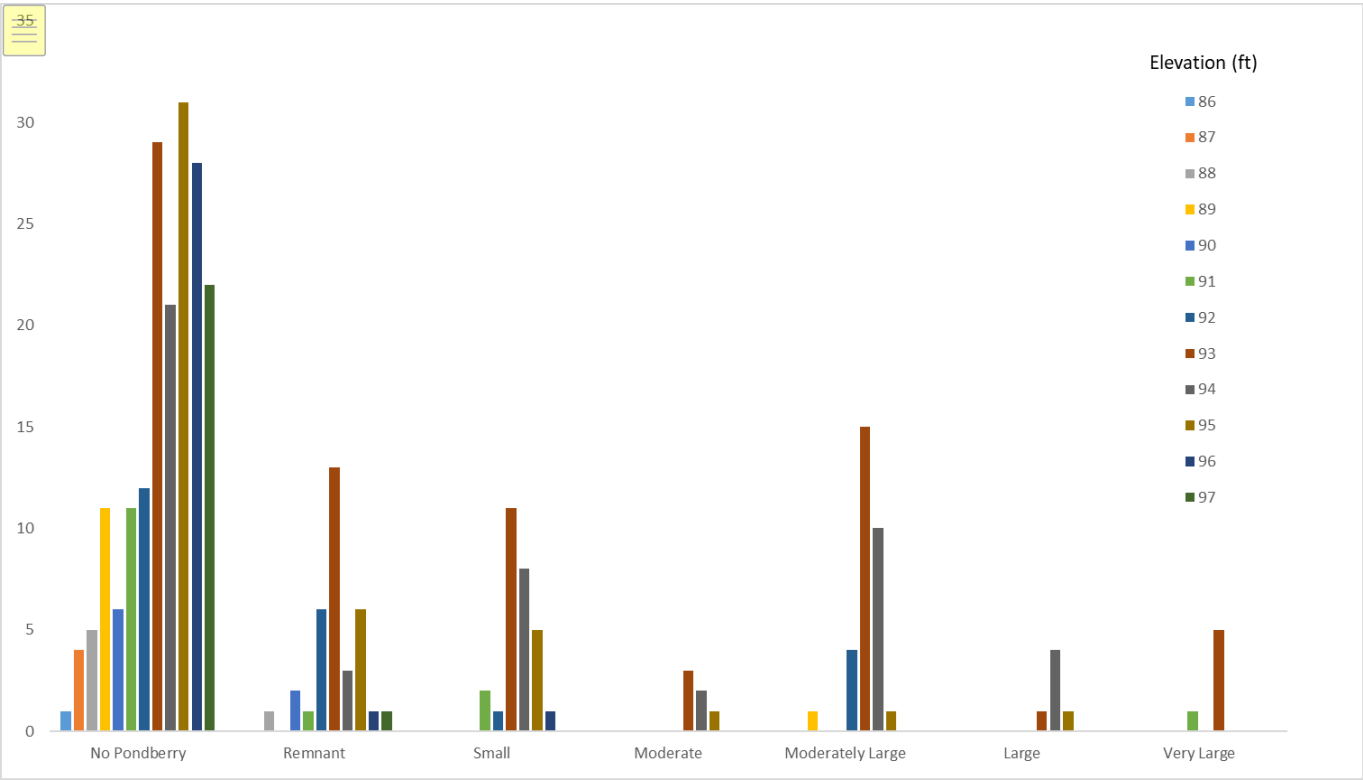


Figure 30. Distribution of differently sized pondberry colonies across elevations in the Yazoo Backwater Area.

7.2 Cumulative Effects

Cumulative effects under the ESA are those effects of future state or private activities, not involving federal activities that are reasonably certain to occur within the Action Area (50 CFR 402.02). Future federal actions that are unrelated (i.e., not interrelated or interdependent) to the proposed action are not considered in this assessment because they will be subject to separate consultation pursuant to Section 7 of the ESA. Because all known extant pondberry colonies within the Action Area occur on USFS lands, ERDC-EL does not anticipate significant external impacts to extant pondberry colonies. Some colonies in DNF do occur proximal to private agricultural inholdings, thus there is potential for land alterations and/or changes in hydrology due to ditching or by other means. Other potential impacts could occur due to alterations in hydrology within rivers and streams within the Action Area (e.g., Big Sunflower River) that result from actions and activities outside of the Action Area.

8 CONCLUSION AND DETERMINATION OF EFFECTS

The determination of effects is based on whether the proposed action (as defined in this BA) is likely to cause loss of potentially occupied habitat, likelihood of loss of individual pondberry plants or colonies, and likelihood of disruption of reproduction and dispersal. Based on the above analysis, assuming any agreed-upon conservation measures described above are in place and working as anticipated, and because of the potential for unknown impacts due to changes in hydrology in some future years and corresponding changes in competing vegetation and other factors on pondberry colonies between elevations 90.0 and 93.0 NGVD, we conclude that the YBA Water Management Plan is **Likely to Adversely Affect** the 27 pondberry colonies (22 extant, 5 unknown status) below or within a distance of 15m of this elevation "effect zone."

For the remaining 100 (82%) extant pondberry colonies above elevation 93.0 NGVD, we conclude that the YBA Water Management Plan is **Not Likely to Adversely Affect** these colonies. While the proposed Yazoo Pumps Project may adversely affect the 22 extant colonies and the 5 colonies of unknown status within the 90.0 to 93.0 ft elevation zone, these 22 extant colonies represent only 18% of known extant colonies (containing approximately 10.4% of all pondberry stems) in the YBA. Furthermore, in years with extreme and prolonged flooding during the growing season, it is possible that these 22 extant (and other at higher elevation) colonies could benefit from the pumps and this possibility may be scientifically evaluated if the pumps are implemented and future monitoring efforts are funded for continuation.

The infrequency of backwater events, and the emerging information on local hydrographs associated with individual pondberry colonies, provide increasing evidence for the importance and role of local precipitation as a leading driver in maintaining suitable growing conditions for pondberry in the Action Area. We suggest that, within the YBA, and especially at higher elevations (i.e., above ~ elevation 95 NGVD), encroachment of palmetto into pondberry colonies, the apparent increase in wild hogs resulting in significant damage (and likely, extirpation) to many colonies, and the potential for laurel wilt disease to impact pondberry colonies in the future (at any elevation), are likely to represent more significant single and/or interacting threats and stressors to persistence of pondberry colonies than the proposed changes in hydrology in the YBA from operation of a pump station given the proposed alternatives. We reiterate the need for continued frequent monitoring of all pondberry colonies in the YBA, as well as those on private lands outside of the YBA, to monitor colony and population status, and to assess the relative impacts of identified threats. The goal should be to continue building a robust data set that, when paired with continued extensive collection of groundwater monitoring well data, will provide significant opportunities for hypotheses testing relative to effects of annual hydrologic changes over time on pondberry colony health and persistence in the YBA.

Pursuant to federal regulations, if, subsequent to the completion of this informal consultation the proposed action is revised either by: (1) selecting a different alternative or (2) adding more stringent mitigation measures through the NEPA process (or any other environmental review process) and new information or information not used in this analysis reveals effects of the action that may affect pondberry in a manner or to an extent that was not previously considered, then the federal agencies with jurisdiction for actions related to potential effects on such species would need to either request a subsequent concurrence that the proposed action was "Not Likely to Adversely Affect" pondberry or initiate formal consultation (50 CFR 402.16).

Please review the above and attached information and inform CEMVK as to whether or not you agree with our determinations. If you have any questions about the project or need additional information contact Mr. Mike Renacker, Biologist/Environmental Manager at (601) 631-5842.

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Appendix A

Hydrographs from Groundwater Monitoring Wells Associated with Pondberry Colonies in the YBA, Elevation 90-93 ft NGVD

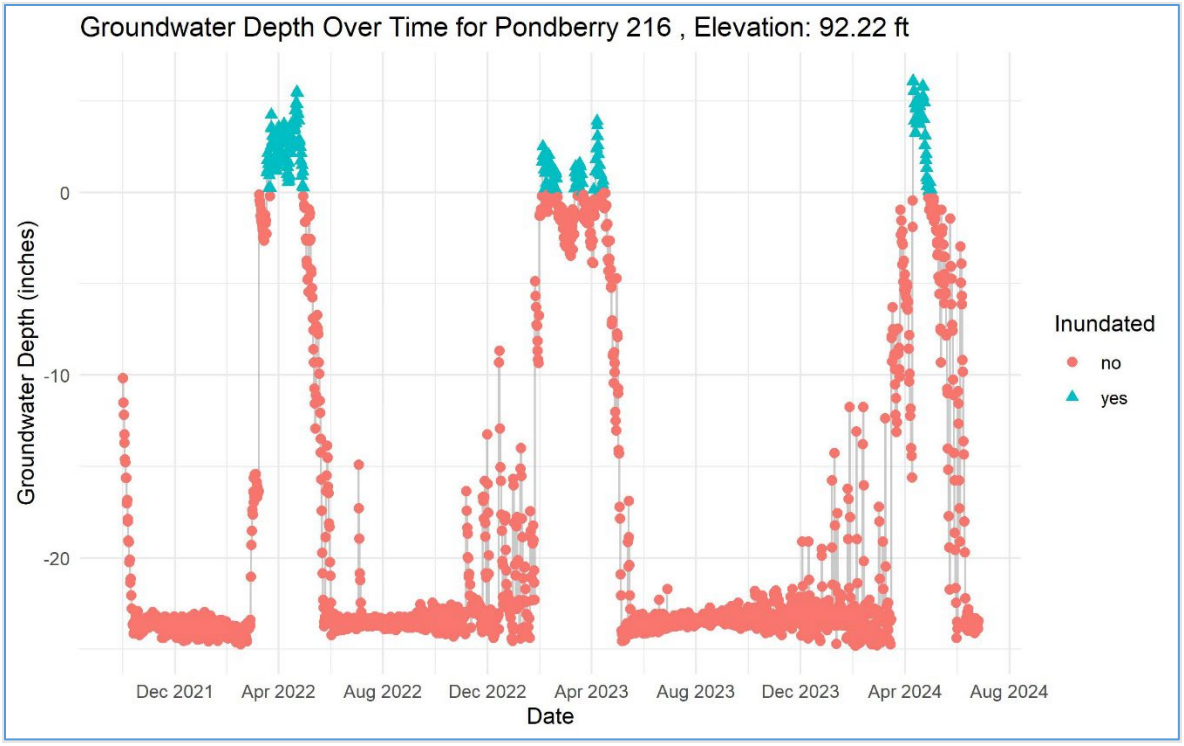

Figure A-1. Groundwater monitoring well data for Pondberry 216, October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

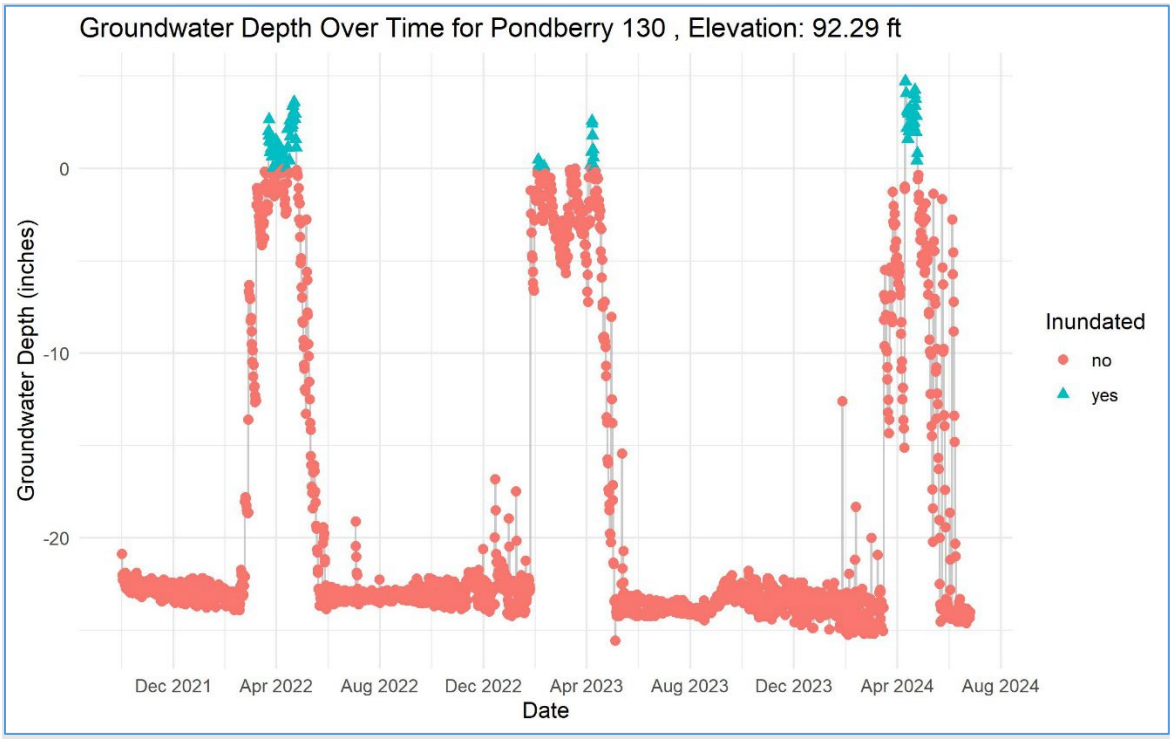

Figure A-2. Groundwater monitoring well data for Pondberry 130, October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

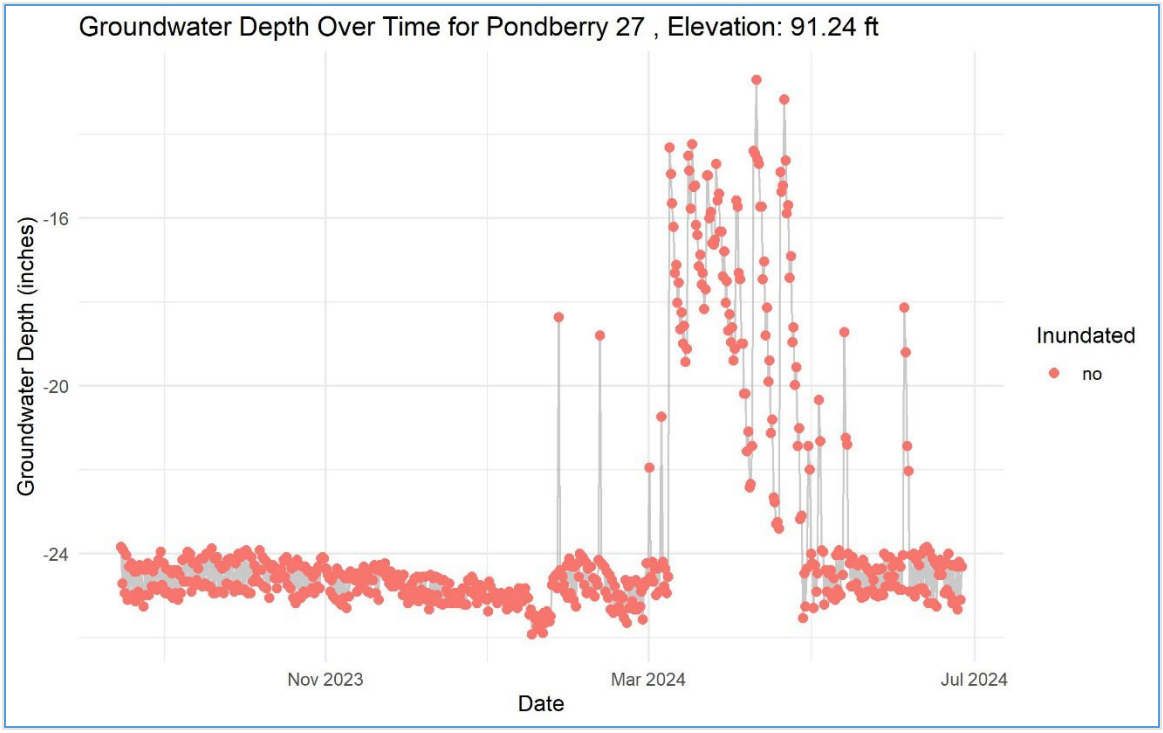

Figure A-3. Groundwater monitoring well data for Pondberry 027, September 2023 to June 2024, showing groundwater depth (including surface inundation) over time.

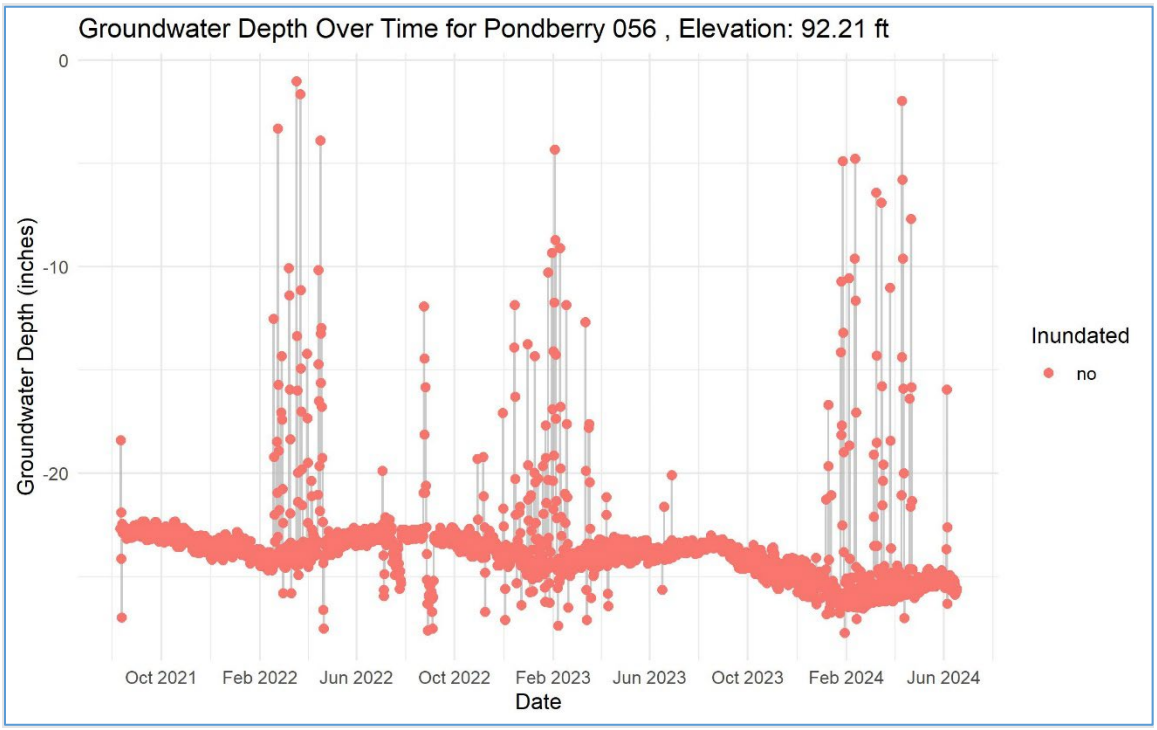

Figure A-4. Groundwater monitoring well data for Pondberry 056 (Spanish Fort), October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

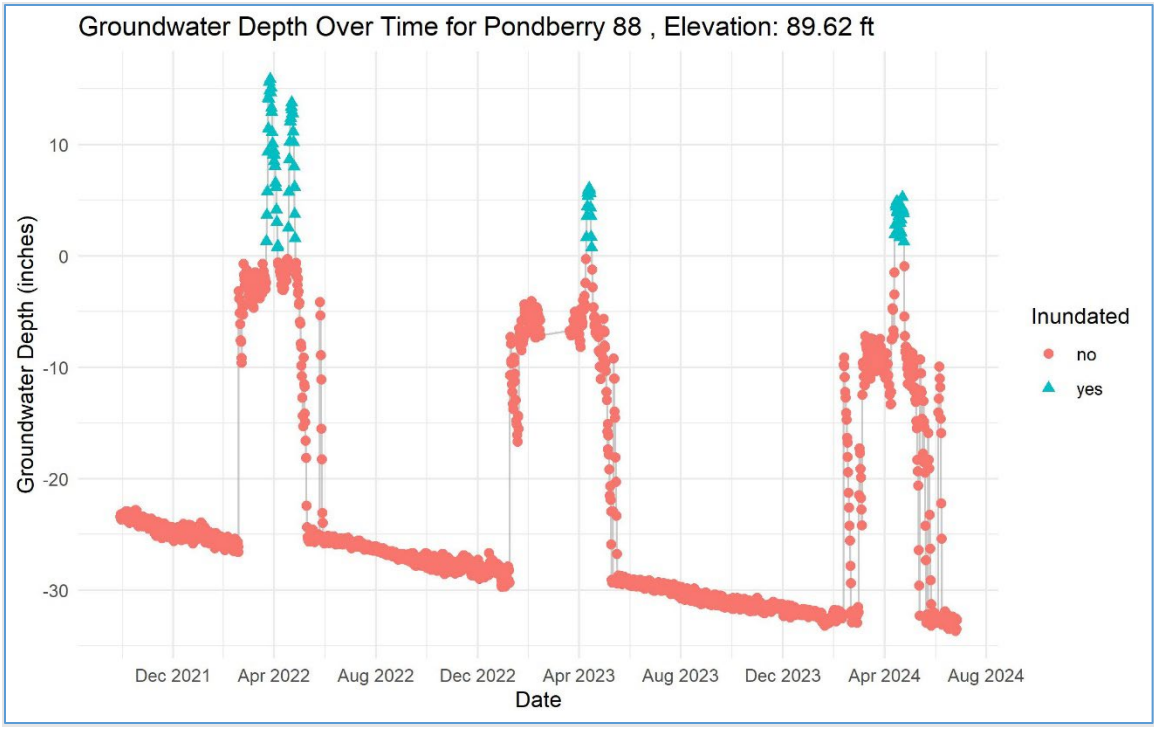

Figure A-5. Groundwater monitoring well data for Pondberry 088 (703 rd), October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

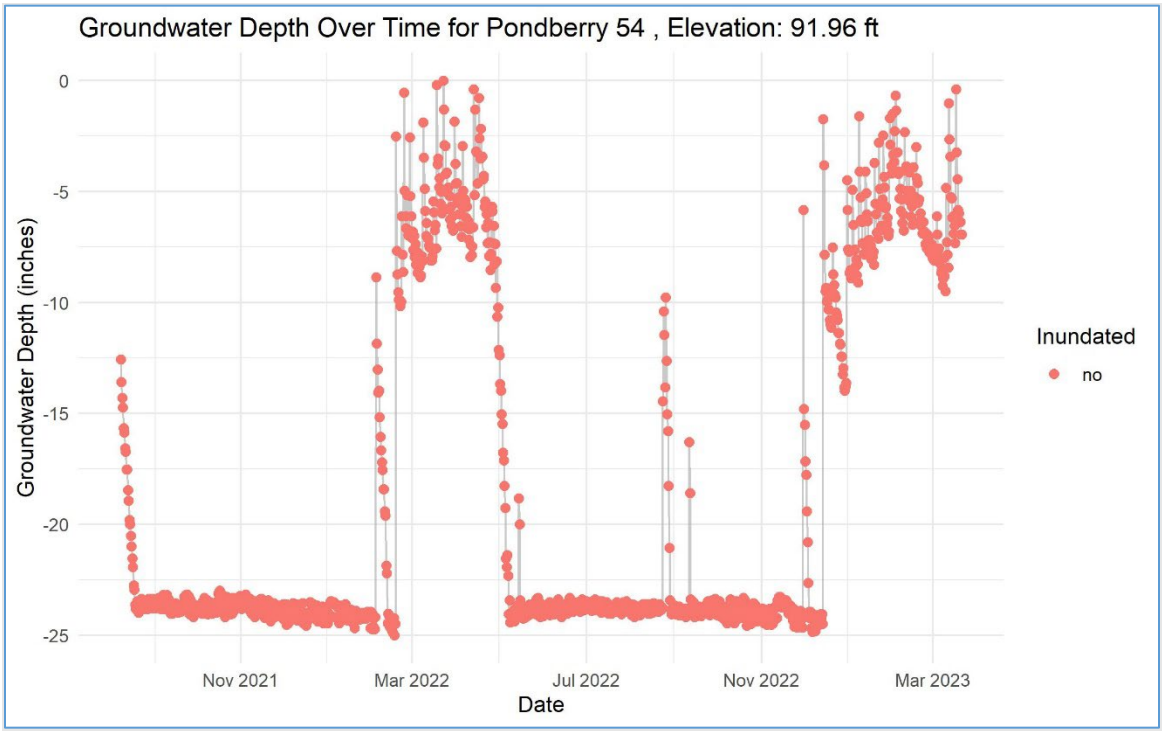

Figure A-6. Groundwater monitoring well data for Pondberry 054 (Spanish Fort), October 2021 to March 2024, showing groundwater depth (including surface inundation) over time.

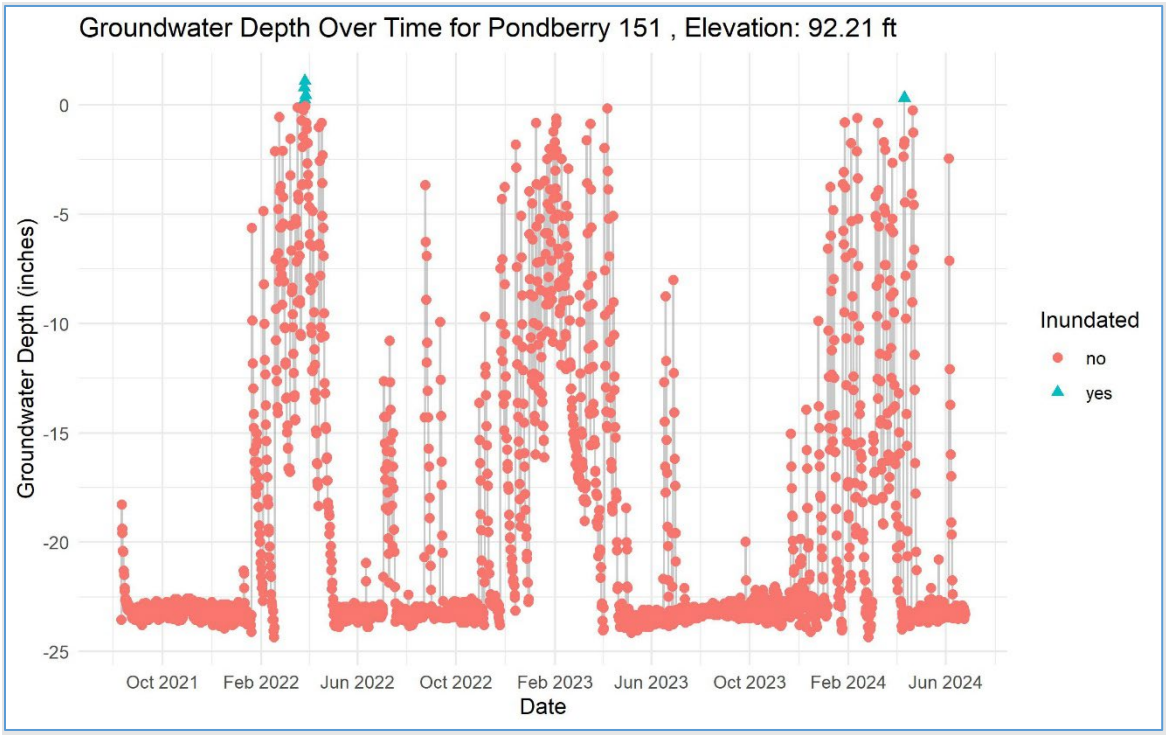

Figure A-7. Groundwater monitoring well data for Pondberry 151 (Spanish Fort), October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

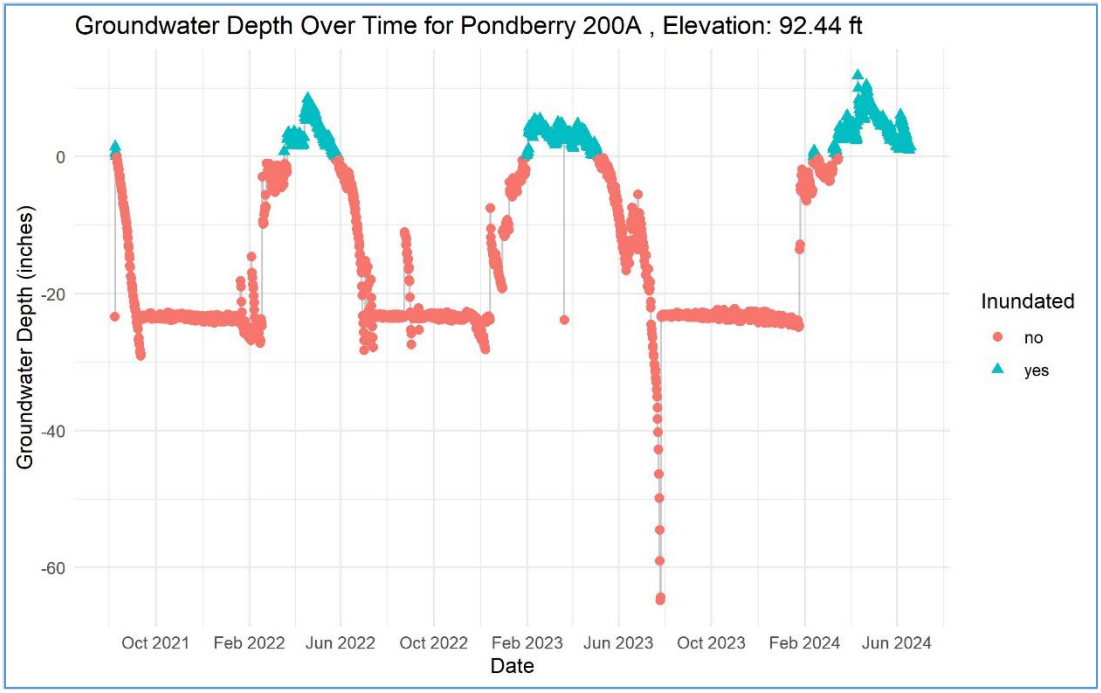

Figure A-8. Groundwater monitoring well data for Pondberry 200 (Spanish Fort), October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

Appendix B

Hydrographs from Groundwater Monitoring Wells Associated with Pondberry Colonies in the YBA, Elevation >93 ft NGVD

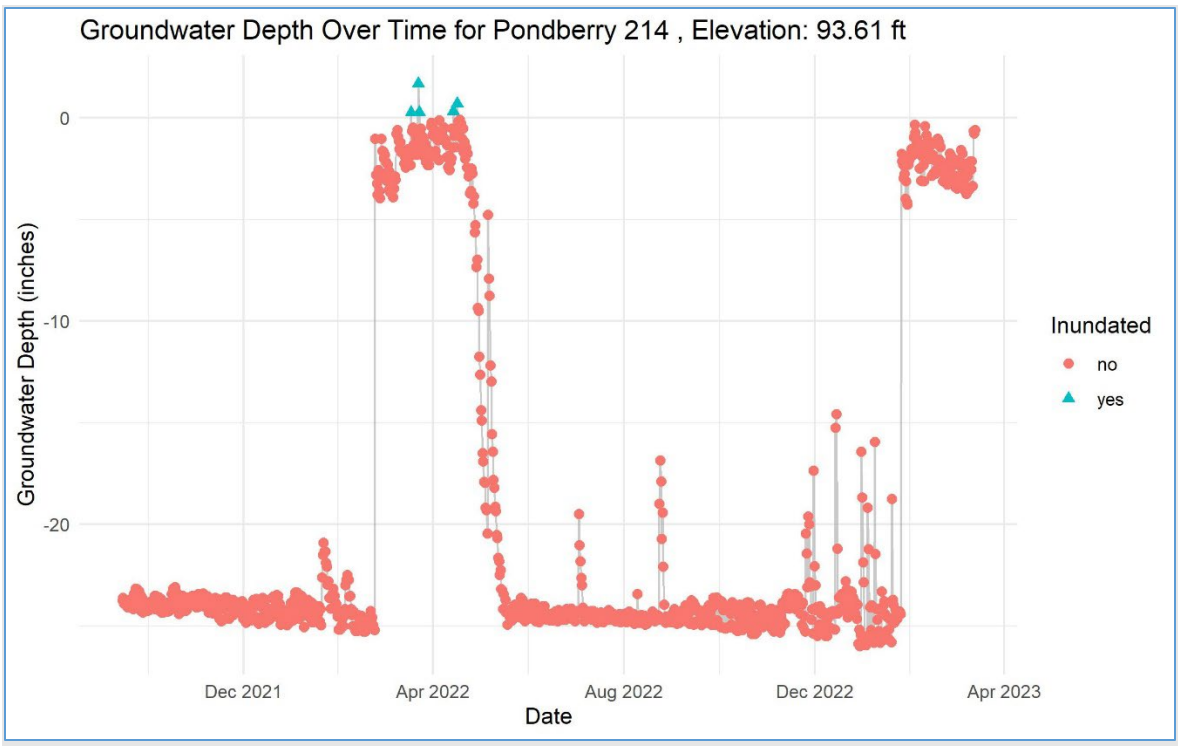

Figure B-1. Groundwater monitoring well for Pondberry 214 (Forest Service plots), October 2021 to March 2024, showing groundwater depth (including surface inundation) over time.

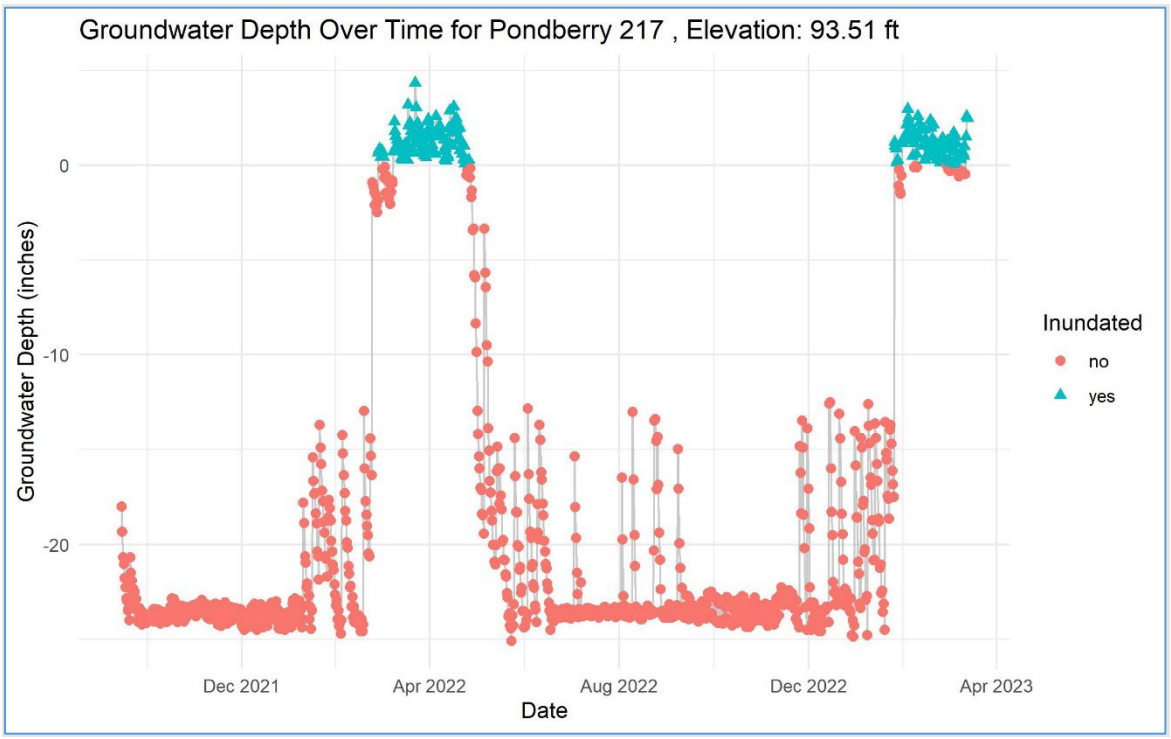

Figure B-2. Groundwater monitoring well for Pondberry 217 (Forest Service plots), October 2021 to April 2024, showing groundwater depth (including surface inundation) over time.

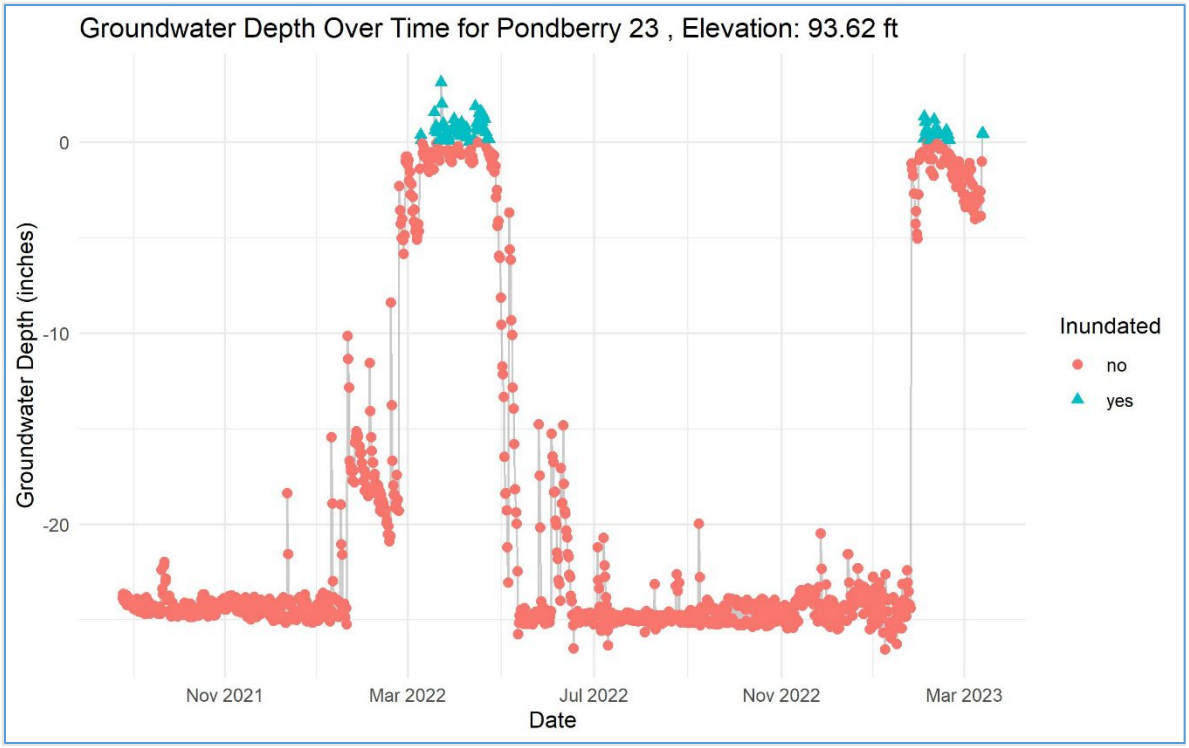

Figure B-3. Groundwater monitoring well for Pondberry 23 (Forest Service plots), October 2021 to April 2024, showing groundwater depth (including surface inundation) over time.

Appendix C

Hydrographs from Groundwater Monitoring Wells Associated with Pondberry Colonies on Private Lands Outside of the YBA

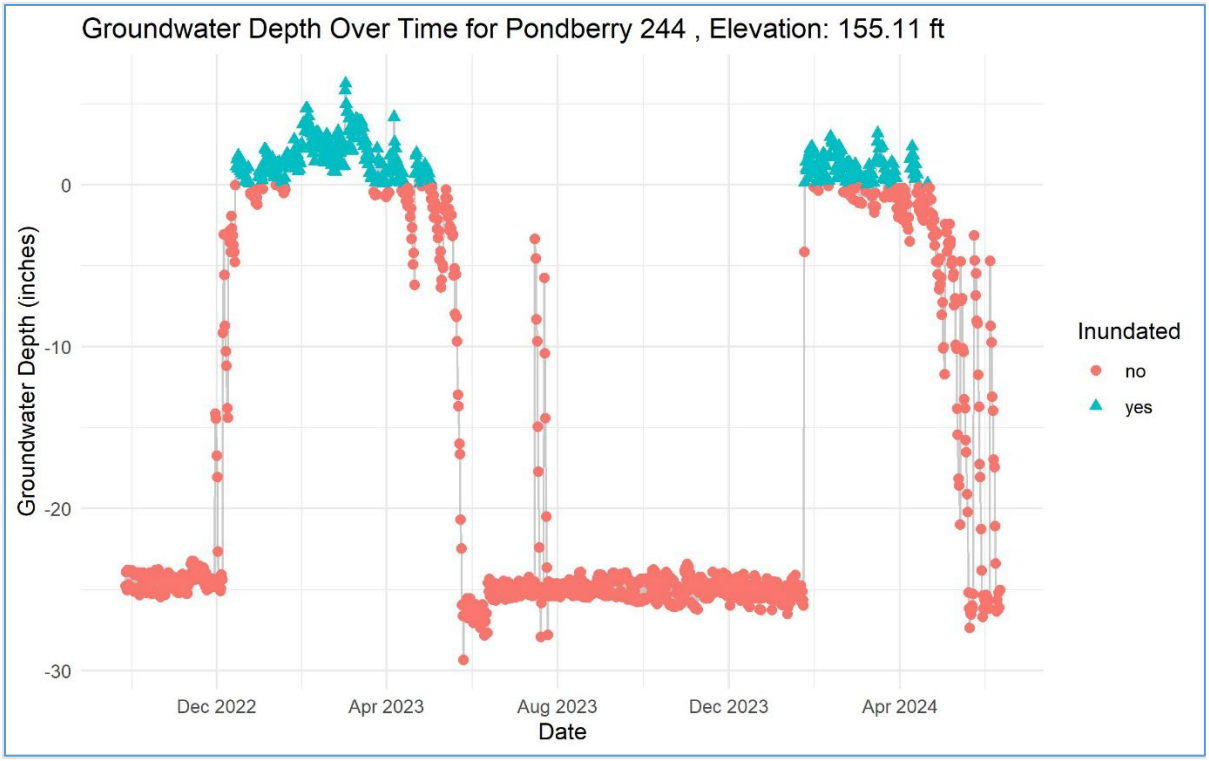

Figure C-1. Groundwater monitoring well for Pondberry 244 (Hester Tract), November 2022 to June 2024, showing groundwater depth (including surface inundation) over time.

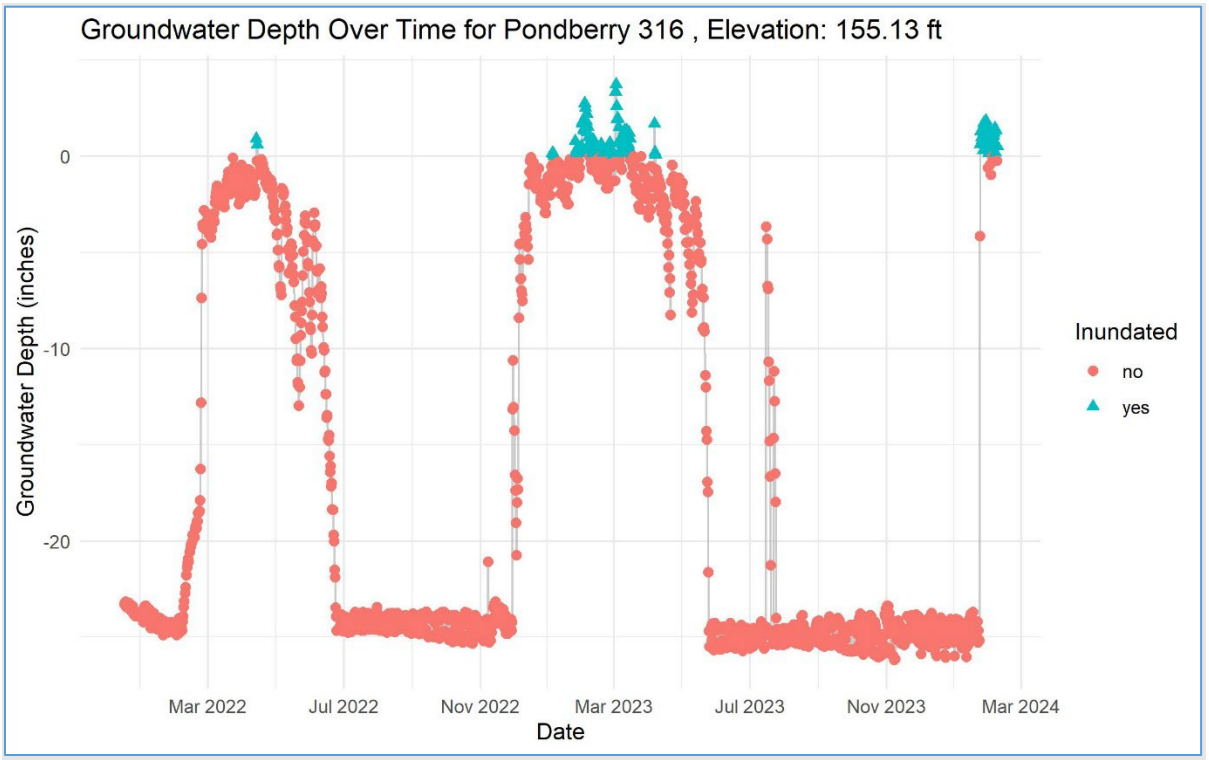

Figure C-2. Groundwater monitoring well for Pondberry 316 (Hester Tract), February 2022 to April 2024, showing groundwater depth (including surface inundation) over time.

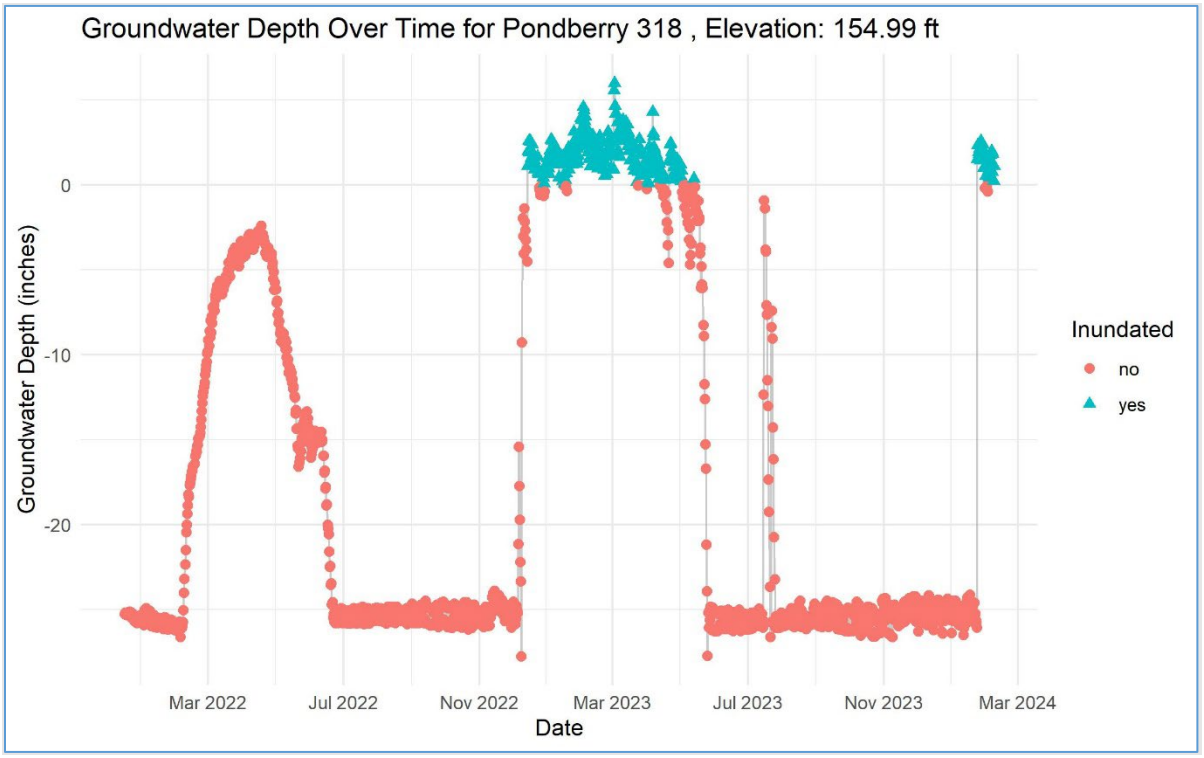

Figure C-3. Groundwater monitoring well for Pondberry 318 (Hester Tract), February 2022 to April 2024, showing groundwater depth (including surface inundation) over time.

U.S. Army Corps of Engineers

Endangered Species Act, Section 7*(a)(1)* Conservation Plan for Pondberry (*Lindera melissifolia*) (Walt.) Blume

July 2024

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PART I: INTRODUCTION

Background. The U.S. Army Corps of Engineers (USACE), Vicksburg District (CEMVK), in coordination with the U.S. Army Engineer Research and Development Center (ERDC), Environmental Laboratory (EL), is preparing an environmental impact statement titled "Yazoo Backwater Area Water Management Project" along with a Biological Assessment (BA) with the determination that the Yazoo pumps project is "**Likely to Adversely Affect**" a subset of 22 extant federally endangered pondberry (*Lindera melissifolia*) colonies that occur in the Yazoo Backwater Area specifically between the elevation 90.0 and 93.0 ft National Geodetic Vertical Datum (NGVD 29) flood zone or within a 15-m buffer of this elevation range. Colonies within this elevation range, while some or all would still be likely to receive inundation from local precipitation and headwater flood events, would also likely experience a decreased flood frequency from backwater floods (which historically occurred in 16.3% to 46.5% of years at this elevation range) under the Water Management Plan. In addition to these 22 extant pondberry colonies, five colonies have an unknown status; therefore, until future surveys can confirm whether they are extant or extirpated, these colonies within the 90.0 to 93.0 ft elevation flood zone will also be considered the same as the 22 colonies confirmed to be extant in 2023. For the remaining 100 known extant colonies that occur in the Yazoo Backwater Area above elevation 93.0 feet NGVD, the USACE determined that the pumps project **"May affect, but is not likely to adversely affect"** these higher-elevation colonies. However, as outlined in the 2024 BA, there may also be positive effects from the Water Management Plan by reducing extreme floods that inundate pondberry colonies for extended periods with turbid water during the growing season, as experienced in 2019 and 2020. Data suggests that these deep and prolonged growing-season floods (e.g., 203 d above 90 ft and 104 d above 96 ft in 2019) negatively affected pondberry and would be lessened in duration and intensity by the proposed pumps, and it is unknown whether these potential positive effects may offset any negative effects from the proposed Water Management Plan within the 90.0 to 93.0 ft elevation flood zone. Further research and monitoring efforts are needed to better understand the relationships of backwater flooding versus local hydrology on pondberry colonies. Additionally, data spanning several decades suggests that colonies (which mostly occur in the Delta National Forest; DNF) at all elevations throughout the Yazoo Backwater Area have experienced general declines including colony extirpations that are likely caused by a myriad of factors, some of which are not related with backwater flooding, and need further study and a coordinated conservation plan.

The USACE had also completed Biological Assessments in 2005 (USACE 2005), and again in 2020 (USACE 2020), for the Yazoo Backwater Reformulation Project, concluding that implementation of the Yazoo Pump Project was not likely to adversely impact pondberry in the DNF. Those assessments were based on research into the impacts of backwater flooding and localized hydraulic regimes on the current distribution of pondberry (U.S. Army Corps of Engineers, 2000b, 2000c, 2005; Lockhart et al. 2009). In its 2007 Biological Opinion, the U.S. Fish and Wildlife Service (USFWS) did not concur with USACE findings regarding the relationship between flooding and pondberry, concluding that the magnitude of reduction in flooding by the prior proposed project designs likely would adversely affect pondberry. At the heart of the disagreement was the role of hydroperiod on the distribution, growth, and development of pondberry, and the need for improved knowledge of pondberry biology and

ecology. Subsequent to the pondberry BA (USACE 2020) for the Yazoo Backwater Reformulation Project SEIS, a significant amount of information and field data on pondberry in Mississippi have been collected, assessed, and analyzed by the ERDC-EL from 2021-2024, in coordination with the USFWS. That updated information, and new data, are included in the 2024 BA and in this ESA Section 7(a)(1) conservation plan.

Purpose and Scope

This Conservation Plan (Plan) is being prepared pursuant to Section 7(a)(1) of the Endangered Species Act, as amended, which requires all Federal agencies to use their authorities to carry out programs for the conservation (i.e., recovery) of endangered and threatened species. The purpose of the Plan is to describe how the USACE will proactively address the conservation of pondberry colonies and populations on U.S. Forest Service lands in the Yazoo Backwater Area, where authorized, and only with available appropriations, for sustainable colonies and populations of Pondberry.

Components of Section 7(a)(1) Conservation Programs. There is no formal template for Section 7(a)(1) conservation programs, or resulting plans, and their design is currently flexible and adaptable. Important components include relating the federal agency's role and contribution to the species baseline within their regulatory footprint, identification of research and monitoring needs relative to agency actions, and management strategies under its authorities to minimize adverse impacts *and* benefit (i.e., conserve) the species (Hartfield et al. 2017). The obvious intent of section 7(a)(1) is to raise the species status baseline within the scope of the federal agency mission program footprint. In general, a Section 7(a)(1) conservation program links the authorized purpose of the mandated mission program with the status of listed species potentially benefitted or adversely affected by the mission program and presents a general and defined strategy for the conservation of the species and their habitats.

Endangered Species Act Section 7(a)(1) Conservation Planning

The MVK, through support from the ERDC-EL, believes that the most beneficial means of promoting pondberry populations in the DNF is through proactive conservation planning and implementation. Section 7 of the Endangered Species Act provides that federal agencies consult with either the USFWS or NMFS (collectively, the Services) to ensure that their actions do not jeopardize the continued existence of threatened or endangered species, or adversely modify their critical habitats. Section 7 is split into multiple parts that relate to how action agencies cooperate with the Services to protect species. The USACE works with the Services primarily via formal and informal consultations under Section 7(a)(2) of the Endangered Species Act, which typically leads to the issuance of Biological Opinions by the Services that mandate special measures action agencies must follow to protect threatened and endangered species in the course of their actions.

There is significantly less familiarity with, and utilization of, the preceding Section 7(a)(1). In 2017, the USFWS Jackson, Mississippi Ecological Services Office, and the ERDC-EL collaborated on a publication (Hartfield et al. 2017) to describe the benefits of interagency cooperation through Section 7(a)(1). This approach proved successful in contributing to the delisting of the interior population of the Least Tern (*Sternula antillarum athalassos*), and the ERDC-EL and USFWS Mississippi Ecological Services Office collaborated on that recovery effort. Many of the proactive conservation activities that have been implemented during the past

several decades on USACE lands pertain directly to this section which describes voluntary conservation measures by federal agencies for federally listed species. This section specifies that agencies' duties to conserve threatened and endangered species can apply widely to programs and is not limited to individual actions. Thus, agencies can distribute conservation obligations program-wide, as well as achieve conservation opportunities outside of defined action areas to attain compliance with the ESA in a way that promotes efficiency, cost-effectiveness, ingenuity, and improved conservation outcomes through increases in species baselines. Thus, more proactive use of Section 7(a)(1) conservation actions provides a way that USACE can gain improved operational efficiency and flexibility in executing mission requirements (Hartfield et al. 2017). Importantly, the U.S. Department of the Interior Solicitor's Office released a Memorandum on 6 February 2024 (Federal Agency Obligations under Section 7(a)(1) of the Endangered Species Act) providing clear guidance affirming federal agency obligations to use their authorities to develop and carry out programs for the conservation of threatened and endangered species.

In addition, the flexibility that can be gained through 7(a)(1) conservation programs enables greater synergy with stakeholder initiatives and promotes strategic collaboration and resource leveraging which can significantly increase objectives achievement and program sustainability. It also allows opportunistic mitigation of past, present, or future adverse effects of agency actions by raising the species population and/or habitat baselines, which may reduce the potential of future interagency conflicts under Section 7(a)(2) and increase operational flexibility and mission sustainability (Hartfield et al. 2017).

Benefits of this Plan to USACE

- Improve outcomes of Biological Opinions
- Assist USFWS in finding proposed actions that will increase species baselines
- Refocus consultations on improving baselines rather than avoiding jeopardy
- Provide more operational flexibility, where applicable
- Provide incidental take statements consistent with agency commitments to conservation, acknowledging that some impacts cannot be avoided

This Plan should commit the Corps to:

- Developing and implementing a *proactive* conservation strategy
- Implementing conservation measures that will avoid and minimize, to the extent practicable, impacts to pondberry
- Proposed conservation actions that will stabilize or improve the population baselines
- Carry out actions and activities where they are within agency *authority*, and *appropriations* are available for actions

Return on Investment of 7(a)(1)

- Streamlining 7(a)(2) consultations with improved Biological Opinion outcomes
- Acknowledgement and credit to Action Agencies for 7(a)(1) conservation actions
- Reduce short- and long-term costs
- Increase operational flexibility
- Contribute to species recovery

U.S. Army Corps of Engineers, Vicksburg District Missions and Programs

The USACE has determined that the proposed water management solution would be likely to adversely affect a subset of 22 extant federally endangered pondberry between the elevation 90.0 and 93.0 ft National Geodetic Vertical Datum (NGVD 29) flood zone or within a 15-m buffer of this elevation range, and that the pumps project may affect, but not likely to adversely affect higher-elevation colonies.

The Yazoo Basin, Yazoo Backwater, Mississippi, Project (Yazoo Backwater Project) was originally authorized by the Flood Control Act (FCA) on 18 August 1941 (House Document [HD] 359/77/1), and further amended by the FCA of 22 December 1944 and 27 October 1965 (HD 308/88/2) and the Water Resources Development Act (WRDA) of 1986 and 1996. As a result of the 1941 authorization and subsequent modifications, the authorized flood control features included levees, associated drainage channels, pump stations, and water control structures designed to provide flood damage risk reduction to five subareas of the Yazoo Basin (Yazoo Area: 926,000 acres; Satartia Area: 28,800 acres; Satartia Extension Area: 3,200 acres; Rocky Bayou Area: 14,080 acres; and Carter Area: 102,400 acres). This Yazoo Backwater Area Water Management Plan and Draft Environmental Impact Statement (DEIS) analysis will evaluate remaining unconstructed features in one of the five subareas of the authorized, Yazoo Backwater Project Area, specifically the Yazoo Area.

Currently, authorized work in the Yazoo Backwater Area includes levees, water control structures, connecting channel, and pump stations. The authorized levee, hereinafter referred to as the Yazoo Backwater levee, is an extension of the Mississippi River east bank levee, generally along the west bank of the Yazoo River to a connection with the Will M. Whittington (Lower) Auxiliary Channel levee in the vicinity of the mouth of the Big Sunflower River. The Yazoo Backwater levee was completed in 1978. The authorized water control structures are Steele Bayou, Little Sunflower River, and Muddy Bayou, which were completed in 1969, 1975, and 1978, respectively. The authorized connecting channel is located between the Little Sunflower and Steele Bayou water control structures and was completed in 1978. Figure 1A shows the completed features of the Yazoo Backwater Project.

Currently, authorized work in the Yazoo Backwater Area includes levees, water control structures, connecting channel, and pump stations. The levee, hereinafter referred to as the Yazoo Backwater levee, is an extension of the Mississippi River east bank levee, generally along the west bank of the Yazoo River to a connection with the Will M. Whittington (Lower) Auxiliary Channel levee in the vicinity of the mouth of the Big Sunflower River. The Yazoo Backwater levee was completed in 1978. The authorized water control structures are Steele Bayou, Little Sunflower River, and Muddy Bayou which were completed in 1969, 1975, and 1978, respectively. The connecting channel between the Little Sunflower and Steele Bayou water control structures was completed in 1978. Figure 1.2 shows the completed features of the Yazoo Basin, Yazoo Backwater, Mississippi, Project. This DEIS will focus on the remaining authorized, yet unconstructed flood damage reduction features of the Yazoo Basin, Yazoo Backwater, Mississippi, Project.

Since 2008, significant flooding events have occurred in the area. In 2019, backwater flooding up to an elevation of 98.2 feet (NAVD88) by 23 May 2019, caused hundreds of millions of dollars in damages, flooded over 600 homes, and increased risks to human health and safety. Also, since 2008, improved environmental and hydraulic data have become available to support more refined estimates of environmental impacts. The combination of more frequent and significant flooding, increased economic safety concerns, and the availability of new and improved environmental and hydraulic data prompted the

initiation of an updated evaluation of the 2007 recommended plan. This DEIS will not reformulate any broad array of alternatives but will only update the proposed plan in light of new environmental and hydraulic data. The proposed plan addressed in this DEIS is the remaining flood damage reduction feature of the Yazoo Basin, Yazoo Backwater, Mississippi, Project, which includes both structural (construction and operation of the pump station), operation of existing structures (ex: Bayou Steele control structures) and nonstructural flood damage reduction (the elevation, wet and dry proofing, and acquisitions) features. The proposed plan will also include an updated mitigation plan to mitigate for all unavoidable environmental impacts.

The cooperating agencies are U.S. Fish and Wildlife Service (USFWS); U.S. Environmental Protection Agency, (EPA); U.S. Department of Agriculture, U.S. Forest Service (USFS); U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS); Mississippi Department of Environmental Quality (MDEQ); and Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP).

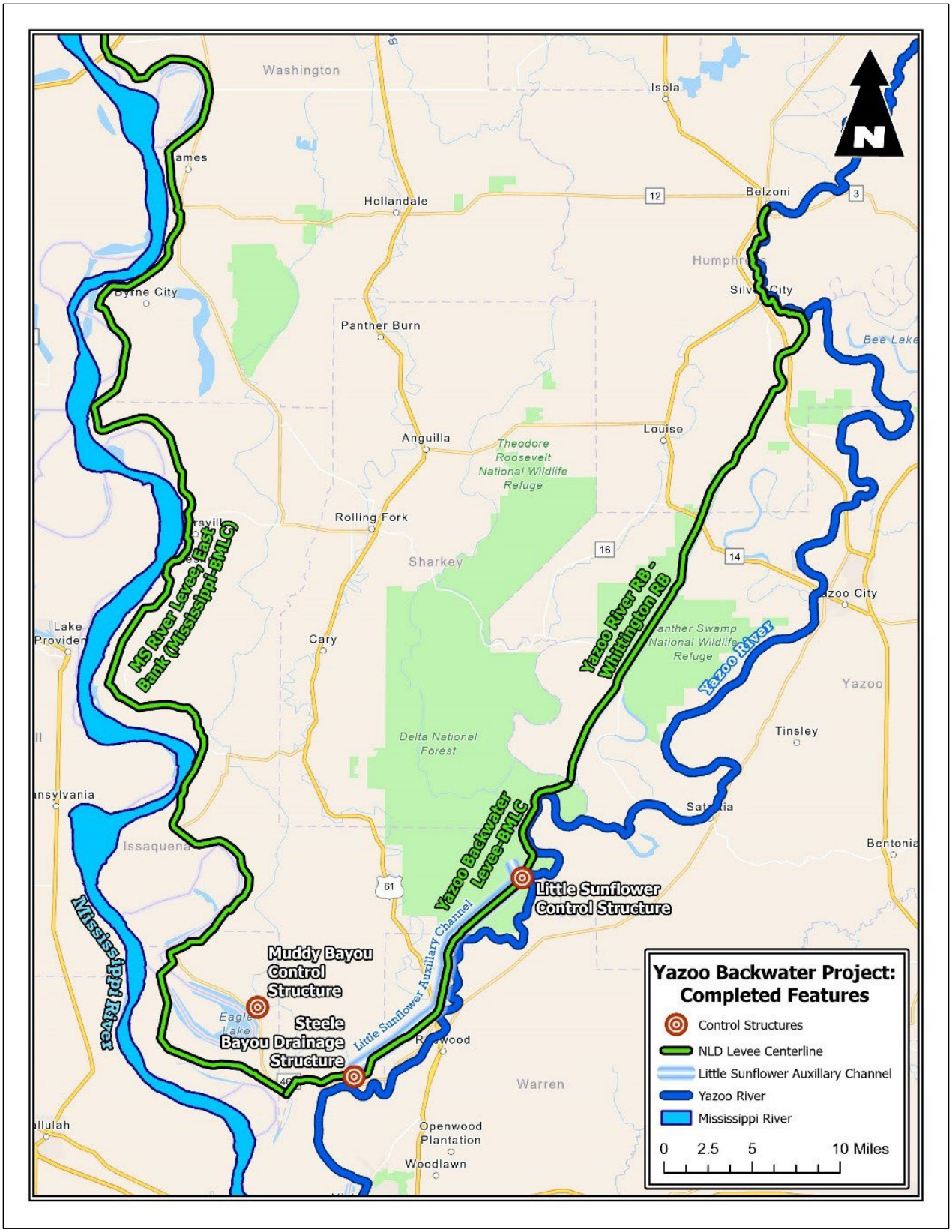

Figure 1A. Completed features of the proposed Yazoo Backwater Project including locations of water control structures.

PART II: ENVIRONMENTAL SETTING

Yazoo Basin

The Yazoo Basin is located in west-central Mississippi immediately north of Vicksburg, Mississippi, and includes all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo counties, Mississippi and part of Madison Parish, Louisiana. The triangular shaped area, also referred to as the Yazoo Backwater Area (YBA, or Action Area; Figure 1B), extends northward about 65 miles to the latitude of Hollandale and Belzoni, Mississippi, and comprises about 1,446 square miles. The YBA Action Area lies in the alluvial valley of the Mississippi River. The topography is characterized by relatively flat, poorly drained land with slopes of 0.3 to 0.9 foot per mile. Elevations range from 120.0 to 75.0 feet, NGVD, from north to south. The YBA has historically been subject to flooding from Mississippi River backwater and headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou (Figure 1B). The YBA includes the entire project footprint and all areas that may be directly (pump construction) or indirectly (changes in hydrology) affected by the various federal actions described above and not merely the immediate area involved in the action (50 CFR 402.02).

The Yazoo Backwater Area is bordered by the left descending bank of the mainline Mississippi River levee on the west, the west bank levees of the Whittington Auxiliary Channel and the Sunflower River and Steele Bayou connecting channel on the east, and the Yazoo River on the south. The Big Sunflower and Little Sunflower rivers, Deer Creek, and Steele Bayou flow through the study area. These four streams drain 4,093 square miles of the Mississippi Alluvial Valley (MAV) and include a major portion of the Mississippi Delta. The Yazoo Study Area contains approximately 926,000 acres of which approximately 500,000 acres are lands within the 100-year flood frequency (Figure 2). The drainage area extends from the confluence of Steele Bayou with the Yazoo River north to the vicinity of Clarksdale, Mississippi, and has an average width of approximately 30 miles. The area historically has been subject to backwater flooding from the Mississippi and Yazoo Rivers, and headwater flooding from the Big Sunflower River and Steele Bayou.

The floodplain frequencies within the YBA have changed over time in response to Flood Damage Reduction (FDR) features of the Mississippi River and Tributaries Project. The Corps has analyzed the flood frequency elevation gauge from historical river gauge data many times over the years. The most recent analysis came as part of the 2024 Draft Environmental Impact Statement (USACE 2024). Historical analysis of stage data is restricted by the availability of data. The Mississippi River gauge at Vicksburg was established in 1871. The first gauge established within the Yazoo Basin was the Yazoo City gauge in 1890. The first gauge established within the Project Area was Holly Bluff in 1932. The second gauge established was the Big Sunflower River at Sunflower (1935). The Big Sunflower gauges at Little Callao and Anguilla were established in 1949 and 1950, respectively. Other gauges used in the historical analysis of duration data were the Yazoo River at Satartia and Redwood, and the Steele Bayou gauges at Onward and Grace. There is scant data available for the period between 1900 and 1931, but the USGS operated two gauges on the Big Sunflower River upstream of the Little Callao gauge from 1908 through 1913.

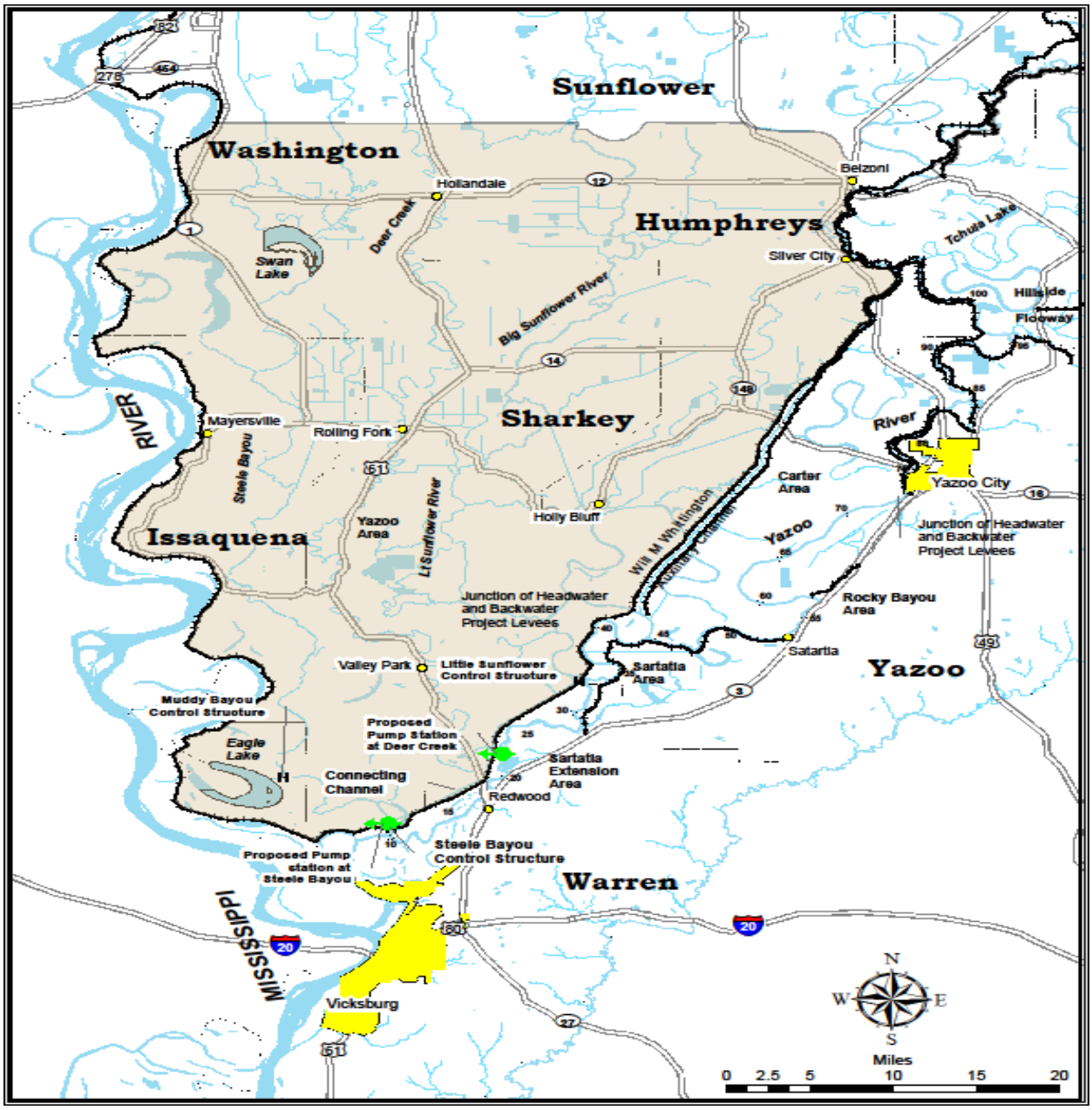

Figure 1B. The Yazoo Backwater "Action Area" (tan shading), including Issaquena, Humphreys, and Sharkey Counties, and parts of Washington, Sunflower, and Warren Counties, in west-central Mississippi.

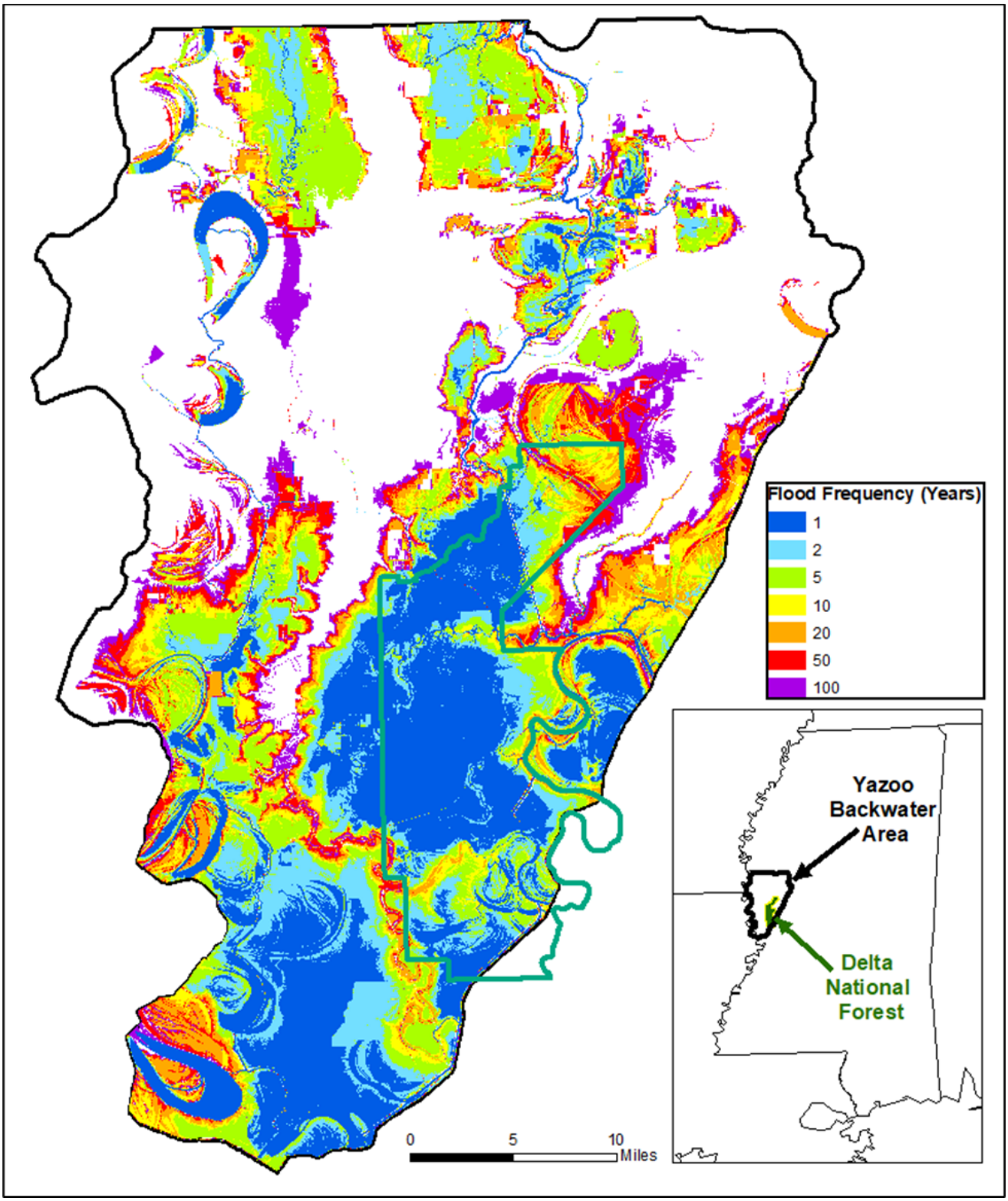

Figure 2. Map of the 1, 2, 5, 10, 20, 50, and 100-year flood frequency zones within the YBA of Mississippi as modeled using historical stream gauge data for this area in Mississippi.

Land Use

The Action Area is comprised primarily of woody wetlands (bottomland hardwood forests) interspersed with agricultural fields (Figure 3). Pondberry is found exclusively within woody wetlands within the DNF (Figure 4). Most of the known pondberry colonies that occur in the Action Area are within the DNF with a few additional colonies surveyed in 2023 (Dahomey National Wildlife Refuge, private lands colonies, and the Hester Tract). Within the Yazoo Backwater Area there has been an overall increase in forested acres between 1980 and 2010 including Humphreys, Issaquena, Sharkey, and Warren counties (Table 1; Oswalt 2013). These net increases in bottomland hardwood forest are likely to benefit pondberry since it is the primary habitat type for which it is known to occur. Land cover within the Action Area, and the DNF, is summarized in Tables 2 and 3.

Table 1. Total land and forested area estimates in Mississippi counties within the Lower Mississippi Alluvial Valley for the reference period 1950-2010. Original data obtained from Oswalt 2013.

		Forested Area (Acres in Thousands)				
County	Total Land Area	1950	1970	1980	1990	2010
Bolivar	591.3	108	96.3	66.3	84.8	128.6
Coahoma	362.2	94	69.8	56.6	67.9	70.4
Holmes	491.2	223	220.1	255.9	269.7	342.2
Humphreys	279.8	101	38.4	41.8	36.3	53.1
Issaquena	269.9	161	120.5	98.4	116.5	117.2
Leflore	362.2	94	69.2	57.9	63.5	75.7
Quitman	262	64	35.3	32.5	26.5	38
Sharkey	290.5	132	82.6	72.7	92.8	115.9
Sunflower	436.3	49	30.2	32.3	38.1	13.9
Tallahatchie	406.8	151	127.6	97.2	114	136.5
Tunica	279.6	91	52.4	57.8	44.6	68.8
Warren	360	233.2	235.8	215.5	253.6	253.7

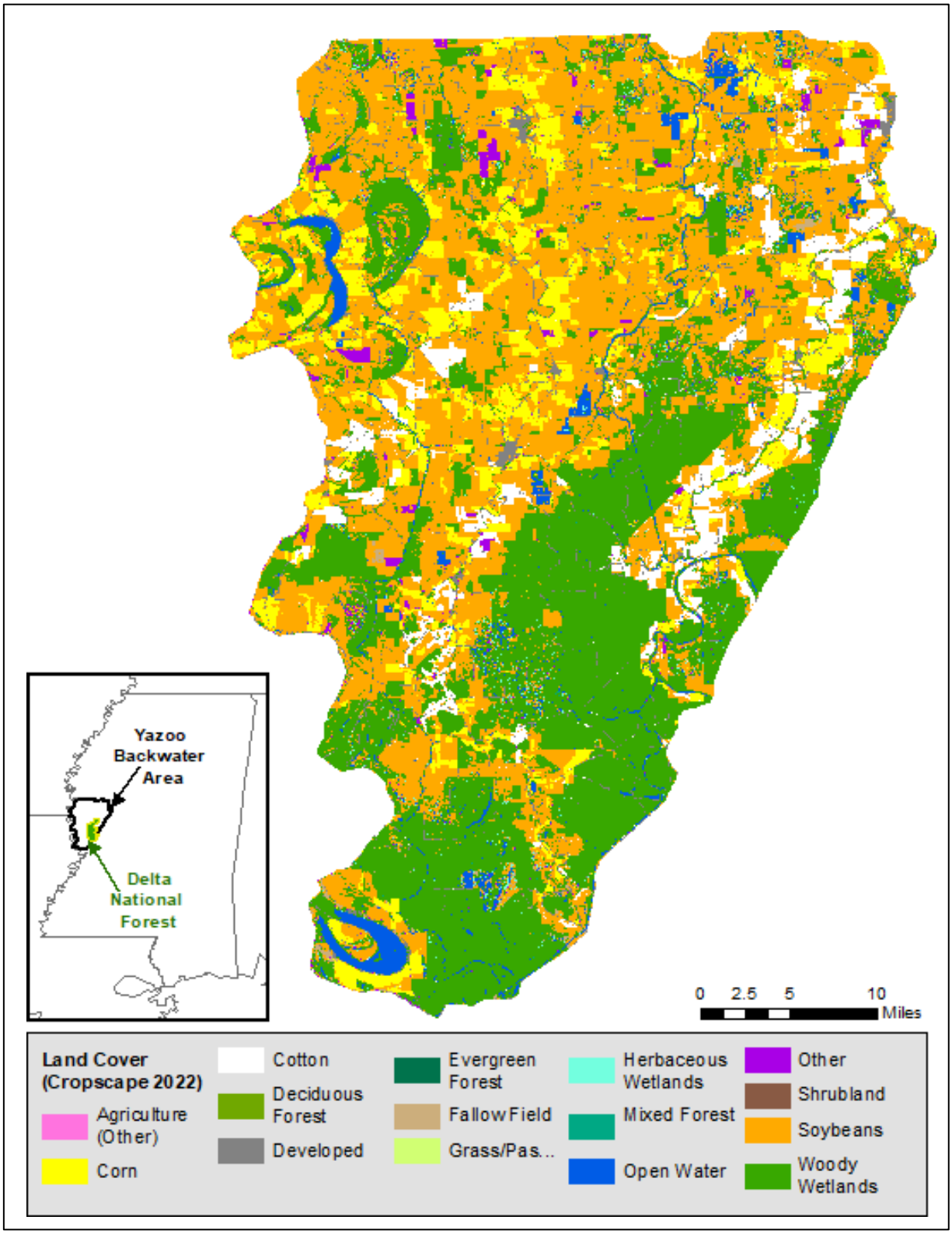

Figure 3. Land cover according to the 2022 USDA National Agriculture Statistics Service (NASS) Cropscape within the Yazoo Backwater Area. Of the forested areas, >99% is classified as Woody Wetland.

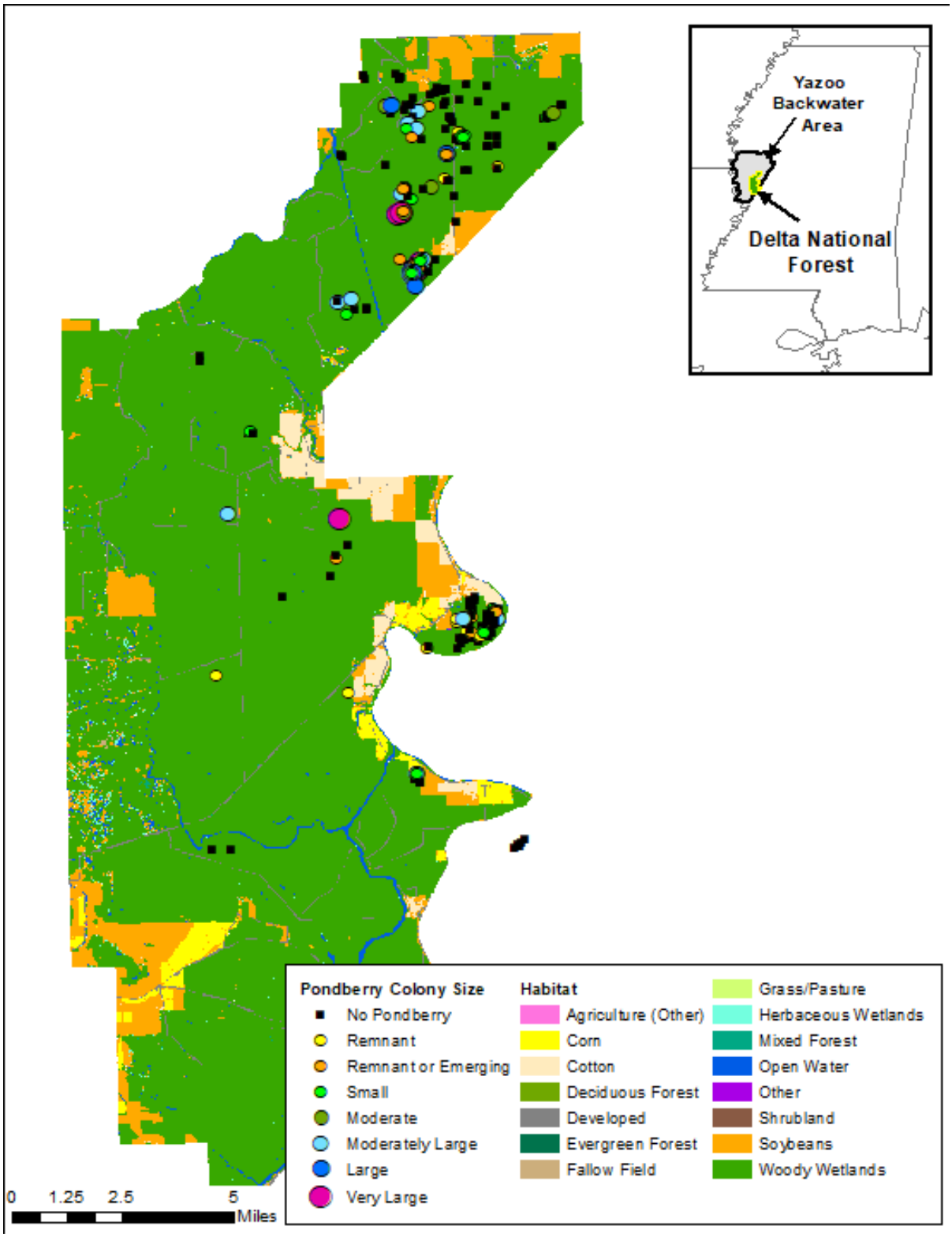

Figure 4. Land cover within the Delta National Forest according to the 2022 NASS database with extirpated and extant pondberry colonies. Table 4 defines pondberry colony size referenced within figures of report.

Table 2. Land cover within the Yazoo Backwater Area according to the 2018 NASS database.

2018 USDA NASS Land Cover Classification	Habitat	Acres
Aquaculture	Other	1,205
Barren	Other	59
Corn	Corn	78,920
Cotton	Agriculture	53,442
Dbl Crop Soybeans/Oats	Agriculture	2
Dbl Crop WinWht/Cotton	Agriculture	172
Dbl Crop WinWht/Soybeans	Agriculture	806
Deciduous Forest	Deciduous Forest	79
Developed/High Intensity	Developed	110
Developed/Low Intensity	Developed	2,520
Developed/Med Intensity	Developed	1,310
Developed/Open Space	Developed	20,183
Evergreen Forest	Evergreen Forest	45
Fallow/Idle Cropland	Fallow Field	7,092
Grassland/Pasture	Grass/Pasture	97
Herbaceous Wetlands	Herbaceous Wetlands	1,308
Mixed Forest	Mixed Forest	46
Oats	Agriculture	0
Open Water	Open Water	30,548
Other Hay/Non-Alfalfa	Agriculture	502
Peanuts	Agriculture	397
Peas	Agriculture	0
Pecans	Agriculture	1,523
Rice	Agriculture	8,655
Shrubland	Shrubland	3,337
Sod/Grass Seed	Agriculture	29
Soybeans	Soybeans	425,894
Sunflower	Agriculture	5
Sweet Potatoes	Agriculture	439
Winter Wheat	Agriculture	1965
Woody Wetlands	Woody Wetlands	284,690

Table 3. Land cover within the Delta National Forest according to the 2018 NASS database.

2018 USDA NASS Land Cover	Acres
Aquaculture	110
Barren	3
Corn	319
Cotton	3,395
Dbl Crop WinWht/Soybeans	3
Deciduous Forest	12
Developed/Low Intensity	13
Developed/Med Intensity	8
Developed/Open Space	1,829
Evergreen Forest	2
Fallow/Idle Cropland	652
Grassland/Pasture	0
Herbaceous Wetlands	171
Mixed Forest	5
Open Water	2,436
Other Hay/Non-Alfalfa	4
Pecans	17
Rice	17
Shrubland	150
Sod/Grass Seed	2
Soybeans	12,672
Winter Wheat	6
Woody Wetlands	98,909

Table 4. Relative colony sizes (# of stems) for pondberry colonies referenced in the following figures of report with symbology of remnant up to very large.

Colony size description	# of stems within size designation
Remnant	<5
Remnant or Emerging	<5
Small	6-20
Moderate	21-50
Moderately Large	51-250
Large	251-500
Very Large	>500

Habitat

Land and water resources within the 926,000-acre Yazoo Backwater Area are comprised mainly of agricultural land or woody wetlands (i.e., primarily bottomland hardwoods), with numerous river and stream systems interspersed across the landscape. Bottomland hardwoods containing Cottonwood *(Populus deltoides),* Sycamore *(Platanus occidentalis),* Black Willow (*Salix nigra),* Pecan (Carya spp.), Green Ash *(Fraxinus pennsylvanica),* Sugarberry *(Celtis laevigata),* Hackberry *(C. occidentalis),* Oaks *(Quercus* spp.), and Elm *(Ulmus* spp.) are dynamic and productive systems that depend on intermittent flooding for maintenance of structure and provide numerous functions (e.g., wildlife habitat, sediment retention). They are the most important ecological landscape component under consideration for impacts by the construction and operation of the Yazoo Backwater Pumps Project. Agricultural lands provide limited habitat for a small number of species.

Hydrology and Hydraulics of River Systems

The hydrology of the study area is affected by both internal and external sources. Both sources have been altered by features of the Mississippi River and Tributaries (MR&T) Project. The frequency and duration of flooding due to the Mississippi River have been reduced by the mainline levees and the channel cutoffs (external sources). The levees keep floodwaters of the Mississippi River out of the Yazoo Study Area. The channel cutoffs lowered Mississippi River stages which in turn reduced backwater flooding. The maximum reduction of backwater flooding due to the channel cutoffs occurred in the 1950s. Aggradation of the Mississippi River channel bed has eliminated most of this reduction. Reservoirs constructed in the hill area of the Yazoo Basin and channel improvements to the Yazoo River also had an effect on stages within the Yazoo Backwater Area and have reduced flooding in the Yazoo River, but high stages on the Yazoo River do not necessarily induce significant backwater flooding in the YBA. For example, during the April 1991 Flood, there was significant flooding in the Coldwater and Tallahatchie River Basin, which amounted to a 50-year flood event. However, the stage at the SBWCS was equivalent to a 5-year flood, and the Steele Bayou and Little Sunflower River gates only closed very briefly at the beginning of this headwater flood event because the interior water elevation was greater than the riverside elevation. The YBA has also benefited from other flood damage reduction features of the MR&T project that have been completed inside the study area (internal sources). A more detailed description of the hydrologic setting is included in Appendix 6 of the Yazoo Backwater SEIS II (USACE 2020a), and the Engineering Appendix A in the 2024 draft EIS.

- Yazoo Backwater levee extending from the end of the east bank mainline Mississippi River levee to the downstream end of the west side of the Will M. Whittington Channel levee along the Yazoo River.
- Water control structures at Steele Bayou and the Little Sunflower River. These structures allow interior runoff to be released when the ponding area stages are higher than the river stages and prevent backwater flooding from the Mississippi and Yazoo Rivers when the river is higher than the ponding areas.
- A 200-foot bottom width connecting channel between the Big Sunflower and Little Sunflower Rivers and an enlarged Little Sunflower River channel between this connecting channel and the Little Sunflower drainage structure.

- A 200-foot bottom width connecting channel between the Little Sunflower River and Steele Bayou, which also intercepts Deer Creek flow.
- A water control structure in Muddy Bayou which controls Eagle Lake inflows and outflows for environmental purposes.
- The inlet-outlet channel and the cofferdam around the pump station site.

The mainline Mississippi River levees are designed to protect the alluvial valley from the Project Design Flood (PDF) by confining flood flows within the leveed floodway, except where it enters the backwater areas or is diverted intentionally into the floodway areas. The mainline levee system is comprised of levees, floodwalls, and various control structures. When major floods occur and the carrying capacity of the Mississippi River leveed channel is threatened, additional conveyance through the Bird's Point-New Madrid Floodway, and relief outlets through the Atchafalaya Basin, Morganza, and Bonnet Carre Floodways are utilized as well as the storage capacity of flat lowlands at the confluences of tributaries with the Mississippi River. These tributary areas are commonly referred to as "backwater areas." These areas are protected from lesser floods by backwater levee systems that are designed to be overtopped near the crest of the PDF in order to reduce the peak flow of the PDF and allow safe passage within the mainline levee system. The system design which utilizes backwater storage at appropriate times in the PDF hydrograph has significantly reduced the need for even higher mainline levees. The Yazoo Backwater levees are designed to overtop by the PDF.

Ponding of runoff from the Big Sunflower River, Little Sunflower River, Deer Creek, and Steele Bayou is provided by two ponding areas connected by a 200-foot bottom width channel. The lower ponding area, formerly referred to as the Steele Bayou ponding area, lies in the lower end of the Steele Bayou Basin while the upper ponding area, formerly called the Sunflower River ponding area, is located in the lower portion of the Little Sunflower River Basin.

The interior area is protected from high stages of the Mississippi and Yazoo Rivers by levees; however, the area is subject to flooding resulting from interior drainage from Steele Bayou, Deer Creek, and Big and Little Sunflower Rivers. Under present conditions, the flooding in the Yazoo Action Area primarily results from interior ponding behind the Yazoo Backwater levee when the Steele Bayou and Little Sunflower structures are closed due to high Mississippi River stages. The interior ponding areas consist primarily of agricultural and forested lands with several developed areas. Interior flooding begins at approximately 80.0 feet, NGVD.

During the rising and falling stages of a flood hydrograph, the water surface elevations in the upper ponding area are generally higher than the water surface elevations in the lower ponding area. This difference is due to the difference in elevation between the two sumps. Near the peak of the flood event, there is little difference in water surface elevations between the two ponding areas.

The Muddy Bayou water control structure was constructed as a means of controlling inflows to and discharge from Eagle Lake during non-flood conditions to enhance the lake's water quality. However, due to the topography surrounding the lake, flood protection is provided as well.

During flood conditions, the Muddy Bayou structure is opened to allow water to pass from the lower ponding area into Eagle Lake only if it becomes apparent that this line of protection will be overtopped (about elevation 96.0 feet, NGVD).

Eagle Lake was formed from an abandoned Mississippi River channel and has been cut off from the Mississippi River by the Mississippi levee. Without the two low-level levees (privately owned) in conjunction with the Muddy Bayou water control structure, the area would see significant backwater flooding.

The Steele Bayou water control structure is the principal drainage structure for the Yazoo Backwater Project. Any time the stage on the landside of the Steele Bayou and Little Sunflower water control structures is higher than the riverside and above 70.0 feet, NGVD, the gates are opened. With a rising river, the interior ponding areas are normally allowed to rise to an elevation of 75.0 feet, NGVD. The floodgates are closed when the river elevation is higher than the interior ponding levels. The Little Sunflower structure generally remains closed. It is opened during flood events when the riverside water surface elevation is less than the landside elevation and the Steele Bayou water control structure is closed.

The Steele Bayou water control structure is operated to control minimum water levels in the Steele Bayou and Little Sunflower ponding areas. The current operation plan calls for holding minimum water levels in the ponding areas between 68.5 feet, NGVD, and 70.0 feet, NGVD.

As was mentioned earlier, there were several FDR features that affected internal stages that were constructed between 1950 and 1978. These included clearing and snagging of the Big Sunflower River and the construction of the Holly Bluff cut-off. These features reduced flooding above the upper end of the Holly Bluff cut-off (Anguilla and Little Callao gauges), but increased stages at Holly Bluff by approximately 1 foot. The 2007 SEIS included a comparison of the 14-day duration flood extents for four periods from 1900 to 1997. That study was updated using the 10-meter LIDAR DEM used in the USACE (2020a) SEIS.

An increasing average annual precipitation trend over more than a century (Figure 5) suggests that likelihood of extreme flood events in the YBA (such as those experienced in 2019 and 2020) may become more likely to occur in the future. If the proposed pumps are installed and operated, duration and intensity of such extreme flooding would be lessened.

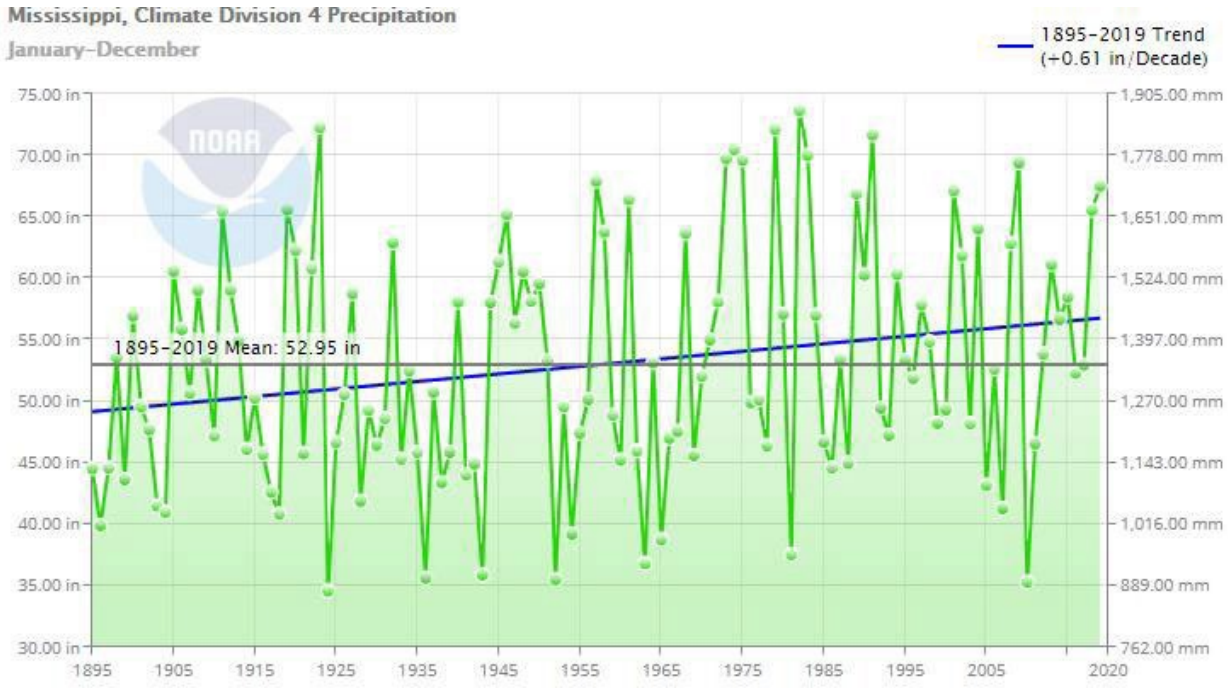

Figure 5. Annual precipitation trend (1895-2019) for Mississippi's Climate Division 4 (NCEI 2020).

PART III: SPECIES ACCOUNT

Pondberry Description and Species Account

Pondberry is a low-growing, deciduous shrub with stems typically ranging in height from 1.5 to 6.5 feet with stems >9.5 feet also documented in 2023 at the Hester Tract, Mississippi. The plant commonly grows in clumps of numerous scattered stems and spreads vegetatively by stolons. The older portions of the stems are dark green to almost black with numerous irregularly spaced, but prominent lenticels, which appear very similar to saplings of young sassafras (*Sassafras albidum*) stems. The leaves are drooping and have a distinct and unique "lemony" sassafras-like odor when crushed (Buchanan and Finnegan 2010). Leaves are 0.75 to 2.5 inches wide and 2 to 6.5 inches long with a round to cordate base. The leaf veins are prominent, and the undersurface of the leaf is hairy. Pondberry is distinguished from the two other North American members of the genus (*Lindera benzoin* and *Lindera subcoriacea*) by its drooping foliage, obtuse or rounded leaf base, conspicuous venation and the two lowest pairs of lateral nerves that are not parallel to the ones above.

Pondberry is dioecious with male and female flowers found on separate plants; flowers of both sexes are pale yellow and small. The flower stalks and buds are often hairy. The plant flowers after two to four years of growth. The fruit is about 0.5 inches long at maturity, elliptical, and turns bright scarlet red at maturity in the fall. The flowers develop in spring before leaves emerge (generally in early March) with mature fruit evident by October. Fruit stalks are often present until next year's flowering (USFWS 1990; Klomps 1980a; Tucker 1984).

Pondberry can form short-term persistent soil seed banks for 1-2 years (Connor *et al*. 2006, 2012; Hawkins *et al*. 2011) and some seeds may remain viable for longer periods in the soil seed bank (e.g., Smith 2003). Seed and seedling depredation may partially explain the lack of observed seedlings (e.g., Tucker 1984; Wright 1989; Devall *et al*. 2001; Aleric and Kirkman 2005b; Connor *et al*. 2006) and seeds on the soil surface with intact pulp presumably are sometimes removed by both birds and mammals (Aleric and Kirkman 2005b). Smith et al. (2004) documented both seed predation (Northern Cardinal [*Cardinalis cardinalis*]) and short-distance seed dispersal (Hermit Thrush [*Catharus guttatus*]) at five fruiting colonies in the DNF. They concluded that bird dispersal of seeds, such as that documented with Hermit Thrush, is unlikely to result in pondberry colony establishment in unoccupied suitable habitat, such as forest patches separated by open spaces. Northern Cardinal (*Cardinalis cardinalis*), Brown Thrasher (*Toxostoma rufum*), Swamp Rabbit (*Sylvilagus aquaticus*), Nine-banded Armadillo (*Dasypus novemcintus*), and Gray Squirrel (*Sciurus carolinensis*) (Abilio *et al*. 2008; Leininger *et al*. 2009) all were initially identified as potential pondberry seed or seedling predators. Subsequently, Martins et al. (2015) significantly expanded the list of avian and mammalian seed and seedling predators using videography. Other factors have also been hypothesized to lead to the lack of observed seeds or seedlings, such as late frosts that may kill flowers (Tucker 1984), or fungal infections (Devall et al. 2001, Unks 2011). This aspect of pondberry life history requires additional research.

The most comprehensive reviews on the life-history and habitat of pondberry are included in the pondberry recovery plan (USFWS 1993), the USFWS's (2007) Biological Opinion for the prior Yazoo Backwater Area Reformulation project, Devall (2013), and the two recent USFWS 5-Year Reviews (USFWS 2014, 2021) for pondberry.

Taxonomic Status

Pondberry is a member of the family Lauraceae. It is one of three members of the genus *Lindera* found in the southeastern United States, which also include *L. benzoin* and *L. subcoriacea*, a new species described by Wofford in 1983. Pondberry was first described as a new species by Tomas Walter in 1788 (Tucker, 1984). The material upon which he based this description was collected from what is present-day Berkeley County, South Carolina (Mercer 1984). The USFWS (2014) reviewed the taxonomy of *Lindera melissifolia* for both the listing document (51 FR 27495) and recovery plan (USFWS 1993), and is currently recognized as an accepted taxon by the Integrated Taxonomic Information System (2012) and Flora of North America (van der Werff 1997).

Pondberry Range and Population Sizes

Pondberry was federally listed as an endangered species on 31 July 1986 (Federal Register 51(47):27495-27500). A Recovery Plan (USFWS 1993) was completed and published in 1993. The two most recent USFWS 5-Year Review (USFWS 2014 and 2021) recommended "No Change is Needed" regarding its current federally Endangered status. The USFWS (2021) believes that the species currently is stable to declining from a range-wide perspective. Pondberry occurs in the Mississippi River alluvial plains of Missouri, Arkansas, and Mississippi, and the Coastal Plains region of Alabama, Georgia, South Carolina, and North Carolina (Figure 6). The USFWS defines a pondberry population using the 1-mile separation distance described in Service's 2007 biological opinion (USFWS 2007) and 2014 and 2020 5-year reviews (USFWS 2014 and 2021). Based on that definition, the USFWS estimated there are at least 73 natural populations, though only 35 of those have been confirmed extant by recent observations (USFWS 2021). As of 2021, there was one extant population in Alabama; 24 known populations in Arkansas (six extirpated, five extant on state- or federally owned land, and 12 on private lands of unknown status; 20 populations in Georgia (4 extirpated and presumed 16 extant); 20 populations in Mississippi (Four in Bolivar County, including Dahomey National Wildlife Refuge; 14 in the DNF [Sharkey Co.], two in Sunflower Co.); . Pondberry historically has been reported from Louisiana and western Florida, however, populations in these states are considered extirpated (Tucker 1984, Wofford 1983, USFWS 1990). Since the 2021 5-Year Review by USFWS, populations undoubtedly have been discovered or extirpated, but to our knowledge, this information recently has not been collated into a single range-wide evaluation. The USFWS (2021) believes that the species currently is stable to declining from a range-wide perspective. Though new populations have been discovered since the 2014 5-Year Review, and many more colonies discovered in Mississippi since the 2021 5-Year Review (as detailed in this document), population declines and recent extirpations have been noted throughout the range. The lack of comprehensive and recent monitoring data across the range has led to uncertainty for a proper rangewide species assessment. The USFWS (2021) summarized what is known about pondberry populations by state, noting that populations are considered stable to declining, with generally stable populations in Alabama, Arkansas, and Missouri; and declining populations in North Carolina, South Carolina, Georgia, and Mississippi (USFWS 2021).

In the DNF, despite USFS best management practices to avoid adverse ground-disturbing activities to these plants/colonies during forest management (Banker and Goetz 1989; Bowker 1989, *in litt*.), some pondberry colonies have either been extirpated or have experienced declines, potentially related to stem dieback, changes in hydrology, interspecific plant competition, and natural canopy disturbances (Gulf South Research Corporation 2005, USFWS 2007, USFWS 2014). Other populations in Mississippi have been known to occur in Bolivar (two pondberry populations on private lands with as many as 20,000 and 5,000 stems/plants) and Sunflower Counties (private lands population of approximately 1,500 stems/plants). Leonard (2010) conducted searches in Panther Swamp National Wildlife Refuge in Yazoo County but found no pondberry during 2006 and 2007. Additional monitoring is needed to more adequately quantify and understand pondberry's current distribution and abundance, health, long-term colony and population dynamics, effects of forest management, and persistence.

Information from recent surveys by the ERDC-EL annually from 2020-2023, as detailed in this Plan, provides additional information on colonies and populations in all three Mississippi counties where it is known to be extant (Figures 7 & 8). Much more comprehensive data collected annually by the ERDC-EL from 2020-2023, and reported herein, provides an updated and relatively comprehensive assessment of all known pondberry populations in Mississippi.

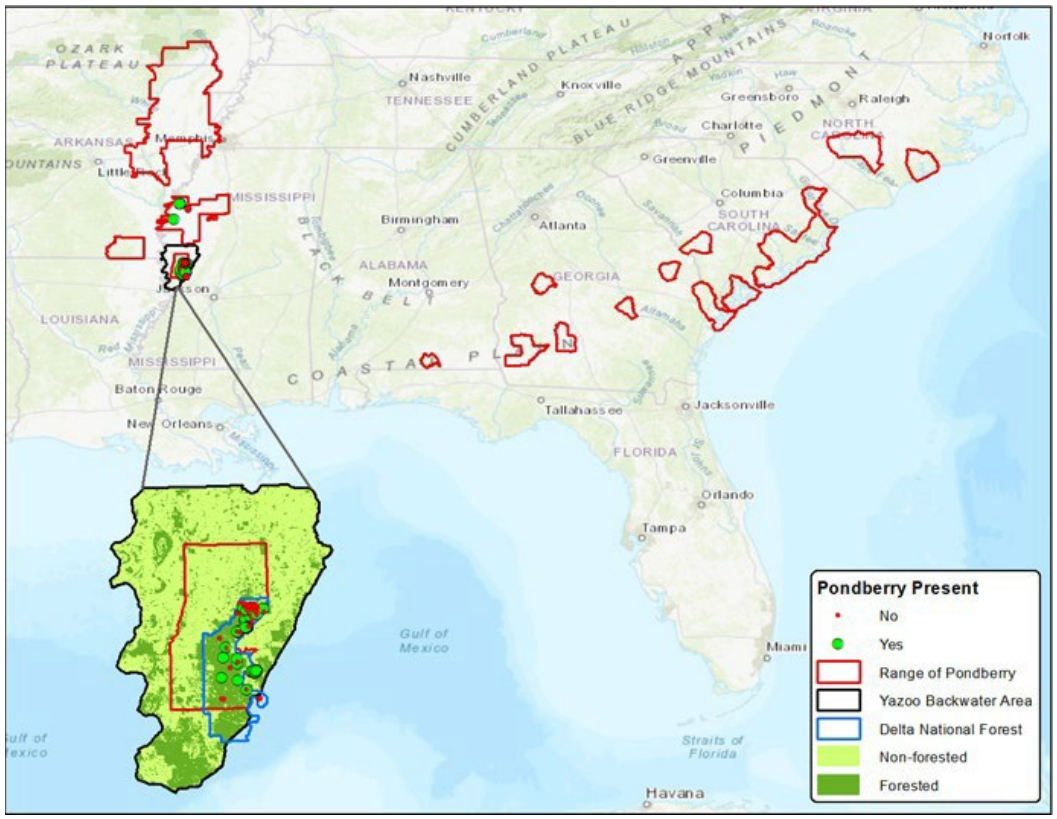

Figure 6. Pondberry range (source: USFWS 2020). Inset shows Delta National Forest with GSRC's pondberry colony locations.

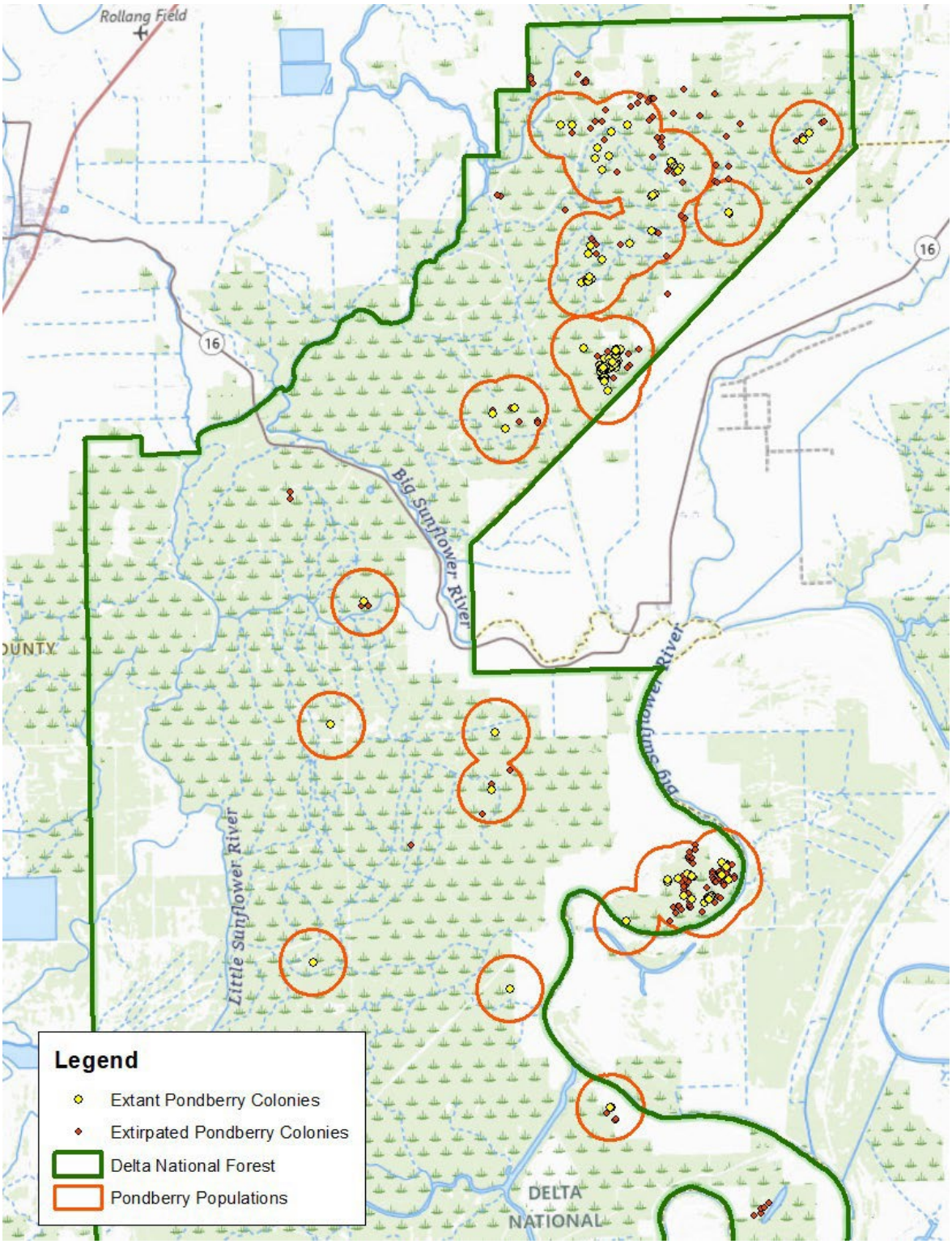

Figure 7. Distribution of 313 extant and extirpated pondberry colonies/sites within 12 populations (separated by a minimum of one mile) within the Delta National Forest as of August 2023. Extirpations, colony expansions, and new colony discoveries, all have led to a change in number and distribution of populations from that noted in the 2005 USFWS Biological Opinion for pondberry (Plate 7; Page 218).

Pondberry Life History

Pondberry populations are generally found in bottomland hardwoods under a partially shaded canopy of mature forest (Klomps 1980a, Tucker 1984). Colonies in Mississippi occur in small dense clumps usually averaging less than 0.10 acre in size. Numerous field investigations indicate that vigorous healthy colonies were found in homogeneous clumps with shrub associates growing adjacent to, but not within, the clumps. In less vigorous colonies, shrub/vine associates were usually growing within the clumps.

Individual stems within each colony are short-lived, generally dying by their seventh or eighth year. Young stems sprout from the rootstock and replace the dying stems. Over time, colonies may expand vegetatively, resulting in many vastly rooted stems. Thus, a typical vigorous colony is composed of numerous relatively tall stems, dead and dying stems, as well as young leaf sprouts. Despite numerous studies attempting to identify seed dispersal agents, there is little information regarding new seedling establishment and growth; therefore, colony expansion is suspected to be almost exclusively vegetative (Tucker 1984, FWS 1990).

Individual stems of pondberry begin flowering by their second to fourth year of growth (Tucker, 1984). Flowering begins in late February to early March in Mississippi and generally lasts no longer than 2 weeks. Pondberry is dioecious (male and female flowers found on separate plants). A typical colony in Mississippi is composed primarily of male stems with few to several female stems. In some instances, the entire colony is composed of male plants. In general, seed production in relation to the total number of stems is low. Because flowering occurs in late February to early March, frost or near-freezing temperatures often damage flowers, thereby reducing fruit production even more. Rayner and Ferral (1988), in a study of 73 colonies from the Honey Hill region of South Carolina, reported that only 22 percent of all colonies surveyed produced fruit, with fruit production averaging only 22 fruits per colony. They also noted that fruit production did not seem to improve with plant health since sexual reproduction appeared to be poor even in large healthy plants. Clonal (vegetative) spread of pondberry may be an important component of its life history, and this is reviewed in more detail in USFWS (2014). Pondberry is suspected to be insect-pollinated. Tucker (1984) noted small bees and flies on flowers in Arkansas. The fruit contains many oils and similar compounds, which are suspected to make the fruit unpalatable to most wildlife. Therefore, seed dispersal is likely accomplished by seeds merely falling to the ground or by animals (such as birds) picking the fruit and depositing it elsewhere (USFWS 1990). No plant species currently are known to hybridize with pondberry.

Pondberry Habitat Requirements

Habitat requirements of pondberry appear to be variable across its range. Pondberry is found within seasonally flooded wetlands that broadly include riverine bottomland hardwood forests and geographically isolated wetlands (i.e., Carolina bays, limestone or lime sink ponds, sand ponds, and lowland sand prairie depressions) in the Atlantic and Gulf Coastal Plains and Mississippi Alluvial Valley of the southeastern United States (USFWS 2014). In general, pondberry occupies wetland habitats that are normally flooded or saturated during the dormant season, but infrequently flooded during the growing season for extended periods (Tucker, 1984).

Hydrology at geographically isolated wetlands typically is maintained by precipitation, and in some cases, groundwater. Hydrology for pondberry colonies in bottomland hardwoods is maintained by overbank flooding, local precipitation, storage in depressions or at sites with soils that impede drainage independent of overbank flooding, or a combination of the previous two factors (USFWS 2014).

Tucker (1984) reported that pondberry populations in Mississippi are associated with "mature bottomland hardwood forests in low depressions." The USACE (1991) reported that pondberry colonies in Mississippi are typically found on slight ridges in a ridge and swale community which is either frequently or periodically flooded or is in proximity to a permanent water body. The extant populations in Mississippi are all associated with bottomland hardwoods at elevations where rainfall/local hydrology dominates the hydrologic conditions at the pondberry colony site (USACE 2005). Hawkins et al. (2009) provided a quantitative description of bottomland hardwood forests in the DNF that supported pondberry colonies. They analyzed extensive data and found that canopy and subcanopy trees were similar among sites, colonies were not associated with mean tree density or dbh, and forest composition and structure reflect hydrologic regime, topography, historical disturbance, and absence of any recent disturbance.
The Mississippi populations were thought to occur on soils characterized by the Sharkey-Alligator-Dowling Association and less frequently on soils characterized as Alligator-Dowling-Forestdale Association as delineated by the Natural Resources Conservation Service 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 soils within these associations all have poor drainage, high water table, low permeability rates, and gleyed B and C horizons (Tucker 1984, Banker and Goetz 1989). The tight clay subsoils of these associations result in slow permeability rates (0.2 to 0.6 inch per hour near surface and 0.06 inch per hour in subsoils). Therefore, overland sheet flow dominates water movement in these soils (Banker and Goetz, 1989).

The USACE (1991) reported that of 44 pondberry colonies surveyed, 41 percent were in surface soils classified as silty clay, 32 percent is silty clay loams, and 21 percent in silt loam soils. In addition, 62 pondberry sites surveyed in 2000 and 2005 (Attachments 3 and 6) contained clay loams or silty clay soils (Gulf South Research Corporation [GSRC] 2000, 2005). This indicates that pondberry colonies will not likely be found on strictly heavy Alligator, Sharkey, or Dowling clay soils.

Associated Species

Hawkins et al. (2009b) investigated the canopy and subcanopy composition of bottomland forests associated with pondberry populations in Mississippi, Arkansas, and Missouri, and found pondberry distribution was not associated with mean tree density or dbh, and no single indicator tree species could be identified. Their data did suggest that pondberry tended to be more associated with flood tolerant than flood-intolerant species. Hawkins *et al*. (2010) conducted focused studies in bottomland hardwood forests of Mississippi on the vascular plants associated with pondberry colonies and found 69 species growing within 1 m of pondberry colonies in Bolivar and Sharkey Counties. Of these species, nine were identified as having weedy

characteristics while eight species of vines (five *Smilax* spp. and three *Vitis* spp.) were identified that could strongly compete with pondberry for light.

Several early investigators from the 1980's studied tree species associated with Mississippi pondberry populations. Tree species most often associated with colonies included oaks *Quercus* spp.), Sugarberry (*Celtis laevigata)*, American Elm (*Ulmus americana)*, Green Ash (*Fraxinus pennsylvania*), and hickories (*Carya* spp.) (Morgan 1983, Tucker 1984). From the early 1990's to 2005, various investigators including USACE and GSRC continued to collect data on associated tree and shrub species, more clearly defining associates (GSRC 2000, 2005). The most common overstory tree species were oaks (*Q. phellos, Q. nuttallii, and Q. lyrata*), sweetgum (*Liquidambar styraciflua*), and elms (*U. crassifolia, U. americana, and U. alata*). In 2005, the most common overstory species were Sweetgum, Overcup Oak, and Pecan. Devall, et al. (2001), recorded the dominant trees inhabiting the 40-acre Red Gum Research Natural Area in Sharkey County. Dominant tree species observed included Sweetgum, Box Elder (*Acer negundo*), American Elm, and Sugarberry. Nordman (2002) conducted a botanical inventory of a 164x65-foot plot containing pondberry in Compartment 7 of DNF in 2002 and characterized the pondberry colony as an "Old growth sweetgum stand with canopy gaps containing Cedar Elm (*U. crassifolia*) trees up to 20-inch dbh in the subcanopy, with a slightly higher topography than most pondberry sites in DNF."

Other Pondberry Research

In 2005, the U.S. Army Engineer District, Vicksburg (MVK) provided funding to the U.S. Department of Agriculture, U.S. Forest Service (USFS), Southern Research Station, to conduct extensive pondberry research investigations. The MVK entered into a $5 million, 6-year cooperative interagency agreement in 2001 (and later amended in 2002 with input from USFWS) with USFS to conduct experiments on pondberry that resulted in a multitude of reports and publications in the following areas-- the role of flooding and sunlight (e.g., Lockhart et al. 2006, Lockhart et al. 2015); silvicultural treatments (e.g., Lockhart 2016), impact of periodic flooding on competition; dynamics of native pondberry colonies; and stem dieback, population genetics (Echt et al. 2011), and seed ecology. This program also involved the propagation of over 80,000 pondberry plants to conduct genetic testing, pathogen and predation analyses, and flood regime requirements. The latter included both laboratory and field experiments involving 12 1-acre ponds (impoundment cells). Some of the resulting publications were included in the 2007 Final Yazoo Backwater Area Reformulation Study EIS (i.e., Pondberry Regional Habitat Requirements; Pondberry Profile; Re-evaluation of Pondberry (*Lindera melissifolia*) in the Big Sunflower River and Yazoo River Backwater Areas; Pondberry Biological Assessment; and Pondberry Final Biological Opinion), while others have been published subsequently in the peer-reviewed literature and summarized below.

Threats and Reasons for Decline

While there are no records in the literature of pondberry's status (whether it was abundant or scarce) before modern times, apparent reasons for the species current endangered status are discussed below. Land clearing operations for agricultural, commercial, and private development have substantially impacted bottomland hardwood forests where pondberry has historically thrived (USFWS 1990). Timber harvesting activities (and especially those that include use of heavy equipment) can crush plants, fell trees into pondberry colonies, uproot trees near colonies,

unfavorably modify forest canopy, and possibly change 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 USFWS, 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 (Banker and Goetz, 1989).

Several investigators have made general statements about drainage activities and subsequent effects on pondberry such as ditching which, could alter 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 (Kral 1983, Wright 1989, USFWS 1990). The USACE, through extensive field studies of pondberry within Mississippi, determined that only drainage activities that significantly alter the local hydrologic regime of depressions, ponds, sinks, or other areas governed by localized hydrology would adversely affect pondberry colonies.

A third factor associated with the loss of habitat is land clearing due to agricultural interests and other developments. Throughout the pondberry range, bottomland hardwoods and similar habitat types have been extensively cleared. These wetlands provide a variety of functions (e.g., water storage; floral and faunal habitat) and values (e.g., flood risk reduction; recreation) within the Mississippi River Valley (Smith and Klimas 2002). However, historic landscape alteration has resulted in significant (>70 percent) declines in forested wetland acreage, and associated losses of wetland functional capacities in the region (King et al., 2006).

Disease/herbivory. The literature indicates that nearly all colonies of pondberry are affected by stem dieback. Rayner and Ferral (1988) reported that stem dieback and herbivory were two factors that lead to poor colony health in the Honey Hill region of South Carolina. Stem dieback has been hypothesized to be fungal and/or drought related but could be characteristic of the species. Predation has been observed by deer and insects, mainly the spicebush swallowtail caterpillar (*Papilio troilus*) (Rayner and Ferral, 1988; USACE, 1991). Devall et al. (2000), found six insect species in association with pondberry, but none of them appear to be a limiting factor for the plant.

Through field studies of pondberry colonies in Mississippi, stem dieback and insect damage seem to influence the general health of many colonies (USACE 1991; GSRC 2000, 2005). Devall et al. (2000), reported dieback of 33 percent of the stems during June at a site in Shelby County, Mississippi. The best available information suggests that stem dieback is related to fungal pathogens, drought, and the interactions between the two. In addition, Devall et al. (2000), noted that in unusual conditions, stem dieback may be caused by winter freezing. Monitoring and studies of plant growth and decline at colonies in DNF indicated most instances of stem dieback were accompanied by abnormal patterns of sudden leaf wilt and death during the growing season on plants of all size classes. This pattern was not indicative of senescence and dieback of old or large plants. Dead stems have been reported at various locations in different pondberry locations (e.g., GSRC 2000, 2005).

Wright (1989) first reported leaf senescence, summer leaf fall (facultatively deciduous), and twig dieback on pondberry plants in response to summer drought conditions in Arkansas. In the DNF, the pathological symptoms of active dieback were directly observed and monitored by McDearman at 10 pondberry colonies (USFWS 2000b). The first symptoms were characterized by rapid leafwilt and sudden death of leaves and stems during a late summer dry period, without leaf abscission. Stem, branch (more than one stem), or whole plant death followed during the subsequent fall and winter. Since leaves died rapidly in the summer without abscission at DNF sites, additional investigations by Dr. Douglass Boyette (USDA Agricultural Research Service) revealed several potential pathogens, including *Diaporthe* sp., the cause of stem-canker. Browsing by vertebrates appears to occur only occasionally. Some stems were reported to have been eaten by rabbits during the winter (Wright, 1989). The USACE (1991) reported evidence of herbivory at only one of 44 pondberry colonies in DNF.

Pondberry also is susceptible to a fungal pathogen (*Raffaelea lauricola*) that causes laurel wilt, which is a lethal disease for the species. Several researchers have investigated the impacts of this pathogen on pondberry (e.g., Fraedrich et al. 2011, Best and Fraedrich 2018).

Lack of reproduction. Most recent accounts and studies of pondberry list poor sexual reproductive success as another important reason in the decline of pondberry colonies. Many of the colonies studied in Mississippi consisted mainly of male plants. Some entire colonies contained only male stems. Consequently, colony expansion is suspected to occur primarily vegetatively. Sexual reproduction can be accomplished in a controlled environment (such as a nursery) as reported by FWS (1990), which indicated successful seed germination when seeds were depressed below the soil surface. During field surveys of the Mississippi population on DNF, numerous seeds were observed on plants although no seedlings were observed. It should be noted that seedlings can be difficult to distinguish from other species (Aleric and Kirkman 2005; Hawkins et al. 2010) and easily overlooked. With the abundance of suitable habitat within DNF, it is likely that if germination and sexual reproduction can occur in the wild, it could be occurring here. However, reports by Tucker (1984) and Morgan (1983) suggested some uncertainty about germination and new seedling establishment in the wild.

Competition. Hawkins et al. (2010) investigated three disjunct pondberry populations in Mississippi over three years and found that most associated species do not appear to have direct competitive impacts on pondberry, except for those that are invasive, become weedy, or have vining growth forms. For the latter, *Smilax* spp. and *Vitis* spp. have high potential as strong competitors to pondberry, and recent ERDC-EL surveys in the DNF noted some colonies with dense trumpet creeper (*Campsis radicans*) and peppervine (*Ampelopsis* spp.) encroachment. Additionally, dwarf palmetto (*Sabal minor*) forms dense stands in the DNF that may be constricting the areal extent of pondberry colonies or prohibiting their expansion

Dwarf Palmetto (*Sabal minor*) forms dense monocultures within the DNF that may prohibit the expansion of pondberry colonies and may cause colonies to retract. Many of the extinct pondberry colony locations in the northernmost section of the DNF, adjacent to Dawling Bayou Road, are now primarily palmetto stands. Some of these stands have gaps in which pondberry can survive, but rarely more than a few stems (Figure 27). Hydrology may play an important role in regulating interspecific competition with pondberry. As discussed in more detail in USFWS

(2007) and USFWS (2014), and references included therein (e.g., Lockhart et al. 2013), competition with pondberry, particularly from less flood tolerant plant species, can be increased in the absence of regular floods. More recently, Hawkins et al. (2016) found increased interspecific competition between pondberry and *Brunnichia ovata*, which has been identified as a potentially aggressive competitor, increased in non-flooded conditions compared to experimentally flooded conditions. However, both pondberry and *Brunnichia ovata* are considered facultative wetland species, consequently, competition might be due to other environmental factors such as light availability, and not changes in hydric regime (or an interaction between light availability and flooding regime [as discussed in UWFWS 2014]). Such interactions warrant further study and analysis.

PART V: ENVIRONMENTAL BASELINE

Pondberry Status

Though new populations and many new colonies have been discovered since the 2014 and 2021 5-Year Reviews, population declines as well as recent extirpations have been noted throughout the species' range. The lack of comprehensive and recent monitoring data across the range has led to uncertainty for a proper rangewide species assessment. The USFWS (2021) summarized what is known about pondberry populations by state, noting that populations are considered stable to declining, with generally stable populations in Alabama, Arkansas, and Missouri; and declining populations in North Carolina, South Carolina, Georgia, and Mississippi. Much more comprehensive data collected annually by the ERDC-EL from 2020-2023, and reported herein, provides an updated and relatively comprehensive assessment of all known pondberry populations in Mississippi. The ERDC-EL acquired information from 2020-2023 from a variety of sources, including USACE MVK, USFWS, and USFS, and through ERDC-EL field surveys to determine there are at least 385 extant or extinct pondberry colony sites in western Mississippi (Figures 8 & 9). These include 313 colony sites in the DNF, 61 in the Hester Tract, 10 on private lands, and one in Dahomey National Wildlife Refuge. Of the 313 colony sites in the DNF, 123 were extant as of summer 2023 and 190 were considered extinct. Twenty-eight of these 123 colonies were either newly discovered or were determined to be separate from existing colonies because stems were >15 ft. from an a currently extant colony. In the Hester Tract, 55 colonies are extant and 6 are considered extinct. For private lands, six colonies are extant and four are considered extinct. The single colony in Dahomey NWR currently is extant.

History of Pondberry Surveys in the DNF

USFS Pondberry Surveys in Delta National Forest. The USFS DNF conducted intermittent pondberry surveys (Table 5) as part of their pre-action evaluation of management activities in stands and compiled a database of pondberry colony data incorporating surveys from 1988 to 2005 (USFWS 2007). In the 1990's and early 2000's, the USFS, USFWS (McDearman, Unpublished Data), Gulf South Biological (1991), Gulf South Research Corporation (GSRC; 2000, 2005), and others, completed a variety of pondberry surveys and site assessments in the Yazoo Basin across both the DNF and adjacent private and public lands, with a goal of documenting distribution and abundance, and to measure a variety of colony and associated forest and hydrologic metrics as a means to characterize optimal pondberry habitat in the Mississippi Alluvial Valley.

In the 1990's the USFS surveyed approximately 32% of the DNF (19,783) acres for pondberry. Also in the 1990's, the Corps surveyed all rights-of-ways for the Yazoo Backwater Project, 2,000 acres of bottomland hardwood forest with high potential for pondberry occurrence, and 3,600 acres associated with the Upper Steele Bayou Project

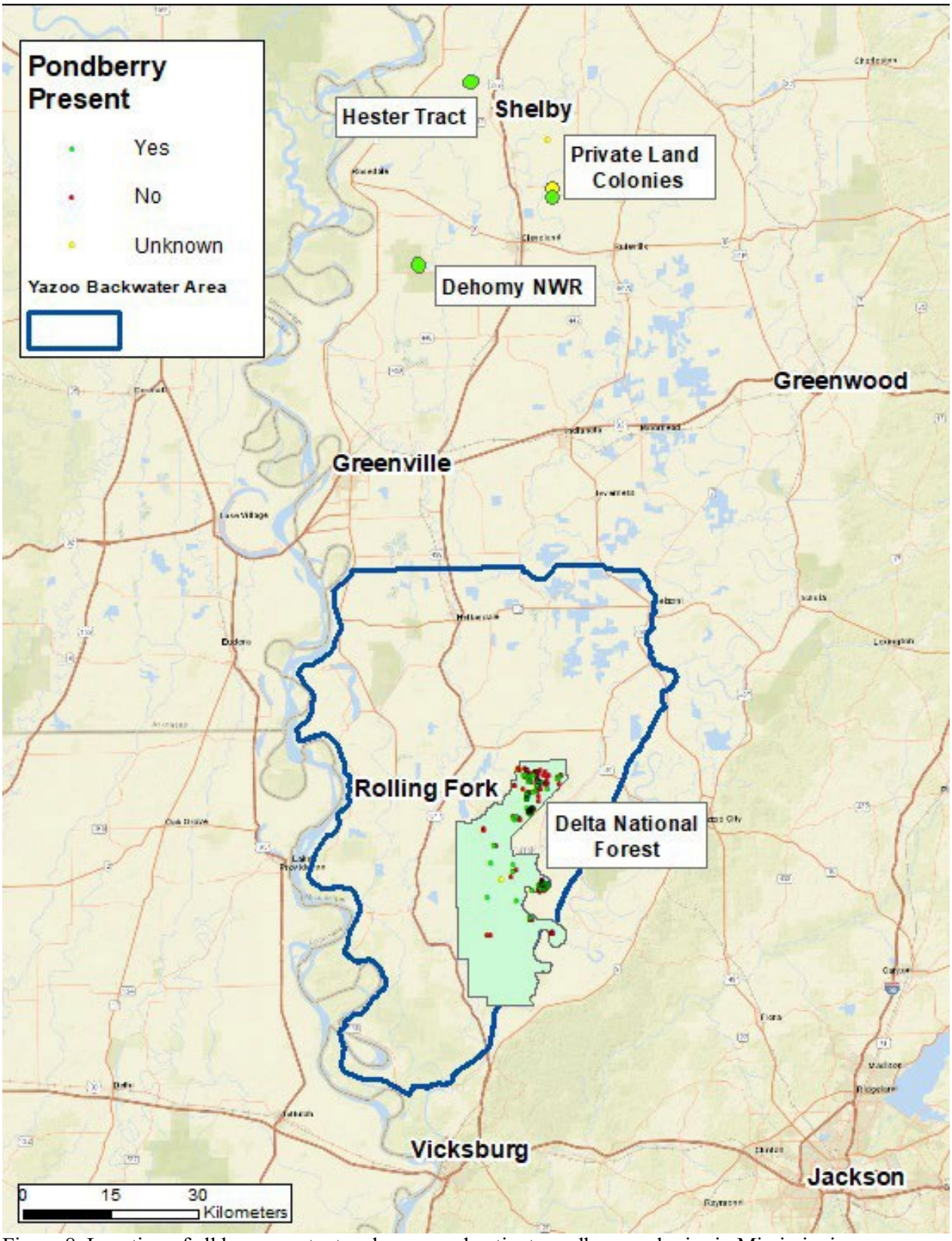

Figure 8. Location of all known extant and presumed extinct pondberry colonies in Mississippi.

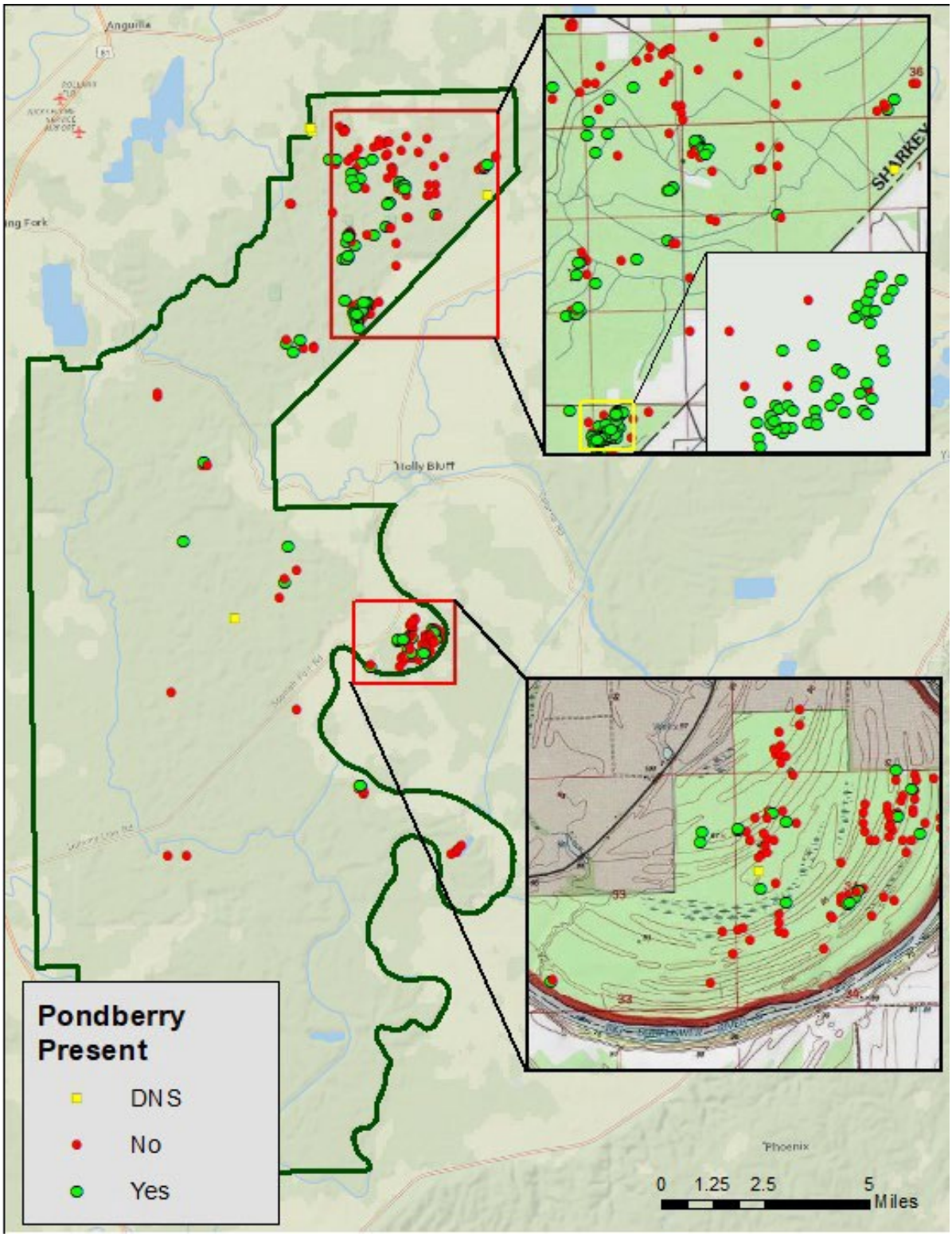

Figure 9. Historical and current pondberry colony locations in the Delta National Forest as of September 2023. Colonies that are "present" contained at least one stem during surveys since 2020. Colonies noted as not having pondberry present were surveyed at least twice since 2020.

Yazoo Backwater Reformulation Project (1994). To help conserve and recover pondberry, the MVK designed investigations with the U.S. Department of Agriculture (USDA) Forest Service (USFS), to address data and recovery tasks contained in the USFWS Recovery Plan for pondberry (USFWS 1993). In 2003, the MVK and USFS entered into a 7-year, $5 million interagency agreement to conduct extensive research on pondberry's biological and ecological requirements (USACE 2007). During the period September-October 1994, field surveys for pondberry were conducted for the Yazoo Backwater Reformulation Project. The surveys included the entire direct rights-of-way for the project and a 5 percent survey (2,000 acres) of forested tracts, with a high potential for pondberry occurrence, south and west of the DNF. In addition to pondberry profile report information, flood frequency data and professional judgment were utilized to select forested tracts to survey. Also, the Mississippi Natural Heritage Program (MNHP) was asked to review its records for reported pondberry colonies within the Yazoo Backwater Project Area. In 2005, the USACE also updated its comprehensive Geographic Information System (GIS) database of known pondberry sites on DNF. This database includes 182 sites and was compiled from several sources, including compartment maps provided by DNF.

Reevaluation of Pondberry in Mississippi (2000-2010). In 2000, GSRC documented and georeferenced via global positioning system (GPS) 62 distinct pondberry colonies, including detailed metrics assessing general forest and colony characteristics (Gulf South Research Corporation 2001). Of those, 50 colonies were located in the DNF (primarily Sharkey County) and 12 were located on private lands in Bolivar and Sunflower Counties. In 2001, the USFWS contracted with Gulf South Biological Surveys, Inc. (2001) to investigate a subset of DNF colonies and their locations relative to hydrology associated with ponded depressions. During this work, Gulf South Biological also conducted stem counts at GSRC points 1-46 and 53-56 in the DNF. In 2005, GSRC relocated 57 of the original 62 DNF colonies and again assessed site characteristics similar to those measured in 2000. The USACE ERDC compiled stem count data collected from 2000-2005.. Of those colonies in the DNF, mean number of stems per colony appeared to have declined from 2000 (n=240) to 2005 (n=147). The USFWS (2007) did a similar analysis on 177 known colonies/sites (removing the 5 colonies that occur outside of the Yazoo Backwater Area) and stated, "The available data reveals a declining trend during this 5-year period. In 2000, the Corps counted 11,839 plants at profiled colonies/sites, which declined in the 2005 census to 7,083 plants, a loss of 40 percent." In 2007, the Vicksburg District and USFWS signed a Memorandum of Agreement to establish two new pondberry populations in the study area and conduct additional field experiments evaluating the effects of flooding, stand thinning, competition, and pathogens on pondberry. The MVK provided funding to the USFS, Southern Research Station, Center for Bottomland Hardwoods Research, to investigate a wide array of research topics, including biology, ecology, and ecophysiology of pondberry. The USACE was particularly interested in effects of light availability (which *in situ* for pondberry is influenced by canopy and midstory cover) and hydroperiod on growth and development of pondberry. Results of a plethora of these investigations are included in this document and in the peer-reviewed literature. In 2010, GSRC revisited 50 of the GSRC colonies last visited in 2005. These efforts combined yielded a minimum of 182 pondberry colony sites within the DNF (USACE 2005b).

Re-evaluation of Pondberry in the Delta National Forest (2020-2023).

During June 2020 and following the long and deep-duration flooding in 2019 and 2020 in the YBA, the ERDC-EL, CEMVK, USFWS, and USFS met virtually to discuss pondberry sampling

in the DNF. All parties agreed that given the timeframe available to conduct fieldwork for the 2020 SEIS, ERDC-EL discovery survey efforts would initially only focus on GSRC colony sites. In July 2020, the ERDC-EL revisited and assessed DNF GSRC colony sites within a 2-week timeframe. Pondberry was not found at any of the colony sites, but in the course of those surveys, 12 new colonies were identified and described. Subsequent to the July 2020 effort, the ERDC-EL determined that coordinates used for these surveys included a historical GIS projection error that resulted in all GSRC points being shifted 200m from their original location.

Table 5. Survey dates for pondberry assessments, 2000-2023, Delta National Forest, Mississippi

Survey	Dates
GSRC 2000	11 May to 20 June, 2000
Gulf South Biological, Inc.	3-18 April, 2001
GSRC 2005	7 June to 13 July, 2005
GSRC 2010	13 April – 16 June, 2010
ERDC-EL[1]	6-17 July, 2020
ERDC-EL[2]	12-22 September, 2020
ERDC-EL	2 August - 29 September, 2021
ERDC-EL	15-26 August, 2022
ERDC-EL[3]	31 July to 31 August, 2023

[1] Initial sampling effort conducted just after floodwaters receded. Point locations were erroneous.

[2] The resampling effort occurred during September to provide ample time for regrowth following extensive flood inundation.

[3] The ERDC-EL conducted multiple sampling events within this date range.

On 11 September 2020, six ERDC-EL biologists met in the DNF for a one-day training effort to (a) enhance skills associated with pondberry identification, (b) finalize the protocol being used to assess a variety of pondberry colony and individual plant metrics, and (c) develop a consensus on how to assess metrics (e.g., canopy and understory cover). From 11-22 September 2020, two ERDC-EL teams deployed daily, with corrected GIS data, to visit sampling plots. The teams visited all GSRC plots, along with the 12 newly discovered ERDC-EL colonies, and 10 additional historical colony sites (McDearman Sites) provided by the USFWS. Williamson et al. (2019) documented pondberry in 2019 at three U.S. Forest Service (USFS) plots within DNF Compartments 9 and 25, and subsequently provided coordinates for these plots to facilitate assessments. Each team navigated to coordinates of previously documented pondberry locations in the DNF using a handheld GPS unit. Plot center was marked with flagging and a 1/5th acre circular plot (52.7-foot radius) was established by stretching a forester's tape along cardinal

directions. The teams searched each plot for pondberry, as well as the PVC pipes used in 2005 to mark prior colony locations and survey points. At each point ERDC-EL conducted a meander search for pondberry within each of four quadrants for a minimum of five minutes; plots with dense groundcover components were allotted additional time per quadrant. As time allowed, ERDC-EL also conducted rapid, untimed searches for pondberry in adjacent areas outside of plots. In addition, ERDC-EL generally searched for pondberry while walking between plots and to and from forest access points. When pondberry was found, colored flagging was used to mark individual plants at small colonies, and the perimeter of large colonies, for colony and associated habitat assessments. We defined distinct pondberry colonies as any occurrences separated by a distance >15 feet. We established a $1/10^{th}$ acre circular plot (37.2 ft radius) at the center of each colony and assessed each colony using the metrics described below.

For plots where pondberry was not found, pondberry was also not detected adjacent to any of these plots. For GSRC plots containing pondberry, some plots had stems outside of the 37.2-foot radius plot, and this usually was noted on the data sheet. If pondberry stems occurred outside of the 37.2-ft radius plot, the entire colony area was measured regardless of whether it occurred wholly within the plot or extended beyond the plot boundary (except for GSRC 42 and GSRC 43 which occurred within the very large cluster of ~2,500 stems over at least an acre now referenced as Pondberry 082). In cases where stems were noted outside of the plot and more than 15 ft from the nearest stem, these were noted as separate colonies (and in some cases, measured metrics in a new 37.2-foot radius plot). The presence of PVC pipe at many of these sites with zero stems lends credence to the possibility that 29 colonies were extirpated between 2000 and 2020 (Table 6). The extensive inundation depth and duration of the 2019 and 2020 floods could have impacted many of these colonies such that some colonies were still viable and extant but did not have above-ground growth at the time of the 2020 surveys. However, in 2023, ERDC-EL revisited nearly 100% of pondberry colonies in the DNF to ensure that each colony was visited at least twice between 2020 and 2023. Since pondberry colonies would have had three years in which to recover from the 2019 and 2020 floods, it is likely that those colonies without any above-ground stems present in 2023 are now truly extirpated.

5.4.7.1 Assessment metrics used by the ERDC-EL from 2020-2023 (note, not all metrics were recorded each year. The supplemental spreadsheet provided with this document provides a comprehensive data set for all information collected by year and colony)

(1) Describe site type
   a. Ridge – Highest elevations in the DNF, typically dominated by less water-tolerant vegetation, and often surrounded by lower elevation flats and depressions.
   b. High flat – higher elevation sites than the surrounding landscape, but below ridges.
   c. Low flat- lower elevation sites than surrounding landscape with evidence of recent flooding, often adjacent to a depression.
   d. Depression – obvious wetland depression in locally low-elevation sites that either held water at the time of surveys or recently were inundated.

(2) Conduct a qualitative assessment of site wetness at the soil surface

a. Measurable standing water
b. Saturated soil, but no measurable water depth
c. Moist but not saturated soil
d. Dry soil

(3) Record existing water depth (centimeters; cm) at plot with one representative measurement.
(4) Record the maximum height (cm) of any water marks or moss trim lines present on trees within the assessment plot.
(5) Record any evidence of current or prior disturbance including cut stumps, beaver activity, feral hog activity, large tree-fall gaps, etc. within a 50-foot radius of the plot center.
(6) Record the distance and azimuth from the center of the colony to the nearest upper-canopy tree.
(7) Record the number, height, and diameter at soil surface (with small calipers) of pondberry stems in each colony. For small colonies (e.g., < 50 stems), measure each individual plant. For medium-sized colonies (e.g., 50-150 stems), measure every other plant. For large colonies, measure a representative number of plants such that at least 50 stems are measured (e.g., every 5th stem in a colony of 250 plants).
(8) Colony Photo Documentation: Take digital image from each cardinal direction from outside of colony facing inward toward colony, such that the entire colony is in view for each image. Images captured in the following sequence: N, E, S, W.
(9) Record number of fruiting pondberry stems, if fruit present.
(10) Qualitative assessment of colony Health:
a. Note presence and severity of (a) stem dieback/damage, (b) herbivory, (c) chlorotic leaf tissue, and (d) necrotic leaf tissue.

0 — absent or negligible (present on ≤10% of stems; if colony is comprised of a single stem then affecting ≤10% of approximate total leaf area affected, dieback/damage on no more than one primary or secondary branch).

-1 — moderate (present on >10% but ≤25% of stems; if colony is comprised of a single stem, affecting ≥10% but ≤25% of the approximate total leaf area, dieback/damage on more than one primary or secondary branch but ≤25% of total primary and secondary branches).

-2 — major (>50% of stems; if the colony is comprised of a single stem, ≥50% of the approximate total leaf area, dieback/damage on ≥25% of primary or secondary branches.

b. Overall health rating of colony based on deductions from prevalence of stem dieback/damage, herbivory, chlorotic and necrotic foliage. (0 = excellent, -1 = good, -2 = fair, and ≤-3 = poor)

(11) Measure canopy cover with a spherical, convex mirror densiometer at the end of each 37.2-foot azimuth (cardinal directions) and obtain an average canopy cover value for the plot.

(12) Determine basal area by measuring diameter at breast height (DBH) of all trees within the plot. Record tree species for each measurement.

(13) Assess stand maturity class based on DBH: most trees approximately 6", 6-18", >18", or Mixed sizes.

(14) Record distance to nearest water body if visible, or determine remotely from aerial imagery.

(15) Measure basic colony dimensions (length x width) with a meter tape or by using a rangefinder.

2**020 Surveys.** ERDC-EL revisited 50 prior-documented GSRC pondberry colonies within the DNF and found above-ground growth of pondberry at 17 (34%) of these sites. At most locations, PVC pipe(s) in the immediate vicinity indicated that the coordinates were accurate. The mean and median number of stems at these 17 colonies was 7 and 34.6, respectively (range 1-319 stems). For these 50 GSRC plots ERDC-EL was able to visit and assess within DNF, the total number of pondberry stems within plots in 2020 (n=589) declined by 95.0% and 90.7% from 2001 (n=11,839) and 2005 (n=6,302), respectively. Only one colony (GSRC 39; now Pondberry 079) had more pondberry than previously documented in 2000 or 2005. Measures of herbivory, chlorosis, dieback/damage, necrosis, and fungal pathogens were noted at multiple colonies, though most colonies appeared relatively healthy.

ERDC-EL found a total of 41 distinct extant colonies at all sites, plus one very large colony (or groups of colonies) encompassing McDearman plots. This latter site and associated colonies were extremely large with pondberry distributed over approximately one acre. We visually estimated this plot containing multiple colonies collectively with several thousand stems. The site was too large to completely characterize given time constraints of conducting detailed habitat sampling at all DNF sites with and without colonies. However, two GSRC plots (GSRC 42, GSRC 43 now Pondberry 082 and 083) fell within the boundaries of this area and metrics from these two points should sufficiently characterize overall habitat characteristics for the larger site.

For all plots combined, mean canopy closure at pondberry colonies (96.8%, n=42) was similar to historical colony locations without stems (95.3%, n=38). Likewise, understory cover at pondberry colonies (42.5%, n=38) was also similar to plots without pondberry (47.8%, n=38). Disturbances documented at 18 colony sites included presence of large tree-fall gaps, beavers, and evidence of moderate to heavy rooting by feral hogs.

Surveys from 2021-2023. During late summer of each year, 2021-2023, the ERDC-EL and USFWS visited every known extant and historic pondberry colony in western Mississippi (Figs 13-18). These sites include the DNF (Sharkey County), Dahomey NWR (Bolivar County), Hester Tract (Bolivar County), and two private lands sites (Sunflower County). A resulting updated and comprehensive database includes pondberry colony ID (with cross-references to all former naming conventions), updated coordinates using projection NAD83 UTM Zone 15N collected with a Trimble R2 unit at cm-level accuracy, comprehensive stem count data, plant and colony metrics, disturbance scores and descriptions, elevations from analyses using the 2024 USGS 3DEP 1-m DEM, and notes from colony visits. To better understand long-term trends of pondberry colonies in the Action Area, the ERDC-EL investigated all available stem count data from GSRC pondberry colony plots. Historic counts occurred in 2000, 2005, and 2010. Contemporary counts included annual counts between 2020 and 2023. During the last count of

GSRC colonies in the DNF (late summer 2023), the ERDC-EL noted a significant decline from 2000 to 2023 in the number of known pondberry colonies in the DNF (Figure 10).

Only 25 of 63 (40%) GSRC colony sites had detectable stems (note this is an increase in six extant colonies from count data from the same sites in 2020) indicating that ~60% of colonies went extinct. Of 62 colonies that were measured in both 2000 and 2023, the mean change in colony size (stem count) from 2000-2023 was -42.4%, the median change was -100% (Figure 10). During course of surveys between 2020-2023, ERDC-EL documented 97 additional colonies or "clumps" within the YBA, of which 56 occurred in the DNF and 41 within the Hester Tract. For maps of extant and extinct pondberry colonies within the DNF, as well as on private lands in Bolivar County and at Dahomey NWR, see figures 11-16.

Presence/Absence of Pondberry During 2020-2023 Surveys Statewide

- Pondberry was not detected at 172 of the historical locations (that were documented to have pondberry sometime between 1990-2014.
- Pondberry has been detected at 79 of the historical locations during 2020-2022 surveys which initially documented pondberry between 1990-2014

DNF

- Pondberry was not detected at 163 of the historical locations that were documented to have pondberry sometime between 1990-2010.
- Pondberry was detected at 58 of the historical locations during 2020-2022 surveys which initially documented pondberry between 1990-2010
- An additional 53 colonies/clumps were discovered during 2020-2023 while conducting searches for known colonies in the DNF.

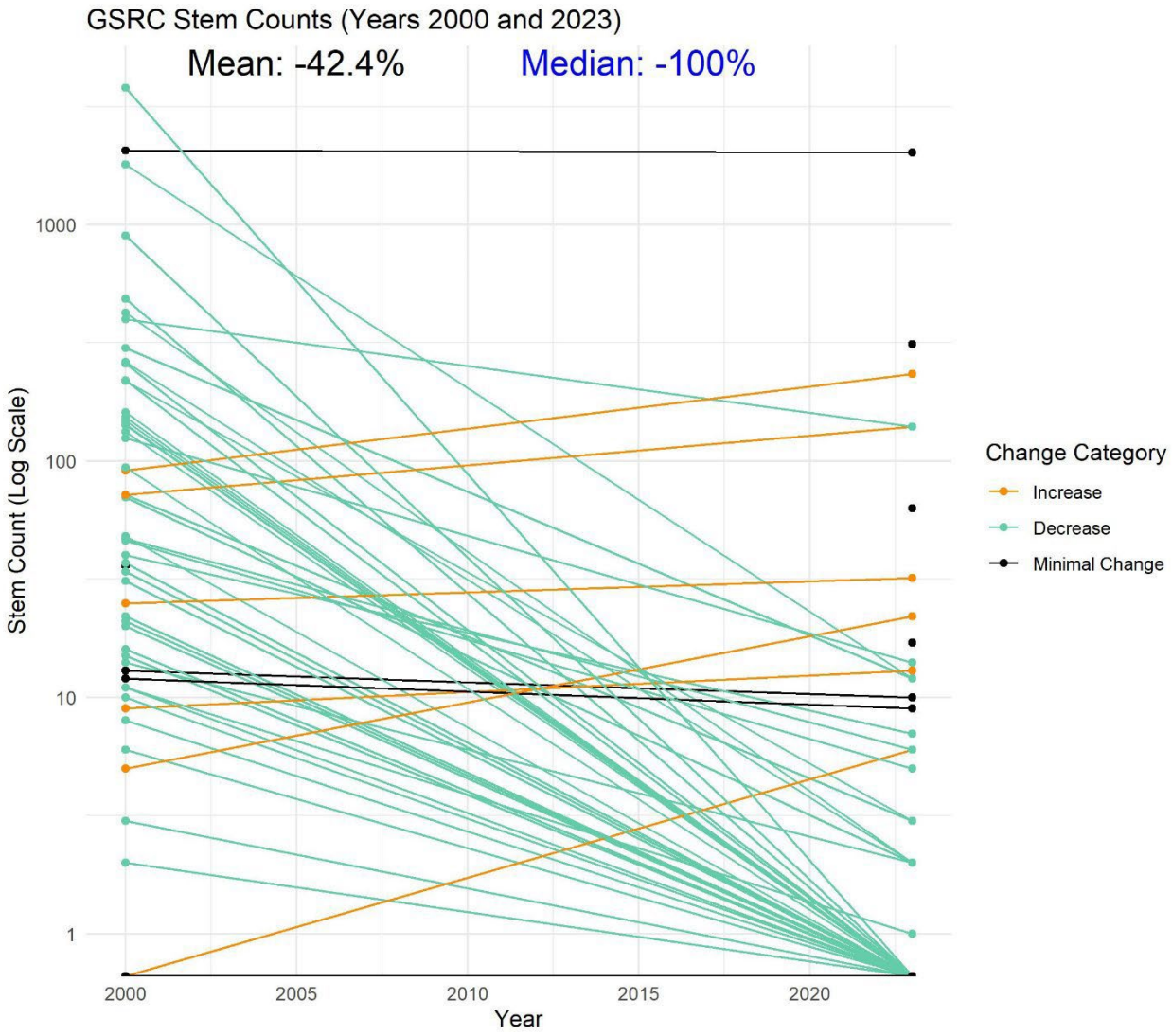

Figure 10. Plot of stem counts at 62 "GSRC" pondberry colonies between 2000 and 2023. The Y-axis has been log-transformed for ease of data visualization. Mean percent change in colony stem count between colonies measured in both 2000 and 2023 was -42.4%. Median change was 0%. Pondberry colonies that did not change more than +/- 25% are labeled as minimal change.

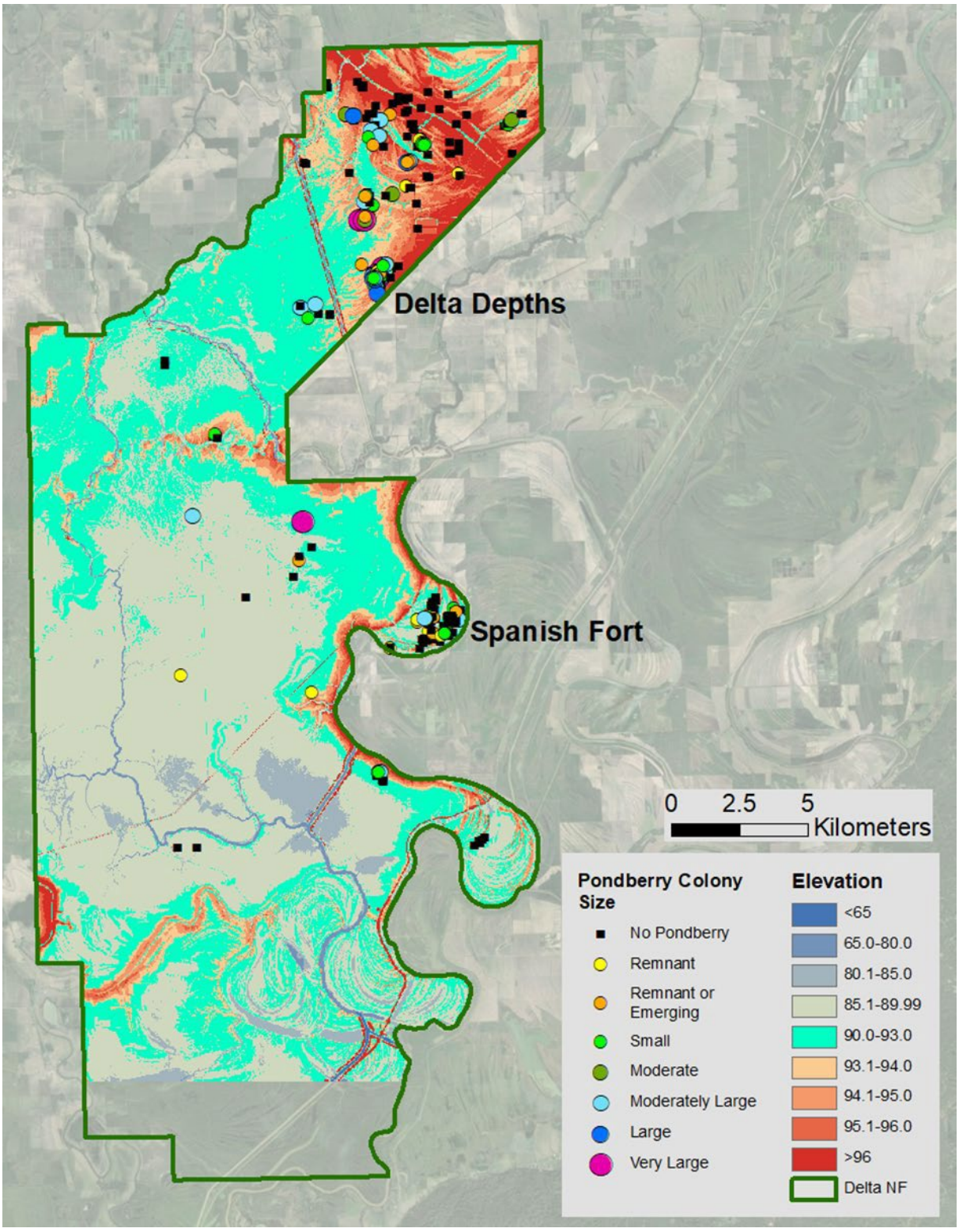

Figure 11. Delta National Forest within the Yazoo Backwater Area depicting elevation zones and the relative size of pondberry colonies. Table 4 defines pondberry colony size referenced within figures of this document.

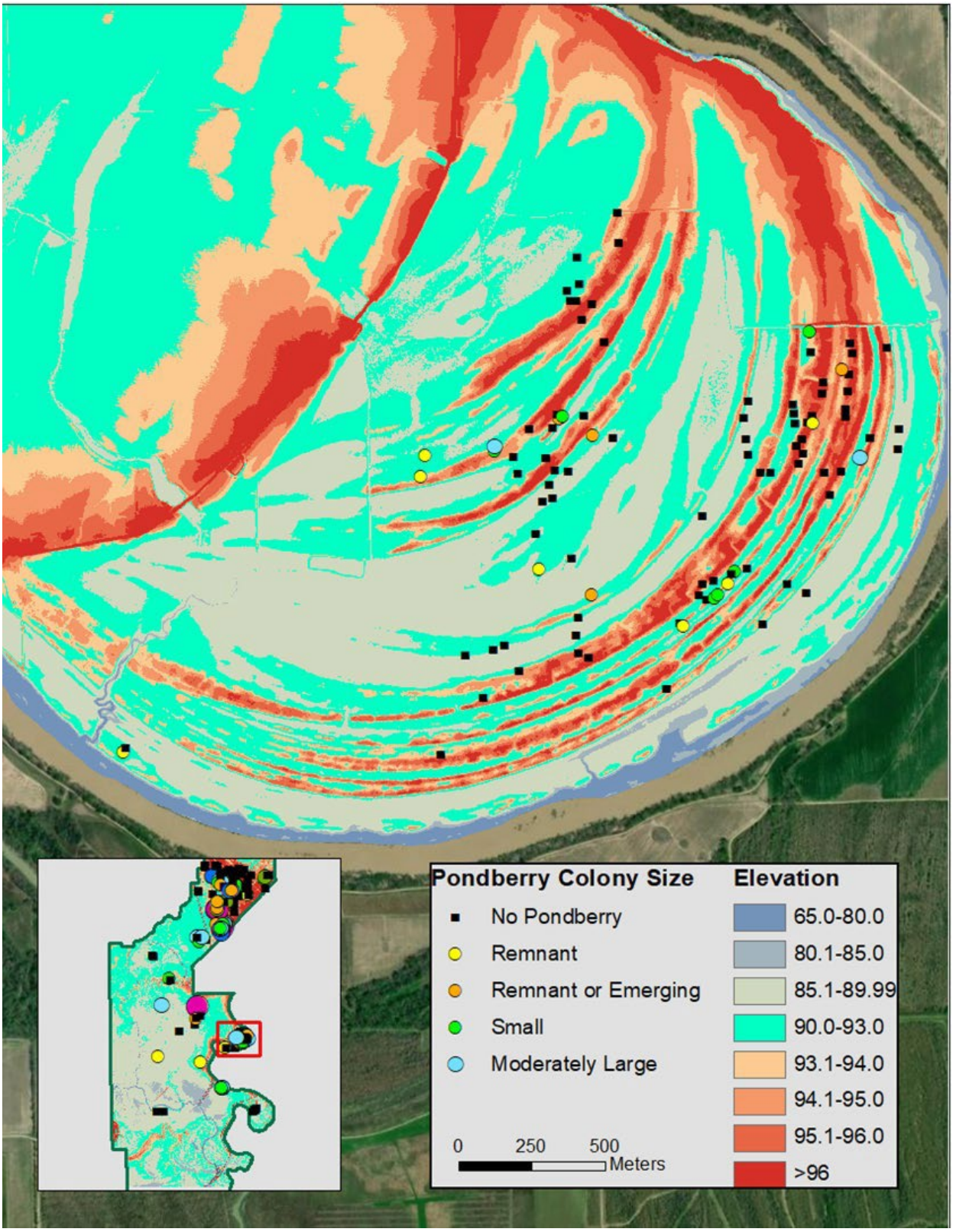

Figure 12. The Spanish Fort area within the Delta National Forest depicting elevation and the relative size of pondberry colonies. Table 4 defines pondberry colony size referenced within figures of report.

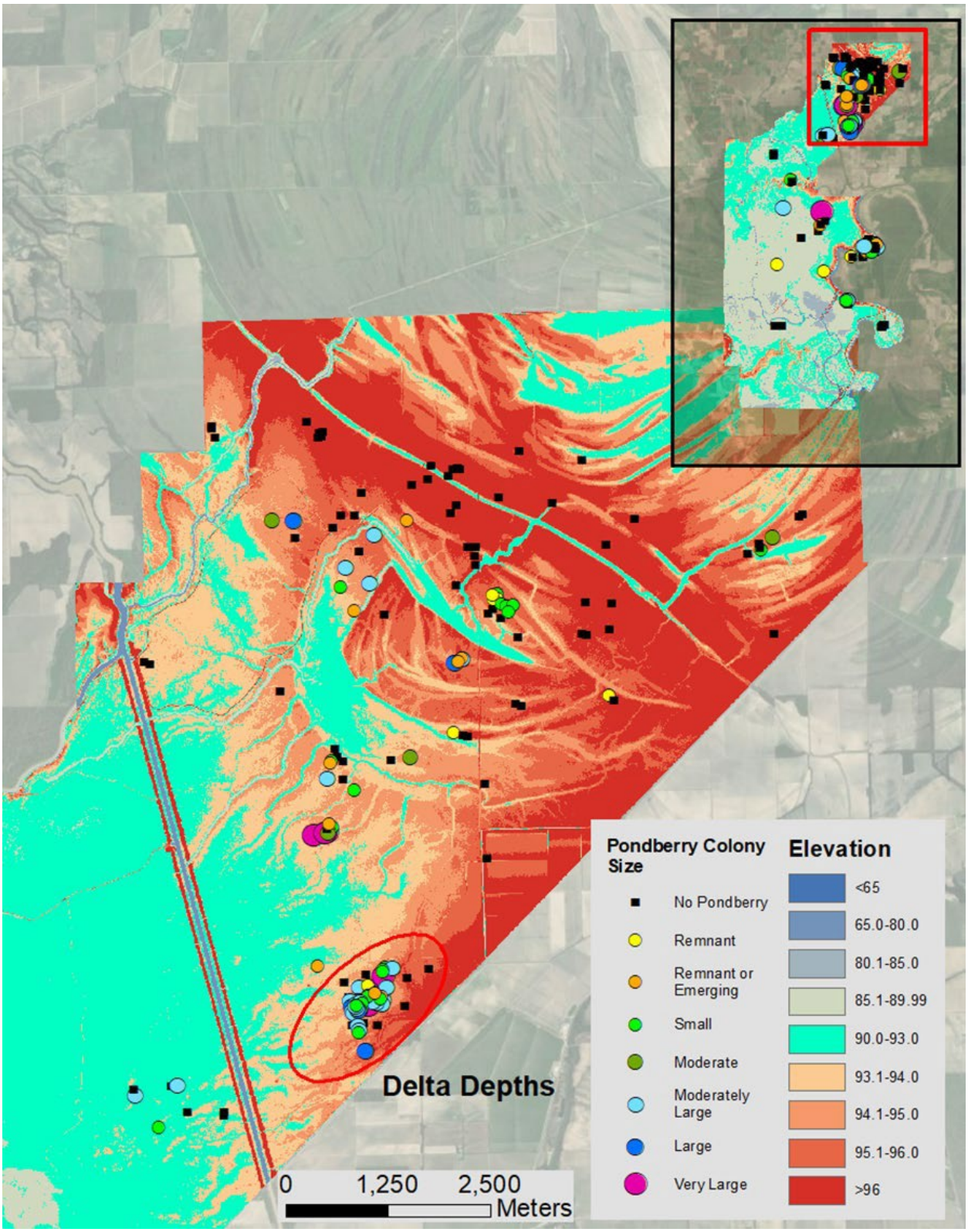

Figure 13. The northern section of the Delta National Forest depicting elevation and the relative size of pondberry colonies. Table 4 defines pondberry colony size referenced within figures of report.

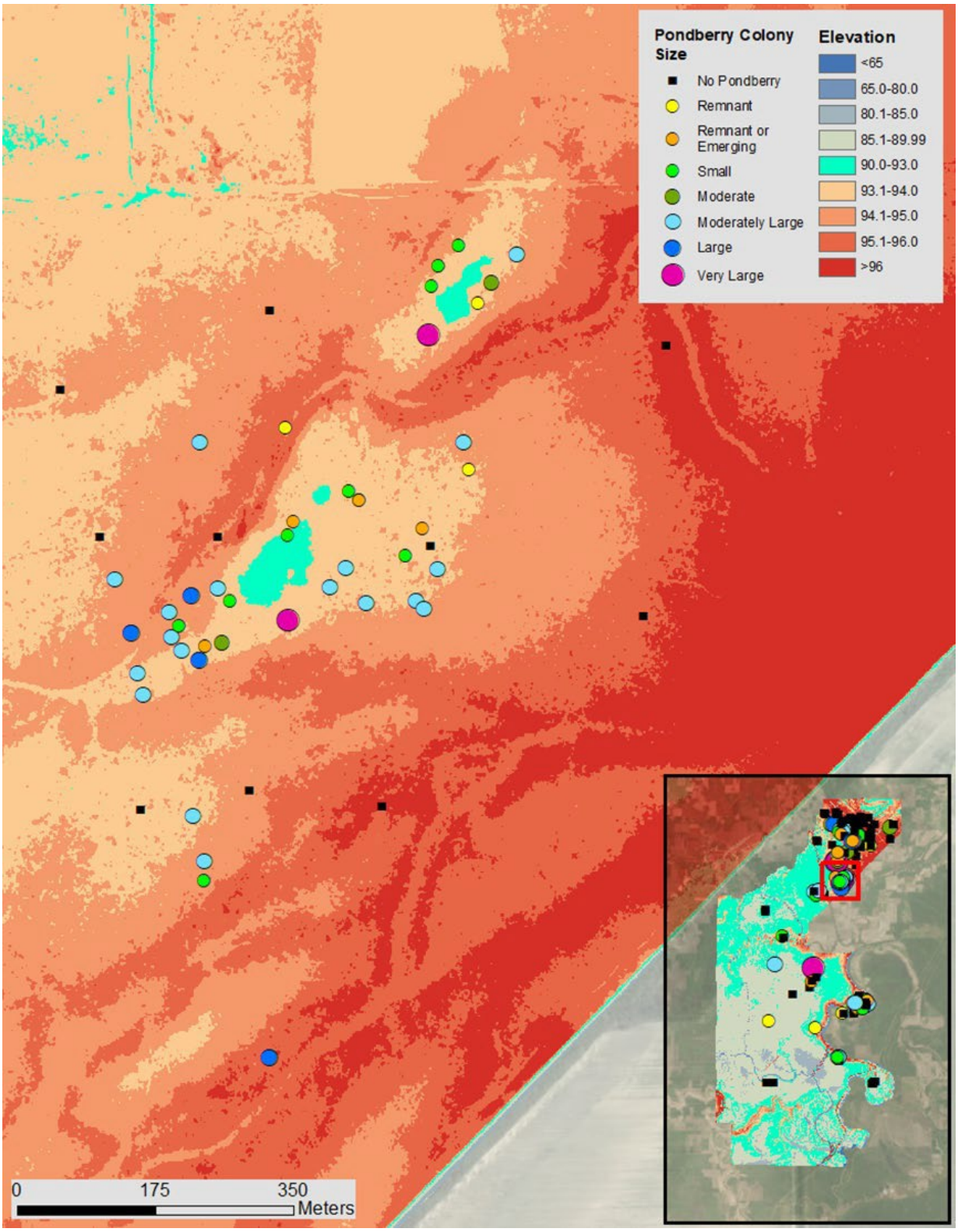

Figure 14. The area referenced as “Delta Depths” of the Delta National Forest depicting elevation and the relative size of pondberry colonies. Table 4 defines pondberry colony size referenced within figures of report.

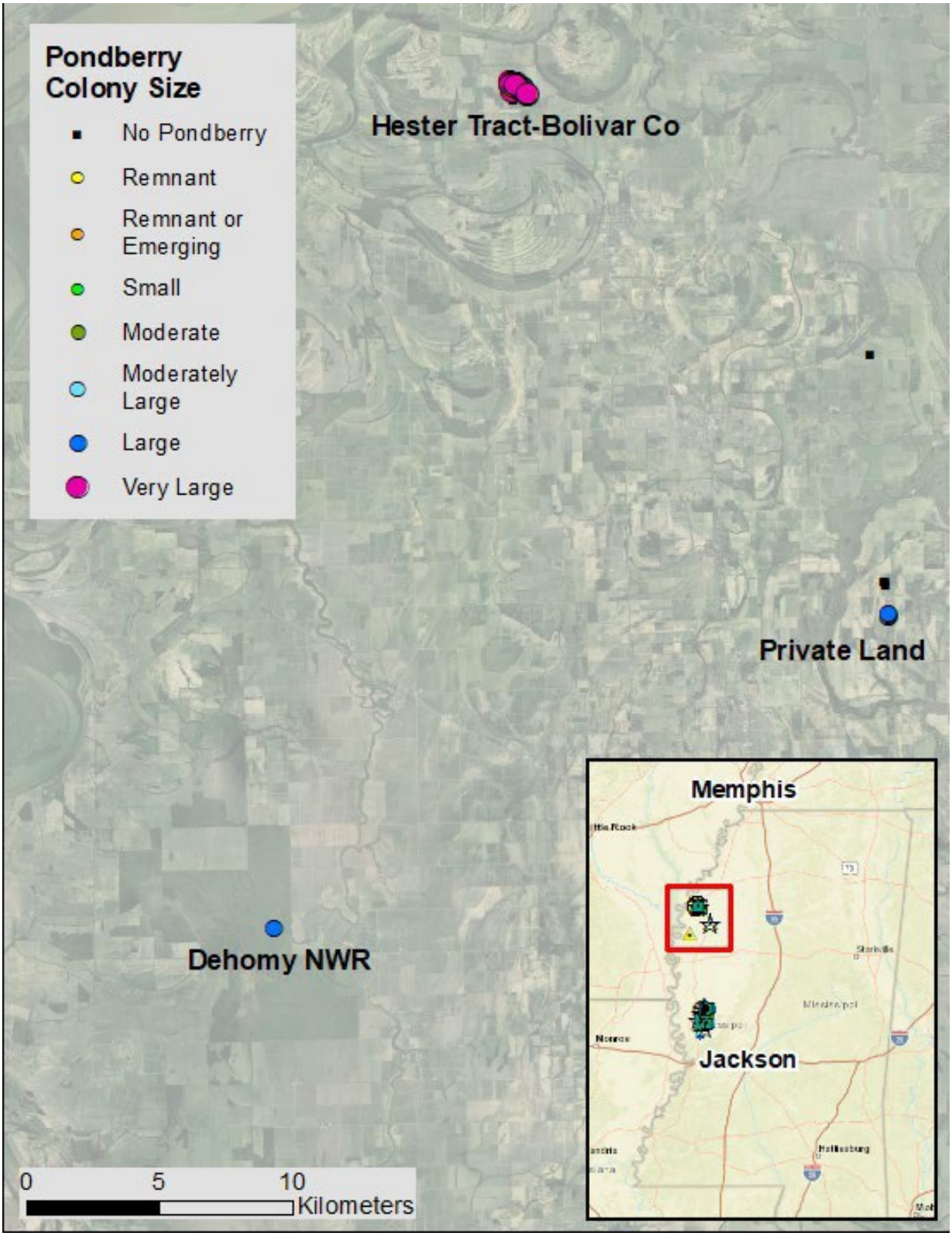

Figure 15. Location of private lands pondberry colonies, and USFWS Dahomey NWR colony, north of the DNF. Table 4 defines pondberry colony size referenced within figures of report.

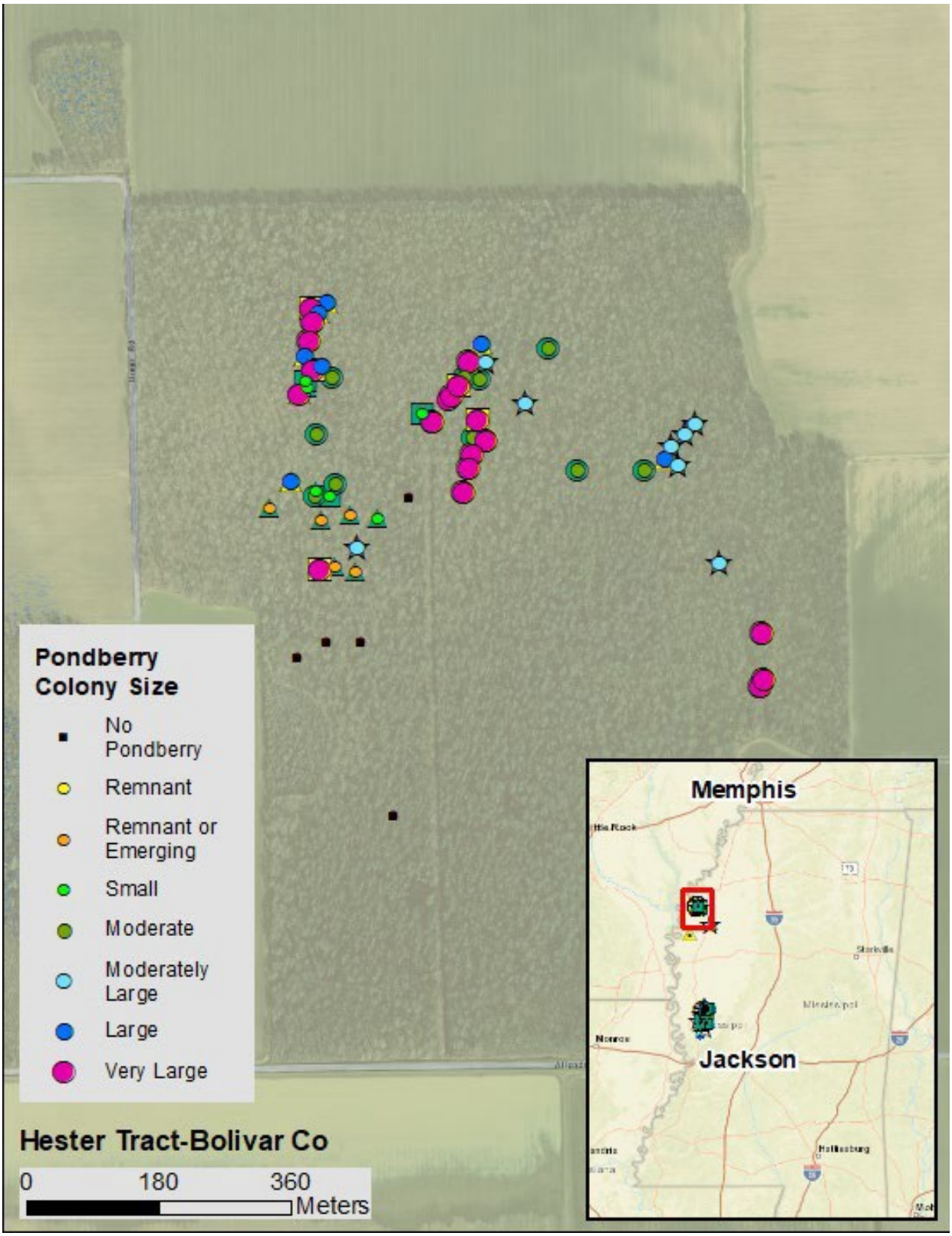

Figure 16. Pondberry colonies within the Hester Tract, Bolivar County, MS as of 2022. Table 4 defines pondberry colony size referenced within figures of this document.

Because surveys occurred in late-summer and well into the growing season (post-flood), ERDC-EL believes colony conditions were representative of current colony stem count and health. Such a dramatic decline in colony numbers and size is concerning, though it is prudent to consider the depth and duration of floodwater inundation within the Action Area during both 2019 and 2020 before drawing any conclusions about the overall status of pondberry in the DNF. From 2020-2023, we discovered at least 53 new pondberry colonies/clumps in the DNF. Because the ERDC-EL discovered new colonies during fieldwork within limited portions of the DNF, we believe that the distribution and abundance of pondberry are higher than currently documented. Future additional and more extensive discovery surveys are highly recommended.

ERDC-EL summarized stem count data from 85 extant pondberry colonies assessed from 2020-2023 in the DNF to determine changes in counts from immediately post-flood through 2023 (Figures 17 & 18). Within this time frame, for colonies existing above 93.0 feet elevation, the mean inter- annual change in stem count was +12.4% (Figure 18), suggesting that colonies were increasing in size over this time-period as they recovered from the extensively deep and long-duration floods. For colonies existing between elevations 90.0 and 93.0 ft NGVD elevation, the mean interannual change in stem count was –2.83%, suggesting a relatively stable colony trajectory during this time period (Figure 17). Plot of stem counts at 15 pondberry colonies that exist between 90.0 and 93.0 ft elevation within the DNF from 2020-2023. The y-axis been log-transformed for ease of data visualization.

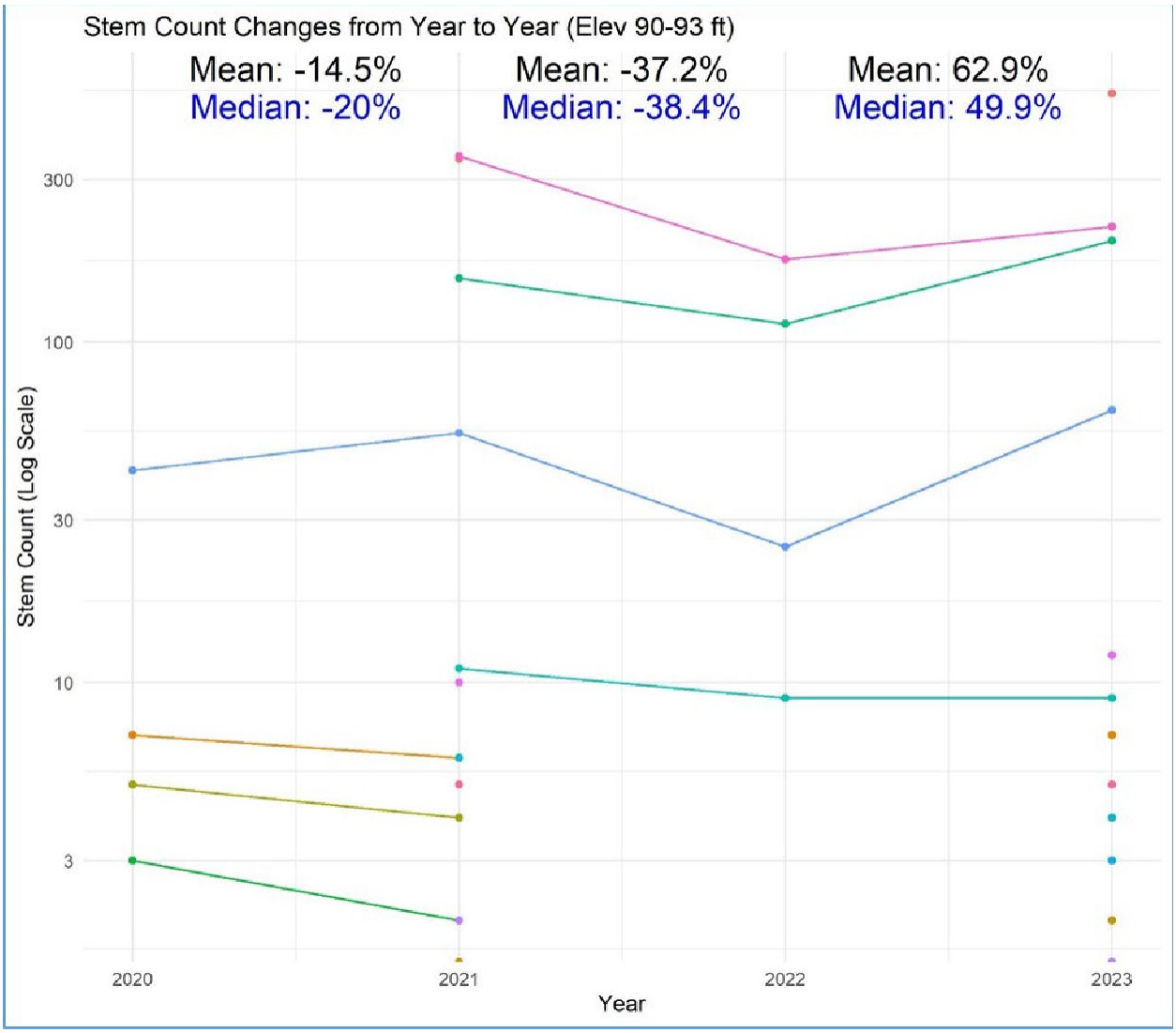

Figure 17. Plot of stem counts at 15 pondberry colonies that exist between 90.0 and 93.0 ft elevation within the DNF from 2020-2023. The y-axis been log-transformed for ease of data visualization.

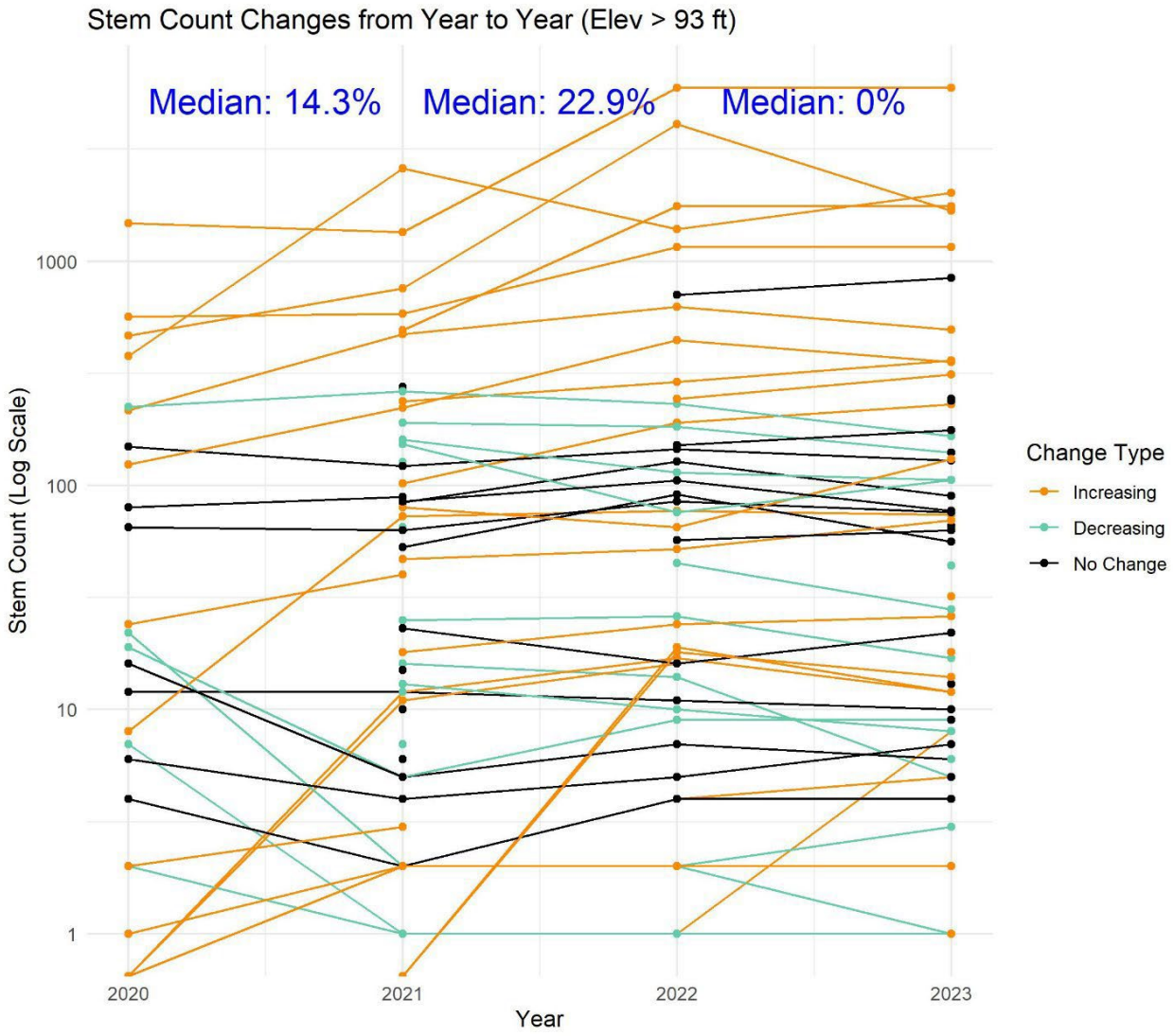

Figure 18. Plot of stem counts at 66 pondberry colonies that exist above 93.0 ft elevation within the DNF from 2020-2023. The y-axis been log-transformed for ease of data visualization. Labels indicate the mean and median change in colony stem counts between years.

Table 6. Comparison of number of pondberry stems counted at GSRC plots during colony surveys in the Delta National Forest, 2000-2023.

		Number of Pondberry Stems							
Colony ID	**Pondberry ID**	**GSRC 2000[1]**	**GCBS 2001[2]**	**GSRC 2005[3]**	**GSRC 2010[4]**	**USACE 2020[5]**	**USACE 2021[5]**	**USACE 2022[5]**	**USACE 2023[5]**
PB039	39	2	0	2	0	- [6]	0	-	0
PB040	40	36	22	14	3	0	0	-	-
PB041	41	70	42	4	1	0	0	-	2
PB042	42	142	60	-	31	3	0	-	0
PB043	43	8	3	4	1	0	0	-	0
PB044	44	10	4	3	1	0	0	-	0
PB045	45	14	9	12	7	0	2	2	2
PB046	46	6	5	3	0	-	0	-	0
PB047	47	133	35+	-	14	0	0	-	0
PB048	48	11	4	6	0	-	0	-	0
PB049	49	37	29	19	28	-	0	-	0
PB050	50	21	21	12	6	-	0	-	0
PB051	51	6	1	6	14	-	0	-	0
PB052	52	13	15	27	32	12	12	11	10
PB053	53	143	50+	39	19	7	0	-	0
PB054	54	40	25	40	16	7	6	-	7
PB055	55	262	75	133	23	7	1	-	2
PB056	56	424	~ 100	-	15	-	0	-	2
PB057	57	20	15	-	5	-	0	-	0
PB058	58	218	60	57	5	5	4	-	3
PB059	59	72	37	45	3	3	2	-	3
PB060	60	34	12	0	0	-	0	-	-
PB061	61	3	3	0	0	0	0	-	-
PB062	62	16	7	8	1	0	0	-	-
PB063	63	2	2	13	8	0	0	-	-
PB064	64	148	73	-	13	-	0	-	-
PB065	65	15	12	-	2	0	0	-	-
PB066	66	48	16	43	12	0	0	-	-
PB067	67	485	> 200	148	33	-	0	-	-
PB068	68	-	-	-	-	-	0	-	-
PB069	69	300	> 100	113	6	0	12	17	12
PB070	70	1,800	150	565	151	9	0	19	12
PB071	71	-	-	-	-	-	5	7	6
PB072	72	9	6	97	34	-	15	-	13
PB073	73	22	27	16	0	-	0	-	0

PB074	74	10	11	11	9	-	0	-	0
PB075	75	25	24	63	33	24	40	-	32
PB076	76	11	1000's	10	7	2	1	1	1
PB077	77	161	-	43	12	0	0	-	0
PB078	78	31	-	29	8	-	0	-	0
PB079	79	12	"Few emergent stems at 39-41 to hundreds of stems at 42-43"	14	13	19	5	9	9
PB080	80	5		-	-	0	11	16	22
PB081	81	46		41	-	0	2	4	5
PB082	82	5855[8]		1993[8]	4132[8]	378[8]	2602[8]	1392[8]	2016[8]
PB083	83	Lumped into GSRC 42		Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSRC 42	Lumped into GSR C 42	Lumped into GSRC 42	Lumped into GSRC 42
PB084	84	72	25	40	-	3	2	-	0
PB085	85	656[9]	291[9]	667[9]	-	-	190[9]	183[9]	280[9]
PB086	86	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSRC 45	Lumped into GSR C 45	Lumped into GSRC 45	Lumped into GSRC 45
PB0223[7]	233	125	-	-	-	-	35	70	-
PB324[7]	324	115	-	-	-	-	-	-	-
GSRC 49[7]	310-315	212	-	-	-	-	-	-	-
PB234[7]	234	-	-	-	-	-	-	7	-
PB228[7]	228	900	-	-	-	-	-	-	-
PB230[7]	230	219	***	-	-	-	-	105	-
PB087	87	91	40	-	-	-	0	-	0
PB088	88	47	150	558	236	87	154	108	234
PB089	89	153	10	130	36	-	12	-	6
PB090	90	94	300	1,280	823	-	3	-	0
GSRC 57[7]	310-315	199	-	-	-	-	-	-	-
GSRC 58[7]	310-315	177	-	-	-	-	-	-	-
PB248[7]	248	500	-	-	-	-	-	0	-
PB251[7]	251	37	-	-	-	-	-	0	-
PB249[7]	249	79	-	-	-	-	-	0	-
PB250[7]	250	250	-	-	-	-	-	0	-
PB332	332	Lumped into	Lumped into	Lumped into	Lumped into	Lumped into	Lumped	Lumped into	Lumped into

		GSRC 42	GSRC 42	GSRC 42	GSRC 42	GSRC 42	into GSRC 42	GSRC 42	GSRC 42
PB325	325	-	-	-	1	-	-	-	0
PB331	331	-	-	-	13	-	-	-	1
PB127	127	-	-	-	51	-	-	-	0
PB279	279	-	-	-	-	-	-	147	-
GSRC 70	023	-	-	-	83	-	-	26	17
PB338	338	-	-	-	243	-	-	-	12

Sources: [1]GSRC (2001); [2]Gulf Coast Biological Surveys, Inc. (2001); [3]GSRC (2005); [4]GSRC (2010); [5]USACE-ERDC (2020-2023)
[6] Dashes indicate missing data
[X] Plot falls inside of USFWS McDearman Plots 1-4 containing approximately 8,000 stems as estimated in September 2020
[7] Plots occur outside of the DNF and Action Area and were not included 2005 or 2020 assessments
[8]GSRC 42 and GSRC 43 combined in 2021 due to a physical merger of the colonies
[9]GSRC 45 and GSRC 46 combined in 2021 due to a physical merger of the colonies
It should be noted that stem counts during each year were completed using plots of varying sizes, making comparisons of stem counts among years difficult to compare.
*** This colony had 16,638 stems according to the GSRC 2005 survey

PART IV: Effects Analysis

Hydrology

Hydrology plays a critical role in the distribution and abundance of pondberry. However, the role of backwater flooding versus local hydrology (local precipitation, headwater flooding) needs continued study. Additionally, the extent to which prolonged backwater flooding is a benefit or a detriment to pondberry needs further study. Forested wetlands within the Action Area receive both local precipitation and backwater flooding as major hydrologic influences (Smith and Klimas 2002). Backwater flooding in the Action Area is a result of inundation resulting from impeded drainage when water control structures are closed due to high flood stages in the Mississippi River. Impeded drainage leads to increasing water tables and surface inundation on the landscape. Over the POR, backwater flooding events at colonies above elevation 93.0 ft (87% of known extant colonies in the Action Area) have not been a frequent occurrence (7 of 43 years), though in 2019 and 2020, backwater events were especially deep and of long duration (Table 7). In 2019, more than 550,000 acres of the Action Area were subject to flooding that lasted more than five months. Flooding was exacerbated by very heavy local precipitation in combination with the closure of multiple water control structures (NOAA 2020).

Price and Berkowitz (2020) studied impacts on wetland functions following long flood inundations in the lower Mississippi River valley and found functional wetland impairment, (with some wetland functions declining as much as 23%) and suggested these decreases in functional capacity likely would persist for many years. Importantly, Berkowitz et al. (2020) studied wetland hydrology drivers in the Yazoo Basin and found that in most wetlands the dominant hydrologic driver is local precipitation rather than flooding.

Deep and Long-duration Flooding. Within this document, the ERDC-EL refers to the potential effects on pondberry of deep and long-duration flooding. To provide some context to this phrase, we summarized data from YBA backwater flood events from 2005 to 2024 using the Steele Bayou gauge landside water levels (backwater flooding events have a “flat or nearly flat surface” across the YBA basin, which acts as a “dry dam reservoir” as described in the draft EIS Appendix A-Engineering Report). The most extensive flooding occurred in 2019 and 2020, when water levels reached 98.22 and 96.84 ft NGVD, respectively (Table 7). In 2022, the ERDC-EL measured maximum stem height at 48 pondberry colonies in the DNF. The median value of all 48 maximum stem height values 29.5 inches. For a colony with a 30-inch stem length maximum located at elevation 92.5’ NGVD in the YBA, the entire colony would be fully inundated at 95.0’ NGVD and would have been inundated with turbid water for at least 146 days (durations may have been longer in depressions or where additional headwater flooding may have occurred) in 2019, and at least 57 days in 2020. Similar calculations for any length stem in any DNF colony can be made using Table 7.

Table 7. Backwater flood events 2005-2024 – Steele Bayou Landside Pool Levels									
Year	2008	2009	2013	2015	2016	2018	2019	2020	2021
Date start	10 Apr	13 May	18 May	28 Mar	23 Jan	03 Mar	25 Feb	17 Jan	03 Apr
Date end	27 May	11 Jun	31 May	06 Apr	31 Mar	07 May	06 Aug	18 Jun	22 Apr
Max (ft)	92.18	93.74	90.91	90.67	91.98	95.11	98.22	96.84	91.81
Days ≥90 ft	48	30	14	10	27	66	203	154	20
Days ≥91 ft	23	26	0	0	17	55	183	136	10
Days ≥92 ft	4	20	0	0	0	46	161	117	0
Days ≥93 ft	0	12	0	0	0	20	159	97	0
Days ≥94 ft	0	0	0	0	0	14	153	81	0
Days ≥95 ft	0	0	0	0	0	4	146	57	0
Days ≥96 ft	0	0	0	0	0	0	104	31	0
Days ≥97 ft	0	0	0	0	0	0	79	0	0
Days ≥98 ft	0	0	0	0	0	0	8	0	0

To assist in better understanding the role of local precipitation on pondberry colonies in the Action Area, the CEMVK deployed 149 groundwater monitoring wells throughout the Action Area in 2021 and 2022. Of those, 58 were intentionally placed immediately adjacent to pondberry colonies. The ERDC-EL initiated preliminary analyses in July 2024 as part of a proposed long-term effort to measure groundwater and surface water inundation levels at these colonies (Figure 19). As an added measure to monitor surface water at a subset of these monitoring wells, we analyzed wildlife trail camera data where imagery provided a clear view of the ground. We also downloaded river gauge and precipitation data for both the Holly Bluff and Steele Bayou gauges for the same period of record as groundwater monitoring well data.

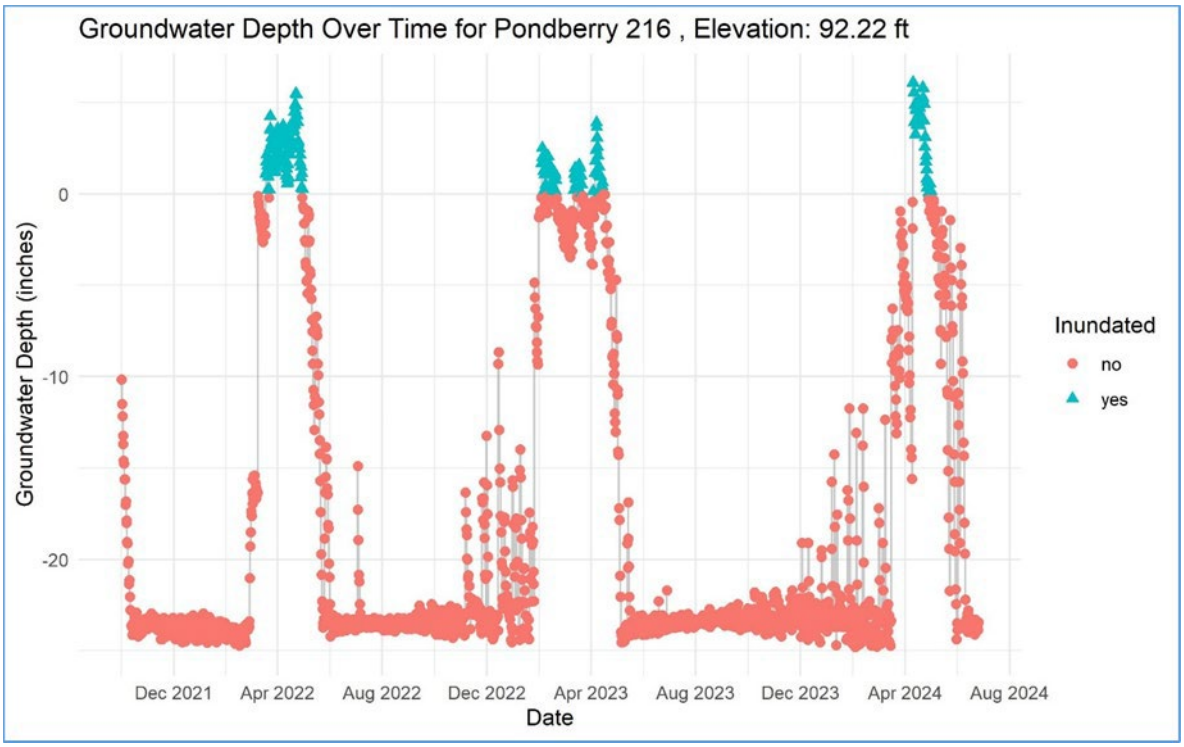

Figure 19. Groundwater monitoring well data for Pondberry 216, October 2021 to June 2024, showing groundwater depth (including surface inundation) over time.

There is significant correspondence among local precipitation, river gauges, and monitoring well data (Figure 20). Over the period of record for monitoring well data (September 2021 to late-March 2023), surface water as a result of local precipitation events was frequent but variable across pondberry colonies. This is undoubtedly influenced by a variety of factors, such as topography, soil type, and localized drainage patterns.

Recognizing that historical pulse flooding from the Mississippi River into what is now the YBA ended many decades ago with the installation of levees and water control structures, and that forested wetlands in the DNF have persisted despite this hydrologic change, it is important to investigate the long-term hydrologic patterns associated with historical and current pondberry colonies. It has been well-documented that pondberry requires at least occasional inundation to meet life-history needs. To characterize the frequency of historical backwater flooding events relative to currently extant pondberry colonies, we took a retrospective look at long-term hydrologic data provided by CEMVK for the POR (1979-2020) as well as more recent gauge data through July 2024 We selected two river gauges nearest to the DNF that included the majority of pondberry colonies (Little Sunflower [LS] and Holly Bluff) HB], as well as at the SBWCS that (when closed during flood events) backs up water into the Action Area at a relatively flat elevation surface. It is uncertain if all currently extant pondberry colonies existed at the start of the POR, and this analysis examines hydrologic conditions at the locations of extant colonies regardless of how long the colonies have been present. Since 1979, backwater flooding to elevation 95.0 ft NGVD only occurred during five [LS and SB, 1979, 1983, 2018,

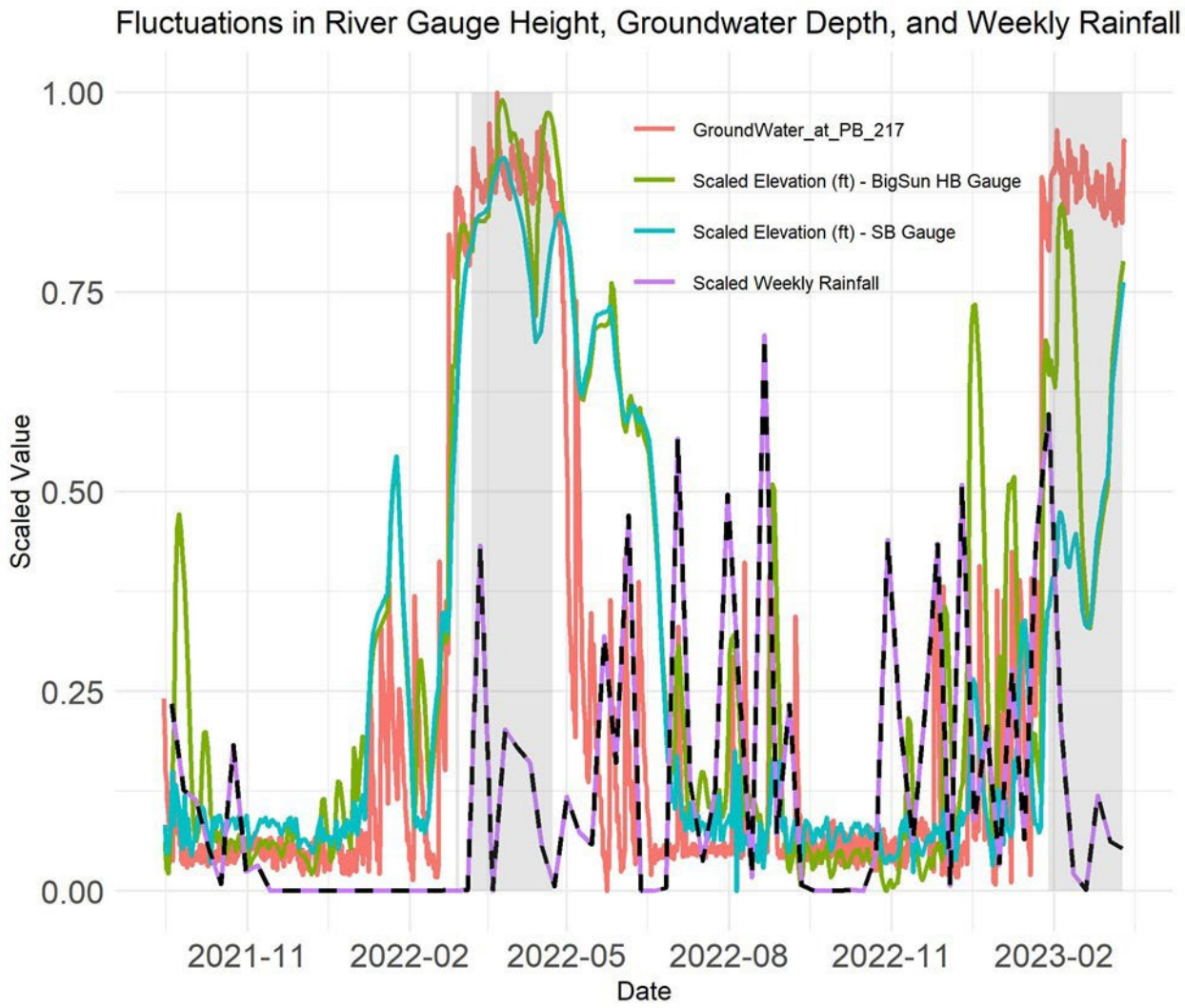

Figure 20. River gauge, groundwater monitoring well, and rainfall data overlayed with dates a single wildlife trail camera imagery showed surface water inundation at pondberry colony PB217 (93.38 m NGVD). Gray rectangles indicate the appearance of inundation on trail camera imagery (Cam_11). River gauges are Big Sunflower River at Holly Bluff and Steel Bayou landside gauge. Precipitation was measured at Holly Bluff.

2019, and 2020] and seven years [HB, 1979, 1982, 1983, 1991, 2018, 2019, and 2020], respectively. These data suggest that the 17 extant pondberry colonies above 95.0 ft NGVD in the DNF, over the POR, did not experience backwater inundation for many years, and in some cases, decades. Backwater flood events above 93.0 ft NGVD were also relatively uncommon over the POR (7/46 years at SB), and thus the 106 extant colonies occurring above 93.0 ft NGVD (out of 122 known extant colonies in the Action Area) would not have been subjected to backwater flooding in 39 out of the past 46 years. The infrequency of backwater events at the vast majority of known extant pondberry colonies in the Action Area, and the emerging information on local hydrographs associated with individual pondberry colonies, provide increasing evidence for the importance and role of local precipitation as a leading driver in maintaining suitable growing conditions for pondberry in the Action Area.

Palmetto

Dwarf palmetto appears to be expanding its range northward in recent decades (Tripp and Dexter 2006) and appears to be increasing in density in the DNF (which is near the northern limits of the species' range; Figure 21).

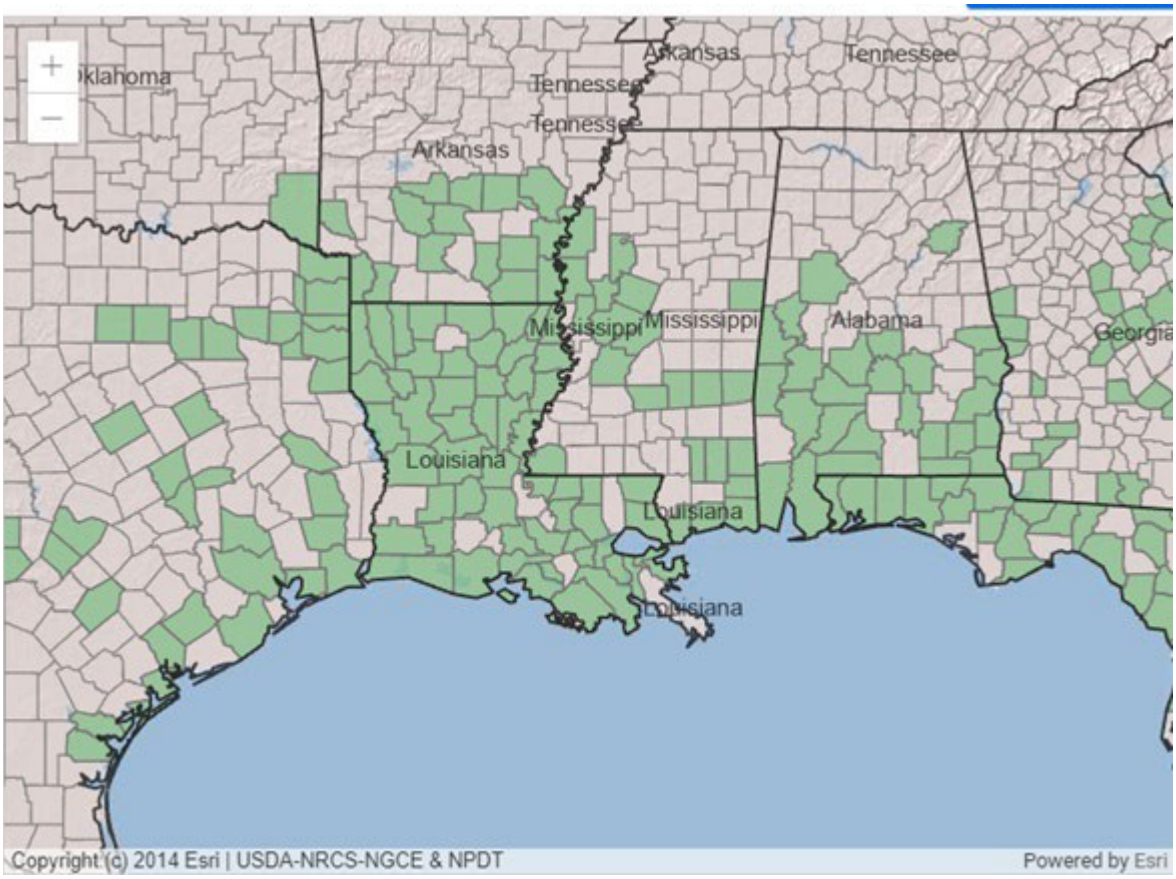

Figure 21. Documented county-level distribution of dwarf palmetto in 2014. USDA Plants Database.

Analysis of historical winter Sentinel-2 NDVI satellite data shows that evergreen vegetation (primarily palmetto) has expanded significantly in this portion of the forest over the last 22 years (Figure 22). This expansion in palmetto overlaps spatially with dozens of now extinct pondberry colonies. Results of this preliminary analysis indicates a mass of evergreen vegetation in the northeast portion of the DNF that aligns with areas with high palmetto occurrence, as noted by ERDC biologists from 2020-2024. For ground-truthing this preliminary analysis, we extracted all colonies in which we made note of palmetto during pondberry surveys in 2023 and overlaid them with NDVI data from January 2023 (Figures 23 and 24).

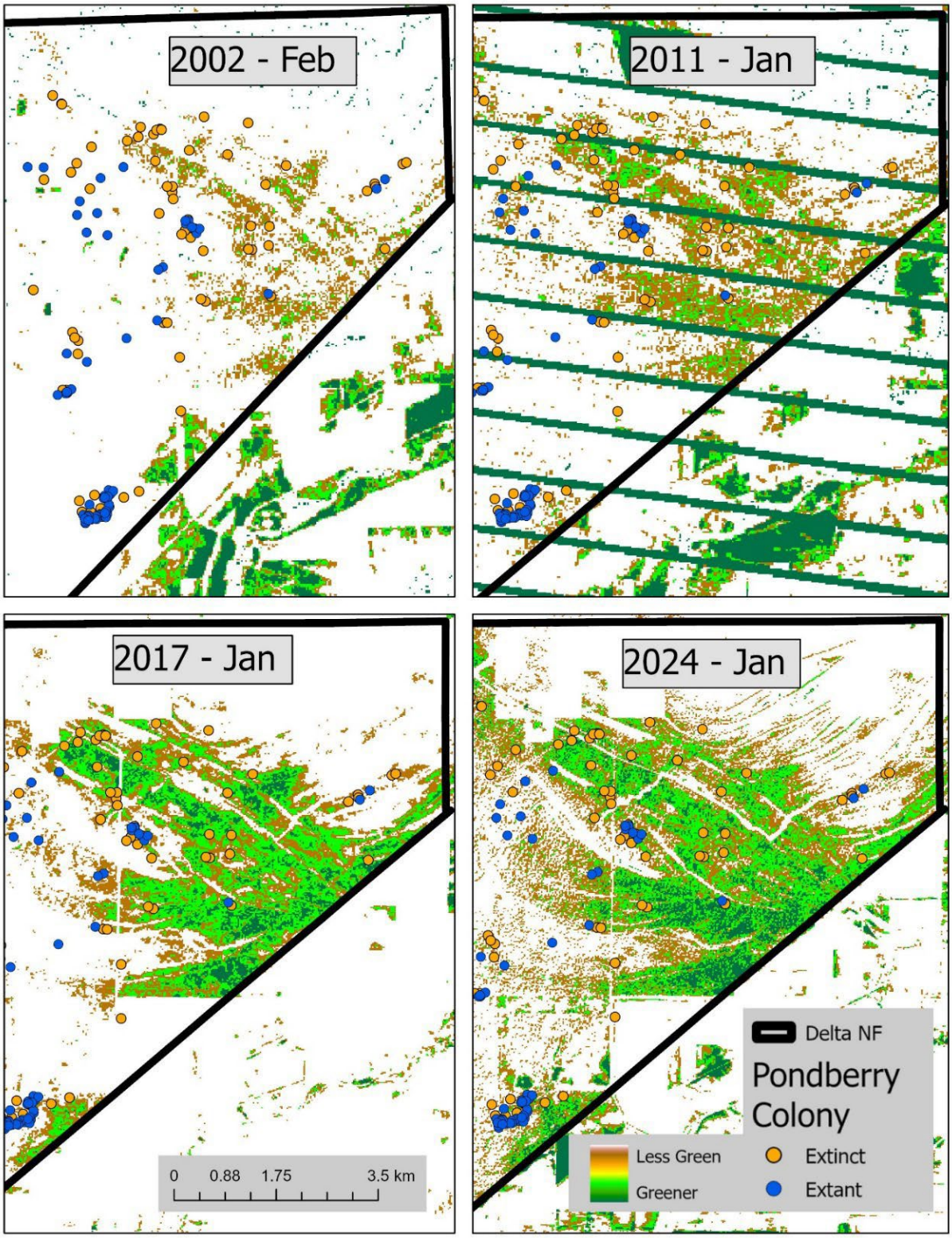

Figure 22. Winter NDVI satellite imagery analysis of evergreen vegetation change over 22 years within a portion of the DNF. Extinct/extant colony status in each panel is as of 2023, and for most colonies it is unknown which year between the extinctions occurred.

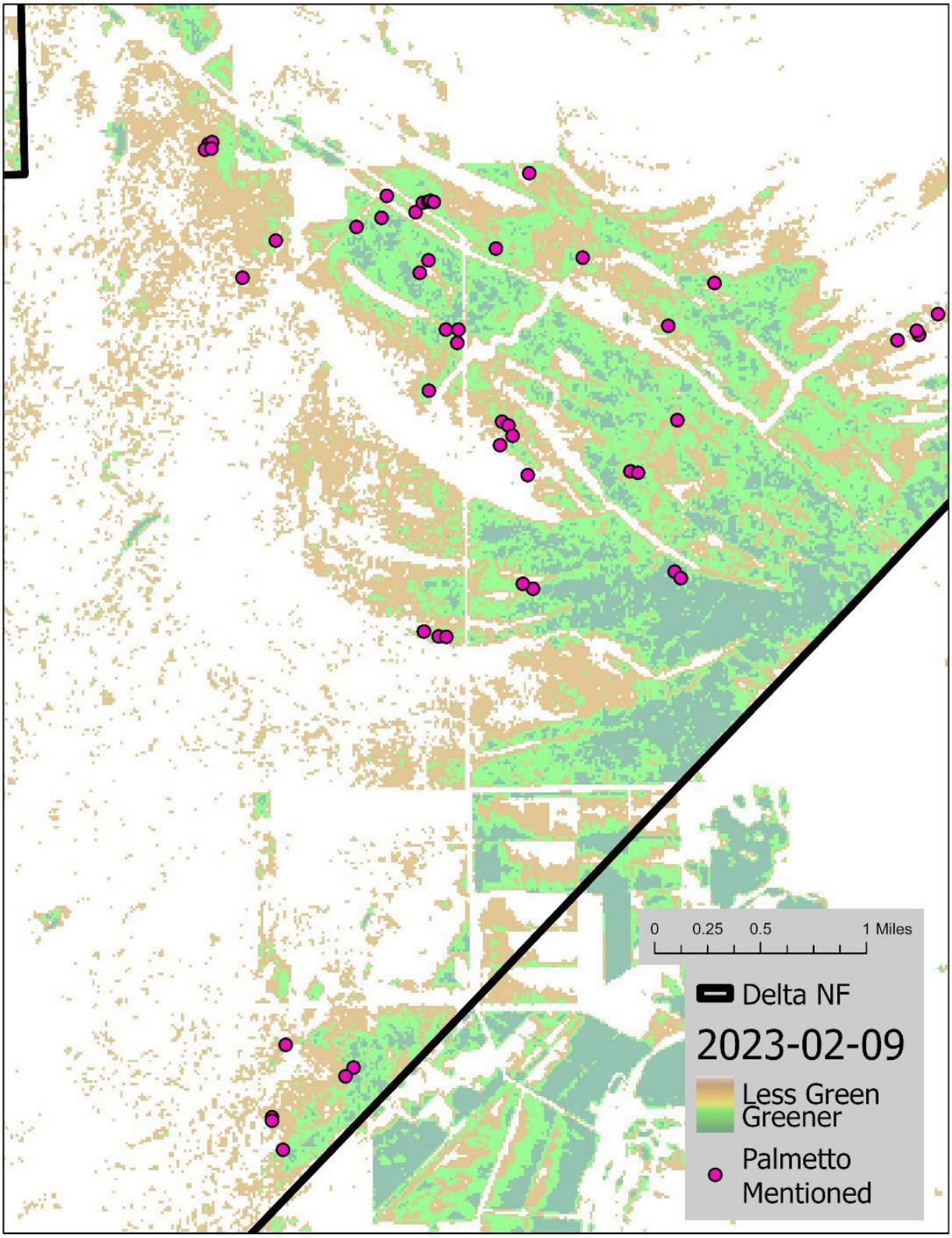

Figure 23. Pondberry colonies in which palmetto was mentioned in data sheet field notes from 2023 ERDC-EL pondberry colony surveys. Map extent shows the northeast portion of the DNF.

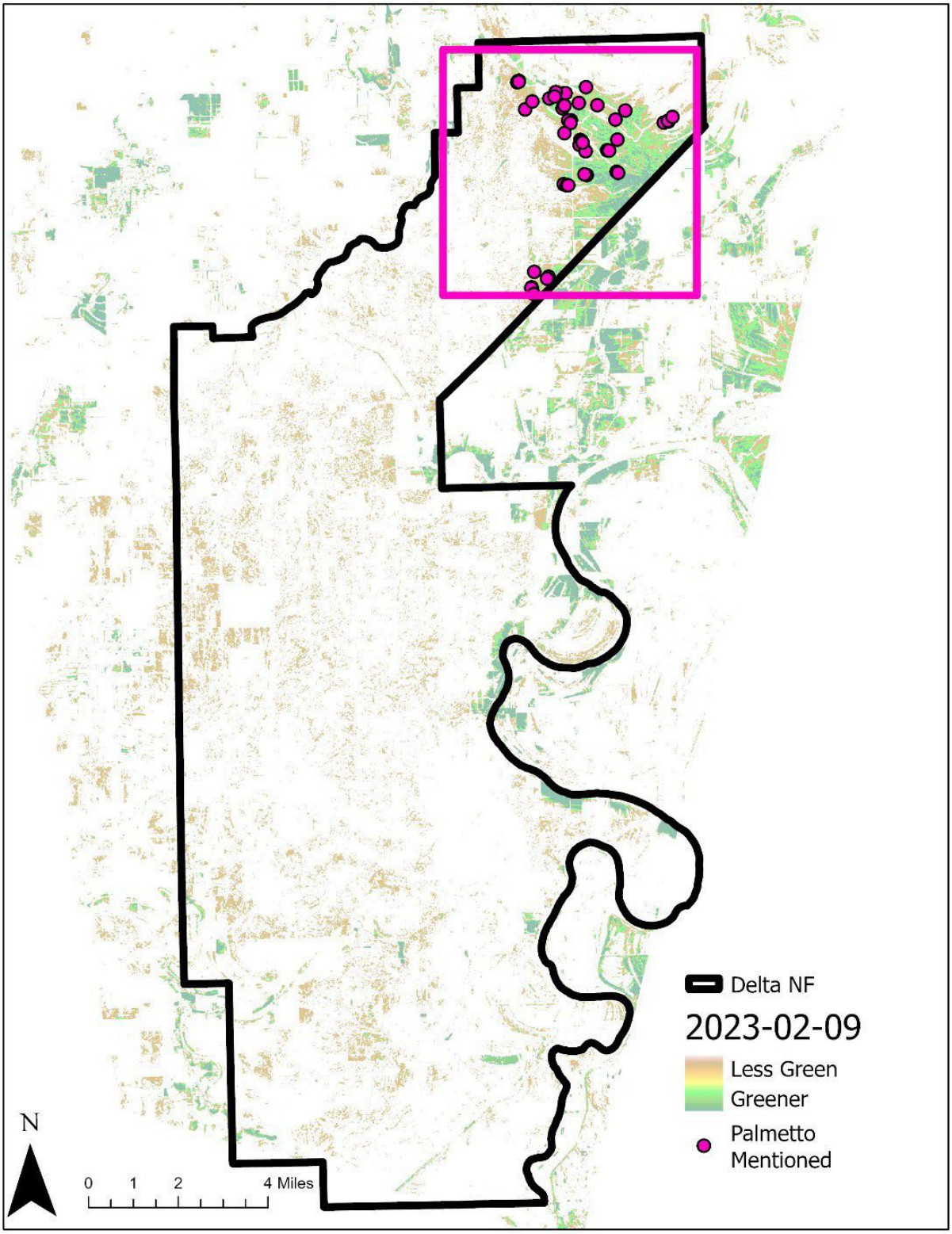

Figure 24. Pondberry colonies in which palmetto was mentioned in the field notes during 2023 surveys. Extent shows the entire DNF.

Laurel Wilt Disease

Pondberry is susceptible to a fungal pathogen (*Raffaelea lauricola*) that causes laurel wilt, which is a lethal disease for the species. Several researchers have investigated the impacts of this pathogen on pondberry (e.g., Best and Fraedrich 2018, Fraedrich et al. 2011). The USFWS (2021) cited laurel wilt disease as an emerging threat of mostly unknown long-term consequences to extant pondberry colonies that needs much more investigation. The disease was not discovered in the U.S. until after the Recovery Plan was finalized, but the pathogen now is known from all states but Missouri within the full current and historic range of the species. The distribution map for laurel wilt in the United States is tracked by The Southern Regional Extension Forestry (SREF) Forest Health Program (http://southernforesthealth.net/news.updated-laurel-wilt-map), and the current online map does not show the pathogen present within the Action Area (latest update 23 July 2021). Nonetheless, laurel wilt disease is of significant concern, particularly if it spreads within the distribution of Mississippi pondberry populations.

PART VI: MANAGEMENT AND CONSERVATION MEASURES

The primary mitigation associated with the overall proposed Water Management Plan includes the acquisition and reforestation/conservation of agricultural lands through perpetual easements from willing sellers. Because there are no known extant pondberry colonies at or below 89.0 ft. NGVD in the Action Area, any acquisition of lands as mitigation for the preferred alternative under the Water Management Plan that occur below 89.0 ft. NGVD would have little to no value for potential future pondberry colonization. Mitigation within the Action area in the 91.0 to 96.0 ft NGVD elevation range (95% of known extant colonies are within this range) would be most likely to benefit pondberry. Because backwater flooding events in the 91.0 to 96.0 ft range have been infrequent over the POR (especially above 93.0 ft), the ERDC-EL believes that, with or without potential changes in hydrology from the preferred alternative for the YBA, there is sufficient and extensive pondberry habitat across broad swaths of the DNF that will continue to be maintained by frequent to intermittent local precipitation events. Because limited discovery surveys by ERDC-EL were yielding previously undiscovered colonies within this elevation range as recently as 2023, future extensive discovery surveys, especially within elevations 91.0-96.0 ft NGVD within the DNF, should continue to yield extant and previously undocumented pondberry colonies.

Future conservation actions, by both the USACE and USFS within the DNF, should provide significant benefits to multiple pondberry populations. The best administrative approach to ensuring proper delivery of appropriate inventory, monitoring, research, and conservation and management is through Section 7(a)(1) of the ESA. Below, we provide some details on proposed actions and activities we believe will further increase the baseline of pondberry in the Action Area. This Plan should help streamline any future ESA Section 7(a)(2) consultations between the USACE and USFWS and provide some assurances that proactive work by USACE will continue so long as there are appropriated funds and recommended actions fall within USACE authorities.

Endangered Species Act Section 7(a)(1) Conservation Planning

The CEMVK believes that the most beneficial means of promoting pondberry populations in the DNF is through proactive conservation planning and implementation. Section 7 of the Endangered Species Act requires that federal agencies consult with either the USFWS or NMFS (collectively, the Services) to ensure that their actions do not jeopardize the continued existence of threatened or endangered species, or adversely modify their critical habitats. Section 7 is split into multiple parts that relate to how action agencies cooperate with the Services to protect species. The USACE works with the Services primarily via formal and informal consultations under Section 7(a)(2) of the ESA, which typically leads to the issuance of Biological Opinions by the Services that mandate special measures action agencies must follow to protect threatened and endangered species in the course of their actions.

There is significantly less familiarity with, and utilization of, the preceding Section 7(a)(1). In 2017, the USFWS Jackson, Mississippi Ecological Services Office, and the ERDC-EL collaborated on a publication (Hartfield et al. 2017) to describe the benefits of interagency cooperation through Section 7(a)(1). This approach proved successful in contributing to the delisting of the interior population of the Least Tern (*Sternula antillarum athalassos*). Many of

the proactive conservation activities that have been implemented during the past several decades on USACE lands pertain directly to this section which describes voluntary conservation measures by federal agencies for federally listed species. This section specifies that agencies' duties to conserve threatened and endangered species can apply widely to programs and is not limited to individual actions. Thus, agencies can distribute conservation obligations program-wide, as well as achieve conservation opportunities outside of defined action areas to attain compliance with the ESA in a way that promotes efficiency, cost effectiveness, ingenuity, and improved conservation outcomes through increases in species baselines. Thus, a more proactive use of Section 7(a)(1) conservation actions provides a way USACE can gain improved operational efficiency and flexibility in executing mission requirements (Hartfield et al. 2017).

In addition, the flexibility that can be gained through 7(a)(1) conservation programs enables greater synergy with stakeholder initiatives and promotes strategic collaboration and resource leveraging which can significantly increase objectives achievement and program sustainability. It also allows opportunistic mitigation of past, present, or future adverse effects of agency actions by raising the species population and/or habitat baselines, which may reduce the potential of future interagency conflicts under Section 7(a)(2) and increase operational flexibility and mission sustainability (Hartfield et al. 2017). Importantly, the U.S. Department of the Interior Solicitor's Office released a Memorandum on 6 February 2024 (Federal Agency Obligations under Section 7(a)(1) of the Endangered Species Act) providing clear guidance affirming federal agency obligations to use their authorities to develop and carry out programs for the conservation of threatened and endangered species.

Components of Section 7(a)(1) Conservation Programs. There is no formal template for Section 7(a)(1) conservation plans or programs, and their design is currently flexible and adaptable. Important components would include relating the federal agencies' roles and contributions to the species baseline within their regulatory footprints, identification of research and monitoring needs relative to agency actions, and management strategies under its authorities to minimize adverse impacts ***and*** benefit (i.e., conserve) the species (Hartfield et al. 2017). The obvious intent of section 7(a)(1) is to raise the species status baseline within the scope of the federal agency mission program footprint. In general, a Section 7(a)(1) conservation program links the authorized purpose of the mandated mission program with the status of listed species potentially benefitted or adversely affected by the mission program and presents a general and defined strategy for the conservation of the species and their habitats.

Historical and Recommended Potential Conservation Actions by USACE. In 2001, the CEMVK entered into a 7-year, $5 million interagency agreement (IA) with the USFS, to initiate various biological and ecological investigations on pondberry. The IA was entered into pursuant to Section 7(a)(l) of the ESA. That IA was supplemented with an updated IA in 2002. These research activities were specifically designed to address recovery tasks described in the USFWS (1993) Pondberry Recovery Plan. Attachment A of the USFWS (2007) Biological Opinion addressed tasks in the Recovery Plan and are also being conducted in accordance with Section 7(a)(l) of the ESA.

At that time, the Corps proposed to conduct the following activities:

(1) Propagation and stocking of approximately 40,000 pondberry plants at Mahannah Wildlife Management Area and Panther Swamp National Wildlife Refuge, at or below the 1-year Backwater flood frequency.

(2) Establishment of field experiments within experimental plots in DNF, Sharkey County, MS, to evaluate the effects of flood frequency, sunlight, competition, and pathogens on pondberry. Proposed treatments included (a) flood frequencies at 1, 2, 5, 10, and 15 years; (b) stand sunlight manipulated through light thinning, heavy thinning and control; and (c) competition investigated with herbicide treatment and control.

Between approximately 2001 and 2015, the USFS conducted a wide variety of research investigations under the IA resulting in a multitude of reports and peer-reviewed publications. To our knowledge, the majority of these investigations occurred in the laboratory, or in limited field settings. These research investigations yielded significant insight on the biology and ecology of pondberry relative to flooding and light requirements, much of which can now be transferred to field settings for direct management treatments that could be monitored over time in an experimental framework. The IA (both 2001 and 2002) between the CEMVK and USFS has been fulfilled. However, the 2007 Memorandum of Agreement (MOA), to have included CEMVK, USFS, the USFWS, is no longer in effect because the project was halted due to the Environmental Protection Agency project veto. All resources/publications that were produced as a result of the IA were coordinated and shared with the USFWS upon completion.

Recommended Potential Conservation Actions by USACE

Agency conservation programs developed under ESA section 7(a)(1) are intended to assist Federal agencies and their potential partners in planning and implementing actions to protect and recover endangered or threatened species potentially affected by the agency's activities. The proposed conservation measures below are a guide for meeting the goal and objective outlined above, and do not obligate any party, including the USACE to undertake specific actions at specific times. Implementation of the actions outlined below is contingent upon opportunity, appropriations, and other budgetary constraints.

There are a variety of management opportunities that could potentially assist with increasing the baseline of pondberry in the DNF. The management practices and conservation actions listed below could provide opportunities to better understand how pondberry responds to changes in stressor levels, which ultimately could provide insight into ways to both conserve and recover the species. At this time, the MVK does not plan on establishing a new interagency agreement for additional research, but instead should begin updating a 2020 mitigation, monitoring and adaptive management plan into the 2024 YBA DEIS to establish monitoring efforts for specific conservation actions for pondberry. The conservation measures proposed below are intended to occur on lands under USFS jurisdiction, but some may be implementable elsewhere. The MVK has communicated with the USFS DNF staff, and a verbal agreement is in place that would allow the USACE (MVK, ERDC-EL) to work with the USFS to implement the proposed conservation measures. Further involvement by the USFS in the overall strategy outlined in this document would provide significant value-added assistance. The USFWS was instrumental in the design phase of the studies referenced in previous interagency agreements (both 2001 and 2002) along with the USFS and MVK. We also believe it appropriate and beneficial to coordinate all proposed conservation measures, research projects, and otherwise, in an interagency context that would allow MVK, ERDC-EL, USFS, and the USFWS an opportunity to each assist in the design and (as appropriate) implementation of all below activities. That coordination should provide assurance that the proposed conservation measures can be implemented as long as there

are appropriated funds available. We propose the following actions, as conservation measures, in priority order below.

- Strategy 1: Continue to Develop and Implement a Long-term Pondberry Monitoring Plan.
- Strategy 2: Investigate role of hydrology and hydroperiod on pondberry
- Strategy 3: Conduct a long-term assessment of the role of local hydrology on pondberry
- Strategy 4: Adaptive monitoring and management of pondberry colonies in the DNF
- Strategy 5: Experimental canopy thinning.
- Strategy 6: Investigate herbivory and other impacts to pondberry by feral hog activity
- Strategy 7: Assess the effects of interspecies competition on pondberry colonies
- Strategy 8: Micropropagation and transplanting

Strategy 1: Continue to Develop and Implement a Long-term Pondberry Monitoring Plan. Pondberry monitoring in the DNF has been ongoing (but very intermittent) in the DNF for at least three decades. In the 2020 USACE BA, the ERDC-EL noted that there were 182 historically known pondberry colonies within the DNF. From 2020-2023, the ERDC-EL conducted a thorough investigation of nearly every known pondberry colony location as determined from multiple sources of information from CEMVK, USFWS, USFS, and others. We now believe that this 4-year effort provides a significant broad and thorough geographical assessment of the status of pondberry in the DNF, and yet it is also likely that undiscovered colonies and populations exist.

Actions:

a. **Conduct additional discovery surveys within the DNF and other bottomland hardwood forest areas within the YBA**. Because the ERDC-EL discovered many new colonies or expanding clumps of pondberry near existing colonies during the course of fieldwork from 2020-2023 within broad areas of the DNF, ERDC-EL believes that the distribution and abundance of pondberry is greater than currently documented within the DNF. We recommend that additional discovery surveys be conducted, and that the methods and spatial extent for such surveys should be explored in consultation with the USFWS. Clearly, continuation of the extensive surveys initiated by ERDC-EL have a high likelihood of future new colony discoveries. Because our data show that 95% of extant pondberry colonies in the DNF occur between elevations 91.0 and 96.0 ft NGVD, future DNF discovery surveys should focus on those elevations. A 1-m resolution USGS 3D Elevation Program (3DEP) digital elevation model (DEM) also allows for depressional areas surrounded by higher elevations to be visually observed within GIS. Future surveys can be informed using this new spatial layer.
b. **Conduct extensive and annual monitoring of all existing pondberry colonies, with a focus on those colonies identified during all 2020-2023**

surveys. We recommend that future visits should not be prioritized at colonies we visited twice and found no pondberry. Priority should be given to historical "GSRC" plots with unknown or extant status in order to continue to supplement the long-term trend dataset. Any new colonies documented during recent and future monitoring should continue to provide information and data before and after the implementation of the proposed Water Management Plan as described in the USACE 2024 EIS. Extensive pondberry monitoring also should be included in any future Monitoring and Adaptive Management Plan for the Yazoo Backwater project.

Strategy 2: Continue Assessing the Role of Backwater Hydrology and Hydroperiod on Pondberry.

A main focus (and disagreement between USFWS and USACE) of the 2007 BO (USFWS 2007) was on the effects of backwater flood frequency on pondberry colonies. The metric used to test hypotheses regarding the potential impacts of hydroperiod on pondberry colonies was the number of stems per colony. Stem counts between 2000 and 2005 showed at least a short-term, yet apparent decline at most colonies. In reviewing GSRC (2000, 2005) reports, it was not clear exactly how those investigators defined plot sizes for stem counts, and no raw data were available in GSRC (2005) for which to adequately determine whether 2000 and 2005 techniques were identical. To further this confusion, Gulf South Biological (2001) also visited GSRC pondberry colonies and counted stems, noting "at almost all sites the number of stems counted….were less than the number of stems counted by Gulf South Research Corporation. In certain instances, the flagged area where pondberry plants were concentrated was smaller than GSRC's original plot census." Pages 261-272 of 2007 BO (USFWS 2007) describe in detail and argue how various parties (including USACE, USFWS, and Applied Research and Analysis, Inc.) analyzed and interpreted data, and used estimates of statistical power to facilitate inference. Without sufficient detail on how plot sizes and stem counts were made among years (prior to 2020 surveys), much of the prior analyses, interpretations, and disagreements are especially difficult to interpret and assess.

Though a trend of stem declines from 2000 to 2020 seems readily apparent, the abovementioned issues also make it difficult to compare prior colony monitoring data with those collected from 2020-2023 and to relate stem counts with historical flood data. There is a significant need to more fully address the impacts of flooding hydrology (flood frequency, inundation depth, and duration) on pondberry colony health and persistence, not only in the DNF but also elsewhere in the range of the species (e.g., large-stemmed, thriving colonies in the Hester Tract within northern Mississippi, and other large colonies in Arkansas and Missouri; see Figure 25 to compare Hester Tract with DNF). Future monitoring coordinated with USFS and USFWS will assist in filling this knowledge gap. Specific details on improved and more consistent surveys and monitoring of pondberry should be coordinated with the USFS and USFWS and documented in a formal agreement.

Because our data collected after the deep and long-duration flooding in 2019 and 2020 suggest that inundation events of high magnitude result in significant impacts to pondberry colonies, long-term monitoring at a subset of persistent colonies with long-term stem counts can assist in determining (1) how pondberry colonies respond to lengthy flood events, and (2) what are the

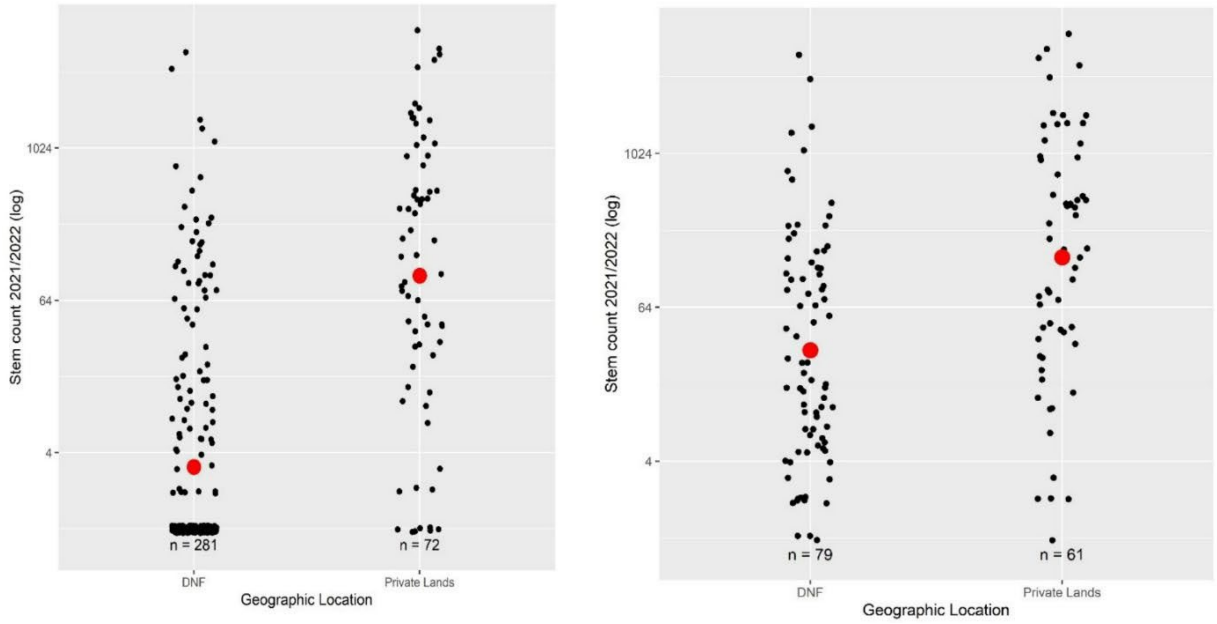

Fig 25. Stem counts between DNF and Private Lands pondberry colonies. The left plot includes all colonies, extant or extinct. The right plot includes only extant colonies. Data is from 2021-2022. Red circles indicate mean values. Y-axis is log-transformed for ease of visualization.

spatial, temporal, and other factors that contribute to colony recovery. Under the proposed 2024 Yazoo Backwater Water Management Plan, there would be an especially significant need to conduct long-term monitoring of pondberry colonies to monitor the long-term fate of colonies that experience a potential change in hydroperiod from flood events that initiate pumping.

Strategy 3. Conduct a Long-term Assessment of the Role of Local Hydrology on Pondberry.

The ERDC-EL believes that a more thorough and long-term investigation of the role of local hydrology (precipitation and flooding of local drainages via overbank or distributary flooding) on pondberry colonies is needed. We suggest using the Berkowitz et al. (2020) methodology as a starting point, conducted at extant and historic pondberry sites, and with associated research to investigate methods to spatially evaluate the role of local landform, elevation, contours, soils, and other attributes at sites with precipitation-driven wetland hydrology for a wider and accurate spatial application of such conditions elsewhere in the backwater area. This should be accompanied by investigations into how to appropriately and accurately spatially extrapolate results from localized groundwater monitoring well study sites, such as those reported by Berkowitz et al. (2020), to relate local hydrology to broader landscapes (where local wells have not been deployed) in a scientifically sound manner. To support this investigation, ERDC-EL also proposes to monitor existing and new groundwater wells relative to pondberry colony sites.

The Berkowitz et al. (2020) study represents the best available scientific data on wetland hydrology sources within the Yazoo Basin. They stated, "All monitoring locations were distributed based upon access to public lands, mapped flood frequency and duration (where

available), and site condition to include analyses of mature second growth forest and reforested farmed wetlands." Their monitoring locations were not determined randomly or based on a probabilistic distribution approach. In addition, their 56 sites represented a large number of monitoring locations for this type of study; the study incorporated analysis of precipitation and stream flow normality into the analysis to place the results in a larger context (this is the standard approach used to evaluate wetland hydrology when <10 years of data are available); and a number of wells were maintained for periods up to eight years (which is also rare in these types of studies). Across all the available data, the period of soil saturation far exceeded (~10x) the period of flooding. These findings align with the conceptual hydropattern of bottomland hardwood forests.

Actions:

(a) **Analyses of Groundwater Monitoring Well Data**. The ERDC-EL and MVK should continue to maintain, monitor, and analyze data from the existing 149 groundwater monitoring wells that were installed in the Yazoo Backwater in 2021-2022. Of these wells, 58 were installed at or proximal to pondberry colonies and are providing critical data on hourly and daily ground- and surface-water levels. Some of these data were reported in the 2024 USACE BA.

Strategy 4: Adaptive Monitoring and Management of Pondberry Colonies in the DNF.

Intensive studies to address a variety of ecological factors affecting the growth, development and sustainability of pondberry should be included in an updated Adaptive Monitoring and Management Plan (AM&M; e.g., similar to USACE 2020c) for the Yazoo Backwater Area. The AM&M plan would allow the USACE to make operational management decisions, develop benchmarks, and make adjustments in the face of uncertainties as outcomes from management actions and other events become better understood regarding the effects on pondberry colonies. Careful monitoring of these outcomes advances scientific understanding and helps adjust policies or operations as part of an iterative learning process.

Currently, a complete understanding of the regional ecology of pondberry is unknown, and even less is known regarding local colonies. However, before implementation of the currently proposed Water Management Plan for the Yazoo Backwater Area (baseline conditions), ERDC-EL will be able to conduct intensive spatial and temporal studies on existing pondberry colonies and populations and establish seasonal trends including a range of environmental conditions beyond hydroperiod including available light, soil properties, herbivory, forest habitat metrics (competition), and stem dieback. Performance measures will include metrics related to growth, development, vigor, and spatial distribution pre- and post-project. During baseline conditions, monitoring will be "adaptively" adjusted as key elements of regional and local pondberry ecology are identified.

Baseline conditions (pre-project) of pondberry colonies within the project action area will be established which includes projections (trends) of future without project (FWOP) on a 12-year monitoring horizon. Baseline conditions will determine natural variability due to seasonality, herbivory, hydric regime, forest habitat metrics, and stem dieback not associated with the

proposed project. The results of the baseline study will set the foundation for any positive or negative effects caused by the project including long-term effects caused by future with project. During the monitoring period, data will be processed, reduced, statistically analyzed, and entered into an adaptive monitoring framework to adjust future monitoring needs and protocols. Those protocols may include the type and frequency of measurements and their location. This monitoring plan will be submitted to the USFWS for concurrence.

To initiate a long-term monitoring plan, it will be necessary to fully understand the distribution of extant pondberry colonies within the DNF. Several factors were identified herein that affect distribution, growth, and development of pondberry colonies:

1. In the 2007 Biological Opinion, the USFWS identified that hydroperiod affects the distribution, growth, and development of pondberry. In addition, the USFWS recognized the need to improve our understanding on the life history of pondberry.
2. The USACE not only recognized the importance of hydroperiod, but also the effects of light availability which is influenced by canopy and midstory cover.
3. The USFWS has not proposed establishing pondberry critical habitat in either Mississippi or in other states in which the species is known to inhabit. However, both the USFWS and the USACE have identified habitat characteristics associated with pondberry colonies found in Mississippi including mature bottomland hardwoods, low depressions dominated by vertical hydrology (rainfall and evapotranspiration), and soils with surface horizon characterized with silty clay to silt loam textures.
4. Competition from other plant species was reported in the USACE 2024 BA, including “weedy” species and vines that may be less flood tolerant (e.g., Smilax spp., Vitis spp., Campsis radicans, and Ampelopsis arborea.).
5. Within the DNF in Mississippi, the USACE 2024 BA reported that the USFS determined 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 pondberry colonies.
6. Stem dieback, feral hog activity, palmetto encroachment, and herbivory all are potential stressors that may contribute to poor or declining colony health in the DNF (Figure 26). Herbivory has been observed by deer and insects (e.g., spicebush swallowtail caterpillar). The best available information suggests that stem dieback is related to fungal pathogens, drought, and possibly, the interactions between them.

Figure 26. Drought-stressed, insect-damaged pondberry stem with chlorosis in Aug 2023. This stem was the only stem present at a remnant colony in the northern portion of the Delta National Forest, within dense dwarf palmetto encroachment, and surrounded by extensive sign of feral hog activity. This colony and others may face extinction without active management intervention.

Strategy 5: Experimental Canopy Thinning. Because data from decades of surveys suggests pondberry populations have declined throughout the DNF, experimental thinning studies should be carefully considered, designed, and (if determined appropriate) implemented, which should provide valuable insight that can be used to inform and guide future management of pondberry and its habitat. This work should be coordinated with experts from the USFS Stoneville Research Laboratory as they have prior expertise in the topic.

Pondberry has been referred to as a disturbance-dependent species (Lockhart et al. 2012, Lockhart 2016). For example, Lockhart (2016) stated, "Observations of extant pondberry populations found in the shaded understory of mature bottomland hardwood forests do not take into account past disturbance. Current pondberry populations may be legacies from past forest disturbance that provided conditions for establishment and development of vigorous pondberry populations. When the forest canopy closed during normal stand development processes, the amount of available light decreased, leading to decreased pondberry growth." In the Atlantic Coastal Plain, Beckley (2012) also suggested that pondberry is a disturbance-dependent species (e.g., disturbances that decrease canopy cover). However, no definitive evidence exists to support pondberry as dependent on disturbances that open the canopy. In fact, those same disturbances can increase competing understory vegetation (e.g., vines). Nonetheless, there remains a need to investigate the role of canopy cover in natural settings. In the DNF, light levels are low, often as low as 5%, which can impact pondberry growth and vigor (Lockhart 2016). Some researchers have experimentally manipulated light availability for pondberry in the laboratory setting (Unks et al. 2014; Lockhart et al. 2013, 2015, 2017, 2018). For example, Lockhart et al. (2013) showed that pondberry plants raised under 37 percent light had greater stem length growth than plants raised beneath 70 percent or 5 percent light. Further, Lockhart et al. (2015) further demonstrated that pondberry plants raised in 5 percent light, and then subsequently provided with additional sunlight (i.e., 70 and 37 percent) released and grew significantly larger. Best stem growth occurred at around 40 percent of full sunlight (Lockhart 2016). Lockhart (2016) suggested that forest management that increased light levels reaching the understory, and vegetation control to reduce competition, could be used in combination to increase growth of pondberry. One caveat to such an approach is how competitors such as *Brunnichia ovata* and other vines also respond to increased light levels (Hawkins et al. 2016), highlighting complexities and potential detrimental tradeoffs with reducing canopy cover above pondberry colonies. Within the DNF, encroachment into colonies and smothering of pondberry stems by sun-loving competitors appears to be a serious impediment at certain colonies based on 2020-2023 surveys.

Mean canopy closure at pondberry colonies (96.8%, n=42) was similar plots without pondberry (95.3%, n=38) during ERDC-EL 2020 assessments. This same metric has been measured by multiple researchers who have found similar canopy cover results (GSRC 2001, GSRC 2005). Therefore, silvicultural treatments could be designed at extant pondberry colonies in the DNF to increase the amount of available light reaching the understory at an optimal level for pondberry. Field measurements could be made over time and compared with control sites to determine the efficacy of this management action

in increasing pondberry growth rates. Lockhart (2016) provided a reasonable outline for designing such experiments, along with caveats regarding need for special use permits from USFWS, NEPA requirements and environmental reviews by the USFS, and the inherent difficulties of experimental field project designs on a rare and endangered species.

Actions:

a. **Investigate relationship between light and pondberry**. Rigorous studies on the effect of existing canopy openness and corresponding light availability on the vitality of pondberry colonies should be conducted to assess colony size and health across a range of light conditions experienced within the DNF, with attention to relationships with indices of relative density of competing vegetation. Incorporating new and high-precision technology (e.g., Licor 2200 Plant Canopy Analyzer) that assists in standardizing canopy measurements to be more objective is also necessary for making future comparisons. Such studies could also be replicated at other sites to compare conditions in the DNF with those experienced in tracts with robust pondberry colonies where stem sizes are significantly larger (e.g., Hester Tract in Mississippi and St. Francis Sunken Lands in Arkansas (Figure 27)).
b. **Conduct thinning treatments.** If investigative studies suggest that pondberry in the DNF is being limited by closed canopy, consider conducting careful canopy thinning treatments and monitor colony responses. Careful attention would be needed to monitor for invading vines, with subsequent hand-removal as appropriate.

Strategy 6. Investigate Herbivory and Other Impacts to Pondberry by Feral Hogs. Though ERDC-EL found no specific research on the potential effects of feral hogs on pondberry, hogs are often mentioned in the literature (e.g., Gustafson 2011, USFWS 2014, Martins et al. 2015), and in many online fact sheets, as significant sources of disturbance (e.g., through rooting, grazing and trampling) to pondberry colonies. In fact, Martins et al. (2015) noted pondberry herbivory by multiple organisms in an investigation that included the installation of wildlife trail cameras at colonies. Though no data are available on the impacts of feral hog activity on pondberry, the hog population in the DNF has increased over the past two decades. During the 2020-2023 field seasons, researchers noted significant hog activity (i.e., rooting, wallows) proximal to many pondberry colonies in the DNF (particularly in the Dawling Bayou area), and hog disturbance to groundcover was noted throughout much of the DNF while surveying extant and searching for new pondberry colonies. Wildlife trail camera data (>600,000 images from 19 cameras deployed by ERDC-EL) continues to document hog activity within the DNF and corroborate field observations and effects on pondberry colonies (Figure 28).

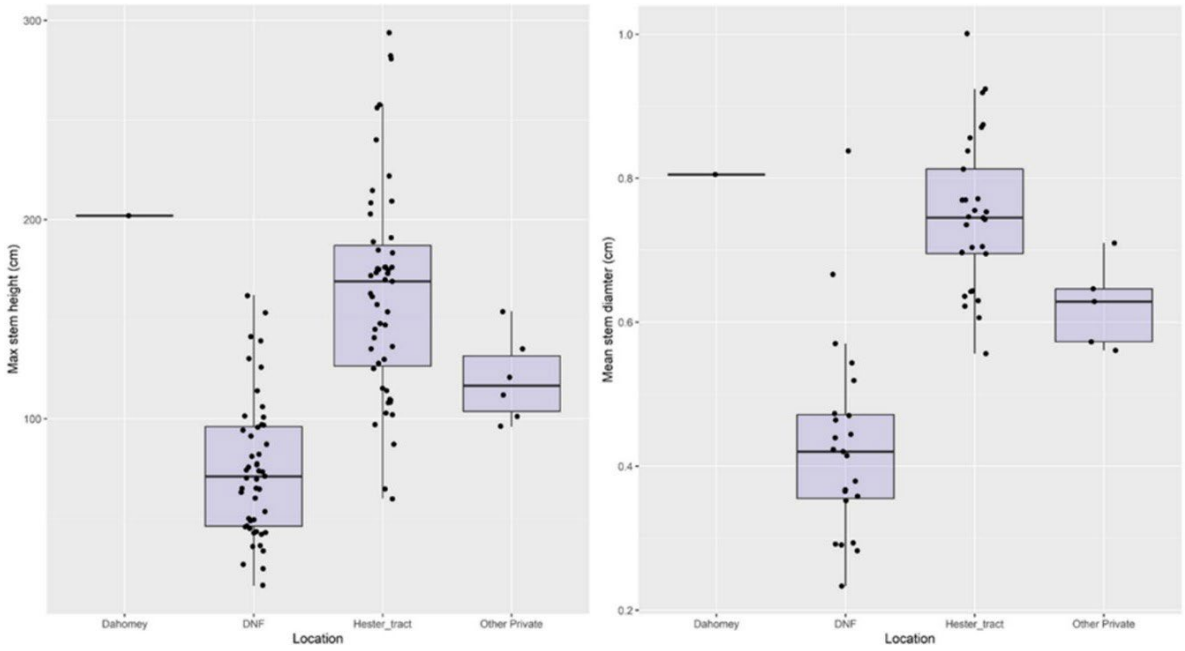

Figure 27. Maximum stem height (left) and mean stem diameter (right) per pondberry colony in the Dahomey National Wildlife Refuge, Delta National Forest (DNF), and private lands in the Mississippi Delta, measured in 2022. Only the DNF colonies are within the YBA and (especially DNF colonies up to 93.0 ft) subjected to periodic backwater flooding.

Figure 28. Feral hogs foraging within a pondberry colony in the Delta National Forest.

Actions:

(a) **Replicated Field Experiments**. Design a replicated field experiment that includes the installation of exclosure fencing around a subset of pondberry colonies, or around delineated portions of certain colonies. Control plots also would be established to compare rooting, soil disturbance, herbivory, and other impacts inside and out of exclosures.

(b) **More Extensive Wildlife Trail Camera Monitoring**. Install additional wildlife trail cameras at multiple points in and near colonies to more extensively monitor feral hog (and other potential herbivores, including white-tailed deer [*Odocoileus virginianus*]) activity.

(c) **Gather existing data.** Identify whether any prior or ongoing investigations are monitoring the distribution and abundance of feral hogs within the DNF.

(d) **Identify Opportunities for Targeted Removal**. Where monitoring suggests that hogs are damaging pondberry or its associated habitats on the DNF, hog control should be considered using methods that will not further harm pondberry (e.g., traps, if used, should be located away from pondberry colonies). Subsequent monitoring, if designed properly, can assist in determining the efficacy of hog control on colony disturbance.

Strategy 7: Assess the Effects of Interspecies Competition on Pondberry Colonies.

Anecdotal evidence, and preliminary investigations using a greenness index (NDVI) from historic winter satellite imagery, suggests that dwarf palmetto distribution and abundance has increased significantly in the DNF over the past two decades, especially at higher elevations. Many of the pondberry colonies at higher elevations in the DNF are either extinct or have significantly reduced stem counts from those made in the early 2000's. Most of these colonies have significant palmetto encroachment (Figure 29).

In addition, wild hogs are an interacting stressor with palmetto encroachment in the DNF, as they appear to have an affinity for palmetto berries and roots, as well as the cover and shelter dense thickets palmetto provides. Secondly, anecdotal evidence suggests that intense competition for light and space by sun-loving herbaceous species may be limiting or even threatening the persistence of some pondberry colonies within the DNF. As noted above, some colonies in the DNF have become completely overgrown with *Campsis*, *Rubus*, *Vitis*, and a myriad of other competitors, with the only persisting pondberry stems existing outside of the melee. Large canopy gaps that become filled with fast-growing heliophytes appear to be incompatible with the persistence of pondberry based on conditions at extinct and remnant colonies. The role that hydrology and light availability plays in mediating the competitive interactions between pondberry, palmetto, and herbaceous vegetation is not well understood.

Figure 29. Remnant pondberry colony (with one extant stem in 2023) in the northern portion of the DNF. The lone small stem had extensive insect defoliation and chlorosis, potentially exacerbated by drought conditions. The surrounding area also had extensive signs of feral hog activity. Note abundant palmetto.

Actions:

(a) **Replicated Field Experiments**. Design a replicated field experiment that includes the experimental removal of palmetto. Determine if there is an available herbicide that kills palmetto without affecting pondberry. Herbicides could be tested on closely related spicebush (*Lindera benzoin*) before further testing and application within or near pondberry colonies.

(b) Assess the potential relationship between palmetto stands and feral hogs. Signs of hog activity seem to be more prevalent in areas in the DNF that have high palmetto density, based on 2020-2023 pondberry surveys and trail camera imagery. Palmetto may be attractive to hogs (for food and for cover), and it may also be possible that palmetto expansion is enabled or accelerated by hog activity.

(c) Assess the role of hydrology/elevation in mediating the competition between pondberry and palmetto. Deeper and more frequent annual hydrology may be affecting the ability of palmetto to move downslope out of the highest elevations of the DNF.

(d) Design a replicated field experiment that includes the removal of herbaceous competition. Experimental design should include matched treatments, such that half of a colony undergoes mechanical weeding while the other half remains untouched.
(e) Assess the role of hydrology/elevation in mediating the competition between pondberry and herbaceous competition. Colonies at lower elevations may receive some relief from competitors that are not able to recover from spring flooding as efficiently as pondberry.

Strategy 8: Micropropagation and Transplanting. Several investigators have met with some success in propagating, and in some cases, outplanting pondberry to natural environments (Wright 1989, Devall et al. 2004, Hawkins et al. 2007). Wright (1989) sowed pondberry seeds in a greenhouse and transplanted seedlings to an existing colony in spring in Arkansas; survival after 4 – 5 months ranged from 10% – 89%. Devall et al. (2004) also met with some success with outplanting, with high survival in the short term but low survival after three years. Hawkins et al. (2007) successfully propagated more than 10,000 pondberry stecklings in both controlled and field settings in Mississippi.

Actions:

(a) **Replicated Field Experiments**. More thorough transplant experiments should be designed under varying light and hydroperiod treatments, at various elevations throughout the DNF. The MVK, ERDC-EL, and USFS should collaborate to design and implement such experiments. Further transplantings could also be considered with USFWS at National Wildlife Refuges within the YBA.
(b) **Controlled Greenhouse Experiments.** Additional research into depth of flooding and light penetration that more closely mimics conditions within the YBA during extreme flooding events like those that occurred during 2019 and 2020 would also contribute to our understanding of how pondberry responds to such conditions.

PART VII: CONTRIBUTORS

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Appendix I. Pondberry and Habitat Photos

Hester Track (Bolivar County, MS)

Typical Delta National Forest, Mississippi pondberry colony

2023, Delta Depths pondberry colony

Pondberry colony DNF, February 2023

ARU/ Groundwater monitoring well images

Biological Opinion

Yazoo Backwater Area Water Management Project

FWS Log #: 2024-0116749

Prepared by:

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James Austin, Project Leader

November 8, 2024
Date

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EXECUTIVE SUMMARY

This Endangered Species Act (ESA) Biological Opinion (BO) of the U.S. Fish and Wildlife Service (Service) addresses the Yazoo Backwater Area Water Management Project (the Action). The U.S. Army Corps of Engineers (USACE) proposes to reduce flood risk in the Yazoo Backwater Area (YBA) located in Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties, Mississippi, and Madison Parish, Louisiana. The USACE determined that the Action is likely to adversely affect the federally endangered pondberry (*Lindera melissifolia*) and requested formal consultation with the Service. The BO concludes that the Action is not likely to jeopardize the continued existence of this species. This conclusion fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the ESA of 1973, as amended, with respect to this species.

The USACE also determined that the Action is not likely to adversely affect the federally listed northern long-eared bat (*Myotis septentrionalis*), pallid sturgeon (*Scaphirhynchus albus*), and fat pocketbook mussel (*Potamilus capax*); and proposed for listing alligator snapping turtle (*Macrochelys temminckii*) and tricolored bat (*Perimyotis subflavus*); and requested Service concurrence. The Service concurred with these findings by letter dated October 16, 2024.

In the Conservation Recommendations section, the BO outlines voluntary actions that are relevant to the conservation of the listed species addressed in this BO and are consistent with the authorities of the USACE. In particular, USACE outlined several conservation strategies and actions in their biological assessment (BA) as part of an associated *Section 7(a)(1) Conservation Plan* for pondberry that include long-term monitoring and studies of hydrology that will improve understanding and management of the species within the YBA. In addition, USACE noted in their BA that focusing future wetland mitigation efforts—which includes acquisition and reforestation/conservation of agricultural lands through perpetual easements from willing sellers—in the 91.0 to 96.0 ft National Geodetic Vertical Datum (NGVD) elevation range would be the most likely to benefit pondberry.

Reinitiating consultation is required if the USACE retains discretionary involvement or control over the Action (or is authorized by law) when:

(a) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
(b) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
(c) a new species is listed or critical habitat designated that the Action may affect.

CONSULTATION HISTORY

This section lists key events and correspondence during this consultation. A complete administrative record of this consultation is on file in the Service's Mississippi Ecological Services Field Office (MSFO).

Date	Consultation
April 17, 2024	Draft BA submitted on the effects of the action on pondberry
May 21, 2024	Service provides comments on draft BA
June 28, 2024	DEIS released for public comment
July 25, 2024	Formal consultation and final BA submitted for effects of the action on pondberry
August 2, 2024	Service receives Draft Section 7(a)(1) Conservation Plan for Pondberry
August 14, 2024	Service requested updated elevation data and clarification on colony statuses from USACE
August 23, 2024	Service receives initial response from USACE regarding colony statuses and provides USACE with file documenting Service's interpretation of data
August 26, 2024	Service receives updated supplementary Excel file from USACE providing current elevation data
August 30, 2024	Service agrees to enter into formal consultation for pondberry
October 16, 2024	Service concurs with MANLAA determination for the northern long-eared bat, pallid sturgeon, fat pocketbook, alligator snapping turtle, and tricolored bat
October 16, 2024	Service provides draft BO to USACE
October 29, 2024	Service receives response letter from USACE concurring with the draft BO
November 8, 2024	Service provides final BO to USACE

Abbreviations: Biological Assessment (BA); Biological Opinion (BO); Draft Environmental Impact Statement (DEIS); May Affect, But is Not Likely to Adversely Affect (NLAA); U.S. Army Corps of Engineers (USACE); U.S. Fish and Wildlife Service (Service).

BIOLOGICAL OPINION

1 INTRODUCTION

A biological opinion (BO) is the document that states the findings of the U.S. Fish and Wildlife Service (Service) required under section 7 of the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the U.S. Army Corps of Engineers (USACE) proposed Yazoo Backwater Area Water Management Project (the Action). This BO considers the effects of the Action on pondberry. The Action does not affect designated critical habitat; therefore, this BO does not address critical habitat.

The Service previously concurred with the USACE's determination that the Action is not likely to adversely affect the northern long-eared bat (*Myotis septentrionalis*), pallid sturgeon (*Scaphirhynchus albus*), fat pocketbook mussel (*Potamilus capax*), alligator snapping turtle (*Macrochelys temminckii*) and tricolored bat (*Perimyotis subflavus*) by letter dated October 16, 2024. This concurrence fulfilled the USACE's responsibilities for the Action under §7(a)(2) of the ESA for these species and critical habitats. We do not further address these species or critical habitats in this BO.

BO Analytical Framework

A BO that concludes a proposed Federal action is *not* likely to *jeopardize the continued existence* of listed species and is *not* likely to result in the *destruction or adverse modification* of critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA.

"*Jeopardize the continued existence* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).

"*Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02).

The Service determines in a BO whether we expect an action to satisfy these definitions using the best available relevant data in the following analytical framework (see 50 CFR §402.02 for the regulatory definitions of *action, action area, environmental baseline, effects of the action*, and *cumulative effects*).

a. *Proposed Action*. Review the proposed Federal action and describe the environmental changes its implementation would cause, which defines the action area.
b. *Status*. Review and describe the current range-wide status of the species or critical habitat.

c. *Environmental Baseline*. Describe the condition of the species or critical habitat in the action area, without the consequences to the listed species caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impacts of State or private actions which are contemporaneous with the consultation.
d. *Effects of the Action*. Predict all consequences to species or critical habitat caused by the proposed action, including the consequences of other activities caused by the proposed action, which are reasonably certain to occur. Activities caused by the proposed action would not occur but for the proposed action. Effects of the action may occur later in time and may include consequences that occur outside the action area.
e. *Cumulative Effects*. Predict all consequences to listed species or critical habitat caused by future non-Federal activities that are reasonably certain to occur within the action area.
f. *Conclusion*. Add the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, formulate the Service's opinion as to whether the action is likely to jeopardize species or adversely modify critical habitat.

2 PROPOSED ACTION

The primary purpose of the proposed Action is to reduce flood risk in the Yazoo Backwater Area (YBA), or lower Mississippi Delta. The YBA continues to experience periodic damaging backwater floods and therefore creates a need to reduce flood impacts that are causing undue hardships and economic losses to residents of the area from the flooding of homes and disruptions of sanitation facilities, lines of communications, and transportation. When high water stages occur on the Mississippi and Yazoo rivers, the flood gates at the Little Sunflower and Steele Bayou water control structures (WCS) in the Yazoo Backwater levee system are closed. Once these flood gates are closed, water from the Mississippi and Yazoo rivers are kept out of the area. However, excess water from precipitation events and runoff within the 4,093 square mile drainage area of Steele Bayou, Deer Creek, Little Sunflower River, and Big Sunflower River ponds behind the Yazoo Backwater levee system and is unable to drain out of the area, resulting in backwater flooding events in the YBA.

Four alternatives are being considered in the 2024 draft environmental impact statement (DEIS) for the proposed Action. Alternative 1 is the no-action alternative and Alternative 4 is the nonstructural plan that would include voluntary acquisition of structures and agricultural lands to the historical flood elevations (i.e., 98.2 feet National Geodetic Vertical Datum [NGVD 29[1]]). As these alternatives would have no impact on pondberry, our BO will focus on the remaining alternatives being proposed.

Alternative 2 includes a 25,000 cfs pump station adjacent to the Steele Bayou WCS. Two different pumping operations are being proposed to minimize and/or avoid potential adverse project impacts on the environment. During the crop season of March 16 to October 15, water levels would be managed at 90.0 feet (ft). During the non-crop season of October 16 to March 15, water levels would be managed up to 93.0 ft. In addition, the Steele Bayou WCS would

[1] All references to elevation in feet in this BO is in NGVD.

allow free movement for water into and out of the lower Yazoo Basin up to an elevation of 75.0 ft before closing the WCS gate. During low-water periods, the operation plan for the Steele Bayou WCS would require water levels to be maintained between 68.5 and 70.0 ft. The installation of 34 low-flow wells to provide a maximum of 5.0 cfs of water per well from shallow groundwater is also being proposed to improve current low flow conditions for 654 miles (9,321 acres) of streams and rivers in the Big Sunflower, Deer Creek, and Steele Bayou watersheds. Finally, the nonstructural features of the proposed plan include mandatory acquisition of all structures (101) below 90.0 ft, the voluntary acquisition of residential and commercial properties (231) between 90.0 and 93.0 ft, and the voluntary acquisition of up to 39,491 acres of cleared agriculture land at or below the five-year floodplain through fee or restrictive easements.

Alternative 3 has the same features as Alternative 2, however, the pump operation schedule would differ by nine days. Water levels would be managed at 90.0 ft during the crop season (March 25 to October 15) and up to 93.0 ft during the non-crop season (October 16 to March 24).

The Service considers both alternatives to have similar effects on pondberry; therefore, our BO considers the proposed Action to be either Alternative 2 or 3. We based this on how often the proposed pump would turn on for each alternative based on the 43-year Period of Record (POR) (1978-2020). For Alternative 2, the USACE determined that the pump station would have been pumping for 851 days over the POR (5.4% of time), with most of the pumping occurring during the months of March-June (780 days). For Alternative 3, the USACE determined that the pump station would have been pumping for 825 days over the POR (5.3% of time), with most of the pumping also occurring during the months of March-June (754 days). Both alternatives would have resulted in the pump operating in 20 of the 43 years based on the POR (46.5% of the years). Therefore, we expect no detectable difference in pondberry's response between these two alternatives.

2.1 Pump Station Construction and Operation

Both alternatives would include construction of a new 25,000 cfs pump station adjacent to the Steele Bayou WCS in Warren County, Mississippi, but with different pumping operation schedules. Both alternatives are designed to pump water out of the YBA into the Yazoo River during high flooding events. This will result in a reduction of the extent and duration of flooded acres above 90.0 ft, which could result in alteration of forest composition and structure, including pondberry habitat. Based on the POR, under each pumping alternative, had the project been constructed and put into operation at the beginning of the POR, the pumps would have operated at least one day in just 3 of 43 (7%) years during the non-crop season and would have operated at least one day in 20 of 43 (46.5%) years during the crop season for both Alternatives 2 and 3. In addition, as described in section 2.0, the pumps would have been operational a total of 851 and 825 days (5.4% and 5.3%) under Alternatives 2 and 3, respectively, during the 43-year POR.

In addition to construction of the pump station, associated structures will also be constructed, including a new levee tying into the Yazoo Backwater levee, a 3,100 ft inlet channel connecting to an existing auxiliary channel, a 3,500 ft long outlet channel connecting to the Yazoo River, and a 210 acre borrow area in Warren County. In addition, construction of 34 supplemental low flow groundwater wells are proposed for installation throughout the Mississippi Delta, with an

estimated impact footprint of 0.25 to 1.25 acres of land each, although specific locations have not been identified.

Direct effects include those from the actual construction of the pumping station and its associated structures, and the indirect effects are the effects on lands within the YBA that will be subject to potential shifts in flood inundation periods (i.e., flood frequency and duration) and depths.

2.2 Other Activities Caused by the Action

A BO evaluates all consequences to species or critical habitat caused by the proposed Federal action, including the consequences of other activities caused by the proposed action, that are reasonably certain to occur (see definition of "effects of the action" at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed action (but not part of the proposed action) are reasonably certain to occur. These factors include, but are not limited to:

1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action;
2) existing plans for the activity; and
3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

Other activities associated with the proposed Action include management of the Steele Bayou WCS gate to allow free movement of water into and out of the YBA up to an elevation of 75.0 ft, the addition of low-flow wells to improve annual low-flow conditions currently occurring in the YBA, mandatory and voluntary structure buyout below 93.0 ft, and the acquisition of up to 39,492 acres of land below 93.0 ft from willing landowners. Finally, compensatory mitigation would result in reforestation of agricultural lands within and near the YBA.

2.3 Conservation Measures

USACE stated in their biological assessment (BA), dated July 25, 2024, that the primary mitigation associated with the proposed Action is the acquisition and reforestation/conservation of agricultural lands through perpetual easements from willing sellers. Noting the paucity of extant pondberry colonies at 89.0 ft NGVD in the action area, USACE further suggested that pondberry would be most likely to benefit from such mitigation efforts within the 91.0 to 96.0 ft NGVD elevation range. Also included in the USACE's proposed Action is a separate *Section 7(a)(1) Conservation Plan for Pondberry* (USACE 2024a). This *Section 7(a)(1) Conservation Plan* identifies eight strategies with associated actions to improve conservation of pondberry, which are listed below, although the BA only highlights Strategies 1 through 3, noting their relevance to long-term monitoring and understanding of hydrology. The proposed conservation measures, strategies, and actions are contingent upon opportunity, appropriations, and other budgetary constraints. Additional coordination with the United States Forest Service (USFS), Service, and other partners will occur to further assist in the design and implementation of these measures.

Strategy 1: Continue to Develop and Implement a Long-term Pondberry Monitoring Plan

- Conduct additional discovery surveys within the Delta National Forest (NF) and other bottomland hardwood forest areas within the YBA
- Conduct extensive and annual monitoring of all existing pondberry colonies, with a focus on those colonies identified during all 2020-2023 surveys
    - Include pondberry monitoring in any future Monitoring and Adaptive Management Plan for the project

Strategy 2: Continue Assessing the Role of Backwater Hydrology and Hydroperiod on Pondberry

Strategy 3: Conduct a Long-term Assessment of the Role of Local Hydrology on Pondberry

- Conduct analyses of groundwater monitoring well data

Strategy 4. Adaptive Monitoring and Management of Pondberry Colonies in the Delta NF

Strategy 5. Conduct Experimental Canopy Thinning Studies

- Investigate relationship between light and pondberry
    - Assess colony size and health across a range of light conditions experienced with the Delta NF
- Conduct timber thinning treatments

Strategy 6. Investigate Herbivory and Other Impacts to Pondberry by Feral Hogs

- Conduct replicated field experiments
    - Installation of exclosure fencing to compare rooting, soil disturbance, herbivory, and other impacts inside and out of exclosures
- Conduct more extensive wildlife trail camera monitoring
- Gather existing data for feral hogs within the Delta NF
- Identify opportunities for targeted removal

Strategy 7: Assess the Effects of Interspecies Competition on Pondberry Colonies

- Conduct replicated field experiments
    - Experimental removal of palmetto
    - Determine if there is an available herbicide that kills palmetto without affecting pondberry
- Assess the potential relationship between palmetto and feral hogs
- Asses the role of hydrology/elevation in mediating the competition between pondberry and palmetto
- Design a replicated field experiment that includes the removal of herbaceous competition
- Assess the role of hydrology/elevation in mediating the competition between pondberry and herbaceous competition

Strategy 8: Assess Micropropagation and Transplanting

- Conduct replicated field experiments
  - Transplant experiments under varying light and hydroperiod treatments, and at various elevations throughout the Delta NF
  - Consider transplantings at National Wildlife Refuges within the YBA
- Conduct greenhouse experiments
  - Depth of flooding and light penetration that mimics extreme flooding events

2.4 Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). Delineating the action area is necessary for the Federal action agency to obtain a list of species and critical habitats that may occur in that area, which necessarily precedes any subsequent analyses of the effects of the action to particular species or critical habitats.

It is practical to treat the action area for a proposed Federal action as the spatial extent of its direct and indirect "modifications to the land, water, or air" (a key phrase from the definition of "action" at 50 CFR §402.02). Indirect modifications include those caused by other activities that would not occur but for the action under consultation. The action area determines any overlap with critical habitat and the physical and biological features therein that we defined as essential to the species' conservation in the designation final rule. For species, the action area establishes the bounds for an analysis of individuals' exposure to action-caused changes, but the subsequent consequences of such exposure to those individuals are not necessarily limited to the action area.

Figure 1 shows the locations of all activities that the proposed Action would cause and the spatial extent of reasonably certain changes to land, water, or air caused by these activities, based on the descriptions and analyses of these activities in sections 2.1 and 2.2. The action area for this BO includes the 926,000-acre YBA, which includes the area directly impacted by pump construction or indirectly impacted by changes in hydrology. The YBA is bordered by the left descending bank of the mainline Mississippi River levee on the west, the west bank levees of the Whittington Auxiliary Channel and the Sunflower River and Steele Bayou connecting channel on the east, and the Yazoo River on the south. The YBA extends northward about 65 miles to the latitude of Hollandale and Belzoni, Mississippi, and encompasses about 1,446 square miles including all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties, Mississippi, and part of Madison Parish, Louisiana. The Big Sunflower and Little Sunflower Rivers, Deer Creek, and Steele Bayou flow through the YBA.

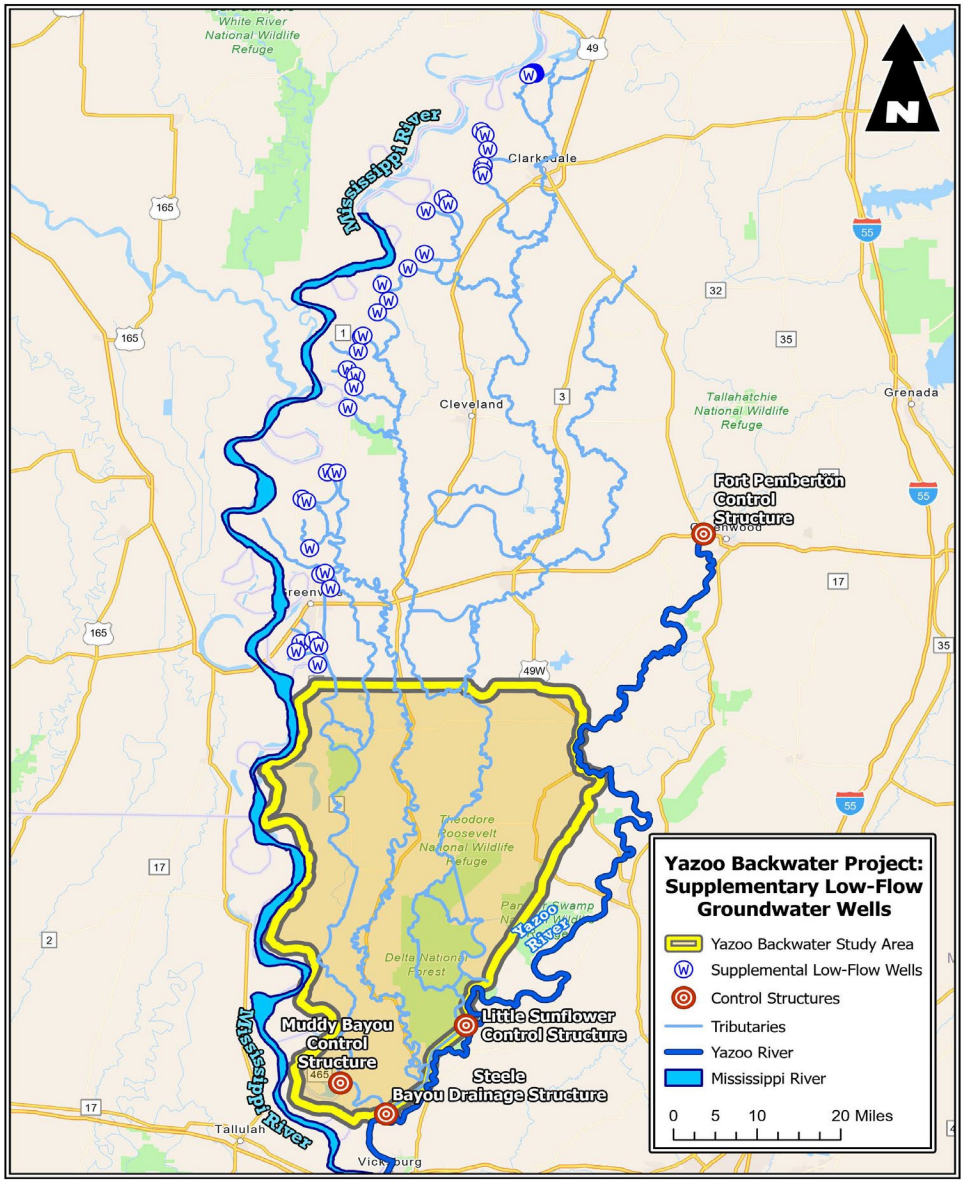

Figure 1. Yazoo Backwater Area including location of existing control structures and proposed supplemental low flow wells. From USACE 2024b, Figure 3-1.

3 SOURCES OF CUMULATIVE EFFECTS

A BO must predict the consequences to species caused by future non-Federal activities within the action area, i.e., cumulative effects. "Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include but are not limited to existing plans for the activity and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the USACE did not describe, and the Service is not aware of, any future non-Federal activities that are reasonably certain to occur within the action area. Therefore, we anticipate no cumulative effects that we must consider in formulating our opinion for the Action.

4 STATUS OF SPECIES

This section summarizes best available data about the biology and condition of pondberry (*Lindera melissifolia*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list pondberry as endangered on August 13, 1985 (50 FR 32581). The most recent 5-year status review of the species was completed October 27, 2021. The two most recent Service 5-year reviews (Service 2014 and 2021) recommended that no change in listing status was needed and that pondberry continues to meet the definition of endangered under the ESA.

4.1 Species Description

Pondberry, *Lindera melissifolia* (Walt.) Blume, was first described by Thomas Walter as a distinct species in 1788, based on a collection from Berkeley County, South Carolina. Pondberry is a distinctive species, with diagnostic characters that clearly distinguish it from the other two species of spicebush native to the southeastern United States, northern spicebush (*L. benzoin*) and bog spicebush (*L. subcoriacea*). Pondberry is a deciduous shrub, growing from less than 1 foot to infrequently more than 6 feet in height. Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins. Shrubs are typically sparsely branched, with fewer branches on smaller plants. Plants are stoloniferous, frequently propagating by vegetative sprouts, forming colonies and clumps. Plants are dioecious, each plant being either male or female, and produce clusters of small yellow flowers in early spring prior to leaf development from buds on branches produced from the growth during the preceding year. Fruits are drupes, having only a single seed, green when immature, and ripening to red by fall.

4.2 Life History

Pondberry was previously considered to be an obligate wetland species (almost always occurring in wetlands under natural conditions) throughout its range (Reed 1988) but is now considered to be an obligate wetland species only in the Eastern Mountains and Piedmont region and a facultative wetland species (usually occurring in wetlands) in the Atlantic and Gulf Coastal Plain region (USACE 2020). Pondberry exhibits several characteristics and adaptations to wetland conditions, including a shallow root system, lacunae (aerenchyma) tissue in roots that enhance oxygen diffusion, and abundant stem lenticels (Wright 1990b). While pondberry is adapted to wetland conditions, such as seasonal flooding, the species may be most tolerant of flooding when plants are dormant, as extended flooding (≥30 days) during the growing season has been demonstrated to reduce pondberry growth (Hawkins et al. 2009b), although short-duration flooding (7-10 days) during the growing season may promote vegetative reproduction (Wright 1990a). Pondberry also possesses adaptations allowing it to tolerate drier conditions, including facultatively deciduous leaves (e.g., dropping leaves during droughts) and development of thicker, more rugose (wrinkled) sun leaves, and colonies have been found extending above local high-water marks (Wright 1990b).

Pondberry is an understory shrub adapted to shaded conditions and plants are often found naturally occurring under hardwood stands with relatively closed canopies that create a low-light environment although plants are not exclusively found under low-light conditions (Wright 1989, 1990b; Aleric and Kirkman 2005a; Beckley 2012). While pondberry exhibits the capacity to acclimate to a variety of light conditions, studies in both natural and experimental settings suggest that plant survival and growth may be highest at low to moderate light levels (Aleric and Kirkman 2005a; Lockhart et al. 2012, 2013). However, too much shade may reduce survival (Lockhart et al. 2013) and seedling establishment (Unks 2011). In addition, pondberry's response to light may also depend on other factors, such as flooding. For example, extended flooding was found to reduce pondberry's photosynthetic rate (Lockhart et al. 2017), which may in turn result in reduced growth (Hawkins et al. 2019).

4.3 Growth and Reproduction

Pondberry is a strongly clonal plant, with population recruitment dominated by vegetative, asexual production of new shoots. Pondberry produces vegetative sprouts from stolons or the base of plants that grow as a single shoot from several inches to 2 or rarely 3 feet in the first year of growth, depending on site conditions. Deciduous leaves drop in the fall, and after winter, lateral and terminal branches are formed from axillary and terminal buds on stems formed during the previous year's growth. Plants grow with this annual cycle until about 7 to 10 years of age, when the number and length of new branches decline with plant maturity (e.g., Godt and Hamrick 1996; Devall et al. 2001).

Stem dieback can be a natural feature of a mature or senescent plant (Godt and Hamrick 1996). Stem dieback at any plant age or size also is caused by the fungal stem canker pathogen *Botryosphaeria ribis* (Wilson et al. 2004), although other organisms may also be responsible (Devall et al. 2001). On larger plants with more branches, dieback can be partial, affecting one or several branches, and new growth continues from surviving branches. With more severe dieback, plants can form one or more new branches from the differentiation of adventitious meristems from the cambium on older surviving branch segments formed during previous years. With complete dieback, new branches sometimes form at the base of the plant, and in other instances the entire above ground plant dies. While the presence of dieback on any branch does not necessarily indicate that total dieback will occur, small plants appear to be more susceptible to complete dieback than large ones (Service 2007). Female plants, particularly following fruiting, may also be more susceptible to dieback (Wright 1989). Although dieback can affect some colonies more severely than others, colonies can recover from episodes of dieback (Devall et al. 2001, 2013).

Vegetative reproduction from stolons and sprouts frequently creates distinct colonial patches of plants. The term colony refers to group of individuals that are either clones of each other or they are genetically closely related. Vegetative propagation from stolons and basal stem sprouts creates genetically identical clones, and colonial patches of plants actually represent one or a few genetically distinct individuals. A genetically individual plant, which is a genet, can consist of many separate shrubs within a colony. Thus, the terms plant, stem, and shrub in the literature have been variously used with different and potentially confusing meanings depending on the context. Recently, the term "stem" has been frequently used in literature and reports on pondberry, as in the number of stems in a colony, to refer to the number of shrubs, and not the

number of branches or annual growth segments on a shrub. Here, the term plant will be used to refer to an individual shrub, represented by a single rooted stem with lateral stems-branches, unless otherwise clarified in context to mean a genetically distinct individual.

Flowers are obligately insect pollinated and cross pollination between male and female plants may involve up to a dozen potential pollinators, the most likely of which are various syrphid flies and ground dwelling or nesting bees, including digger bees (*Anthophora ursina*, *Ceratina calcarata*) and mining bees (*Andrena pallidifovea*, *Andrena imitatrix*) (Devall et al. 2001, 2004). No pollinator studies have been conducted, and the pollinator effectiveness of these or other species is unknown. Pondberry flowers in early spring, as early as late February depending on weather, and flowers are subject to damage due to late freezes (Tucker 1984; Devall et al. 2001), with male flowers opening before females (Devall et al. 2004). Seeds are fully formed within 90 days after flowering and subsequent pollination, and fruits reach maturity in July and August (Connor et al. 2006). Fruit production is erratic, although it can be abundant in some years (Morgan 1983; Wright 1989, 1990b; Devall et al. 2001). Poor fruit production at sites with few plants and colonies may be associated with unequal sex ratios, flowering asynchrony, or other factors that limit cross pollination (e.g., Wright 1989, 1990b, 1994). Late frosts may also kill flowers (e.g., Tucker 1984) resulting in reduced fruit production and subsequent seedling recruitment.

Dispersal mechanisms of pondberry remain poorly understood. Pondberry's bright red fruits suggest that animals may play an important role in the dispersal of the species (Smith et al. 2004). While numerous animals have been associated with pondberry plants (e.g., Smith et al. 2004; Abilio et al. 2008; Leininger et al. 2009), only the hermit thrush (*Catharus guttatus*) has been confirmed as a dispersal agent of pondberry. The effectiveness of hermit thrushes as seed dispersal agents is limited by their small home range and, thus, they are short-range (about 160 feet [55 meters]) seed dispersers of pondberry (Smith et al. 2004). Other, larger animals, such as black bears (*Ursus americanus*) have been proposed as potential long-range dispersal agents (Devall et al. 2004b Smith et al. 2004). Water has also been proposed as a potential dispersal agent of this species (e.g., Devall et al. 2001; Smith et al. 2004), but Hawkins et al. (2011) observed neither fruits nor seeds floating during flooding experiments and noted that water movement in pondberry habitats is limited. Frugivory by animals is also likely important for seed germination in pondberry (Aleric and Kirkman 2005b). Indeed, percent germination of pondberry seeds with the pulp experimentally removed is greater than seeds with pulp (Wright 1989; Aleric and Kirkman 2005b; Connor et al. 2006) and can be as high as 90 percent (Wright 1989).

Pondberry is capable of producing abundant fruits, although fruit production may be erratic (e.g., Wright 1989, 1990b; Devall et al. 2001, 2004b; Gustafson 2011). The species may also be capable of forming short-term persistent soil seed banks (i.e., 1-2 years) (Connor et al. 2006, 2012; Hawkins et al. 2011) and some seeds may remain viable in the soil seed bank for longer periods (e.g., Smith 2003). However, seedlings have rarely been observed in pondberry colonies and populations (e.g., Tucker 1984; Wright 1989; Devall et al. 2001; Aleric and Kirkman 2005b; Connor et al. 2006). Skewed sex ratios at some sites may limit pollination success, thus resulting in poor fruit production (e.g., Wright 1989, 1994; Gustafson 2011) and subsequent seedling recruitment. Late frosts may also kill flowers (e.g., Tucker 1984) resulting in reduced fruit production and subsequent seedling recruitment. Depredation of seeds or seedlings may partially

explain the paucity of observed seedlings. Indeed, Aleric and Kirkman (2005b) found that unprotected seeds on the soil surface with intact pulp were removed at high rates, presumably eaten by birds and mammals, whereas Connor et al. (2012) suggested that herbivores may eat pondberry seedlings. Martins et al (2015) found that seed survival rates increased as understory cover decreased, suggesting that seed predation increases with increasing understory cover. Various animals have been identified as potential pondberry seed or seedling predators, including the northern cardinal (*Cardinalis cardinalis*), brown thrasher (*Toxostoma rufum*), swamp rabbit (*Sylvilagus aquaticus*), nine-banded armadillo (*Dasypus novemcintus*), gray squirrel (*Sciurus carolinensis*), and eastern wood rat (*Neotoma floridana*) (Abilio et al. 2008; Leininger et al. 2009; Martins et al. 2015). Other seeds may succumb to fungal infections, such as the ubiquitous black mold, *Colletotrichum gloeosporioides* (Devall et al. 2001; Unks 2011). Alternatively, seedlings may have been overlooked because they lack distinctive identification characteristics (Aleric and Kirkman 2005b).

4.4 Demography

As a strongly clonal plant, pondberry's population recruitment is dominated by vegetative, asexual production of new shoots. Most of the shrubs in any pondberry population are clones or genets of a much smaller number of genetically unique individuals (Godt and Hamrick 1996; Echt et al. 2011). Because sexual reproductive success is rarely observed by the production of seedlings, pondberry demography is likely dominated by the dynamics of vegetative growth, survival, and mortality; therefore, the persistence of existing pondberry populations is mostly affected by the vegetative production and survival of stems and shoots (Service 2007).

There are no detailed studies characterizing pondberry demography by size-stage or age dynamics, including survival rates, population rates of growth, and the factors affecting dynamics and rates in different environments. Colonies/populations often exhibit male biased sex ratios (e.g., Wright 1989; Devall et al. 2001; Echt et al. 2011; Gustafson 2011; Unks 2011; Devall 2012) and many are unisexual (e.g., Wright 1989, 1994; Devall 2012). Net changes by general monitoring and observations of various colonies and sites indicate pondberry is not normally subject to large annual fluctuations in colony or population size in the absence of land use changes.

Pondberry experiences periodic episodes of stem dieback, whether by natural senescence or by fungal pathogens, so that an individual shrub rarely appears to live or persist for more than 10 years (e.g., Godt and Hamrick 1996; Devall et al. 2001). However, pondberry apparently is long-lived as genetic individuals (genets) in stable environments because of clonal growth following dieback from stolons and the production of new stems/shoots from adventitious meristems at or near the base of a surviving stem segment on the ground. An individual shrub may die, but the genet continues to exist by virtue of vegetative reproduction.

4.5 Status and Distribution

Pondberry was federally listed as an endangered species on July 31, 1986 (47 FR 27495-27500). When listed, the species was known from 12 populations in Arkansas (4), Georgia (1), Mississippi (1), Missouri (1), North Carolina (1), and South Carolina (4). Pondberry was also considered extirpated in Alabama, Florida, and Louisiana, where it had been historically collected. The primary threats were inadequate reproduction, wetland drainage, clearing and

conversion of wetland habitat, and certain timber harvest practices. The primary wetland habitat for these occurrences and populations were Carolina bays, limesinks, sand ponds, and bottomland hardwood forests.

According to the pondberry recovery plan, a pondberry population is "one or more colonies that are in close enough proximity to regularly interbreed and be separated from other populations by a sufficient distance to preclude interbreeding on a regular basis" (Service 1993). The recovery definition recognizes a population as a demographic and genetic unit. Demographically, pollination between male and female plants in a population must occur regularly and sufficiently as one component of reproduction to produce fruits and seeds. Genetically, plants within a population would not be isolated or significantly different from one another, by this definition, because they mostly would be offspring of parents from within the population. The recovery plan does not further define a population according to a spatial function or distances between pondberry that would prevent regular interbreeding. This was identified as one of the recovery tasks to be completed. Based on long-distance flight distances of ground dwelling bees that pollinate pondberry, Devall et al. (2002) proposed the working definition of a pondberry population as a "colony or colonies separated by at least one mile from other colonies." In other words, pondberry colonies separated by more than one mile from other colonies would be separate populations. The Service has since applied this 1-mile spatial definition to delineate pondberry populations (e.g., Service 2007, 2014, 2021; see Appendix 2 of Service 2007 for additional background and rationale). For this assessment and biological opinion, we continue to use this definition to define and identify pondberry populations.

Based on the working population definition, there are currently up to 70 natural populations potentially extant in 7 states: Alabama (1), Arkansas (18), Georgia (14), Mississippi (17), Missouri[2] (1), North Carolina (4), and South Carolina (16). However, only 36 of these populations have been confirmed extant and the statuses of the remaining 34 are uncertain. Sixteen populations are either extirpated or historical, including Ashley County, Arkansas's only known population, which no longer exists in the wild (i.e., extirpated in the wild) although propagules from this population's only remaining plant are safeguarded *ex situ* (off-site). Two transplanted populations are also extant (one population each in Georgia and South Carolina) while the current status of a third such population (in North Carolina) is unknown. Three other unsuccessful transplanted populations are known from Missouri (1) and Georgia (2). Pondberry's distribution is depicted in Figure 2.

[2] Missouri's population in Ripley County is shared with the northernmost population in Arkansas, Clay County, as due to the proximity of known colonies across the state line.

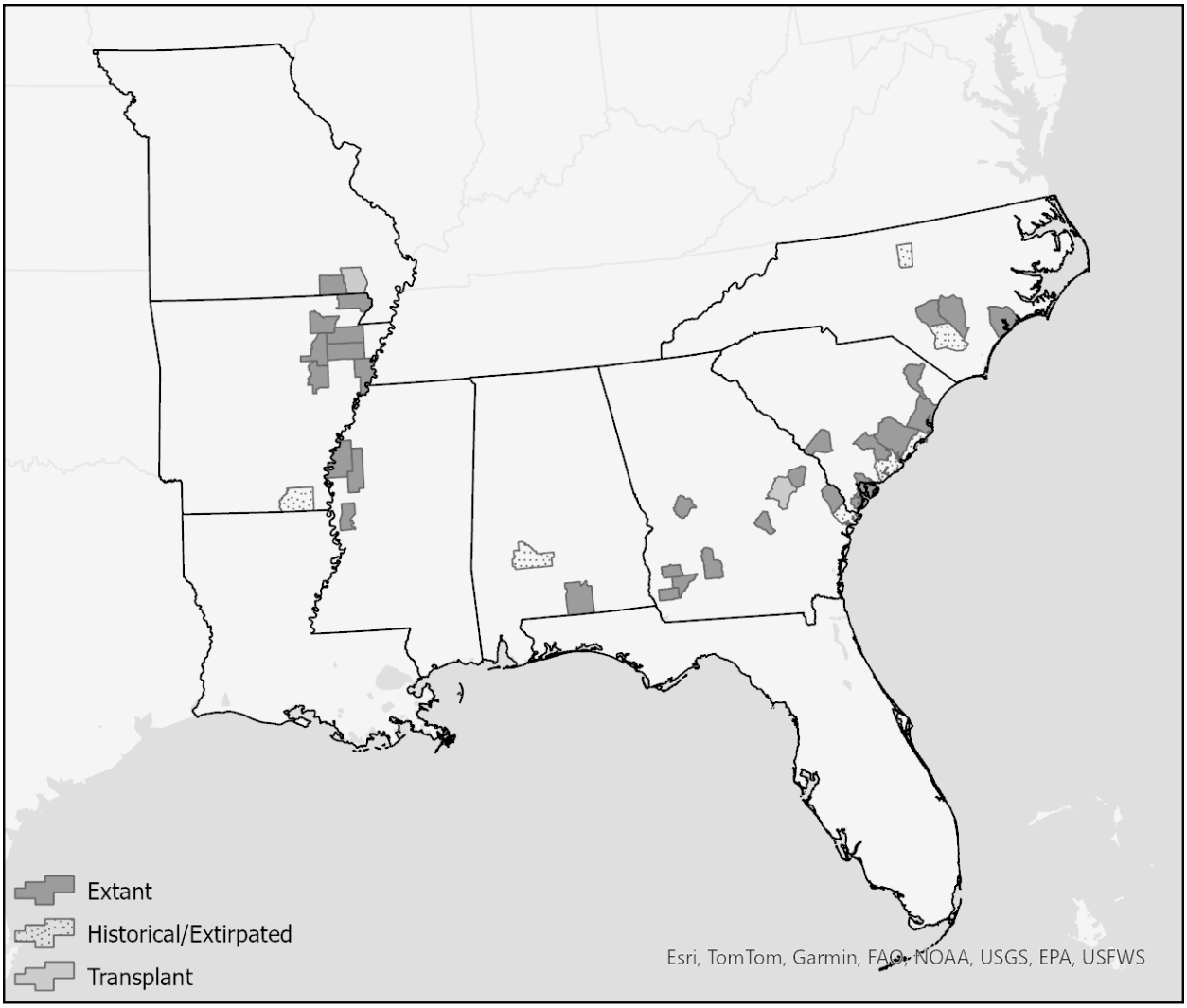

Figure 2. State and county distribution of pondberry.

Pondberry's largest populations occur in Arkansas, Missouri, Mississippi, and South Carolina. As summarized in previous 5-year reviews (Service 2014, 2021), bottomland hardwood forests in Arkansas' St. Francis Sunken Lands Wildlife Management Area (WMA)—which is a mixture of state, federal (USACE), and privately owned and managed land—is home to two populations which together support thousands of stems across approximately 1,500 acres. According to recent monitoring data from USACE, Mississippi's largest population, with over 55,000 plants, is found on privately owned lands protected by a conservation easement in Bolivar County (the Hester Tract). The Delta NF in Sharkey County, Mississippi, has 11 populations, which collectively support over 20,000 plants, although, most plants (over 18,500) occur in 2 of the Delta NF's populations. As reported in the latest 5-year review (Service 2021), Arkansas and Missouri are also home to a large pondberry population found in multiple sand ponds on either side of the state line, with the sand ponds in Arkansas supporting at least 70,000 plants. In South Carolina, limesink ponds and similar depressions on the Francis Marion National Forest are home to 6 populations supporting over 31,000 plants (Service 2021).

Pondberry was only known from one population in Mississippi (in the Delta NF) when the species was listed. The Service's latest 5-year review noted 20 pondberry populations in Mississippi in Bolivar (4), Sharkey (14), and Sunflower (2) counties, which included 7 extant, 4 potentially extirpated, and 9 uncertain status populations (Service 2021). As noted in the BA, USACE staff initiated extensive surveys for pondberry within the Delta NF (within and outside of the YBA) in 2020, later expanding to other Mississippi populations outside of the Delta NF and YBA in 2021, and continuing surveys through 2023, which ultimately included 19 of the state's known populations. Accordingly, these recent surveys by USACE represent the most current and best available information on the status of these populations, including one population previously considered to be of questionable validity and therefore excluded from the Service's 2021 5-year review. As a result of this new and updated information, 21 pondberry populations are now known from Mississippi, 11 of which are extant (Bolivar County – 2, Sharkey – 8, Sunflower – 1), 4 are extirpated (Sharkey), and 6 are of uncertain status (Bolivar – 2, Sharkey – 3, Sunflower – 1). Two populations (1 each in Bolivar and Sunflower counties) were not visited during these recent surveys and their statuses remain uncertain but, as noted in the 5-year review, aerial imagery indicates bottomland hardwood forests remain, suggesting that these populations may be extant. USACE's surveys indicate that there are over 77,000 pondberry plants in Mississippi, with the vast majority (over 55,000) found on private lands protected by a conservation easement (the Hester Tract) in Bolivar County and Delta NF's (Sharkey County) populations collectively representing over 20,000 plants. Most (nearly 92%) of Delta NF's pondberry plants occur in two of the forest's northernmost populations. Also of note, pondberry was previously thought to occur in Tallahatchie County, Mississippi (e.g., Devall et al. 2013), but the Service now considers this to be a misidentification (Service 2014).

4.6 Habitat

Pondberry occurs in various seasonally flooded wetland habitats of the Atlantic and Gulf Coastal Plain. These wetlands occur in at least five primary and distinctive hydrogeomorphic settings; Carolina bays, limestone or limesink ponds, sand ponds, lowland sand prairie depressions, and riverine bottomland hardwoods. With the exception of bottomland hardwood sites, most all others are geographically isolated wetlands with precipitation as the primary source of hydrology, although some bays and limesinks may receive shallow groundwater (e.g., Schalles and Shure 1989). Carolina bays and limesinks have been collectively described with other seasonally inundated depressions in the southeastern United States as seasonally ponded, isolated wetlands and non-alluvial depression wetlands (e.g., Kirkman et al. 1999) as a distinction from other wetlands affected by overbank flooding by streams and rivers. Bays and limesinks as referenced here do not include Citronelle ponds and Grady ponds in Alabama and Mississippi. Carolina bays with pondberry are found in North Carolina and South Carolina; limesink and related depressions with pondberry are in South Carolina, Georgia, and Alabama; sand ponds are in Arkansas and Missouri; sand prairie depressions are in southern Arkansas; and bottomland hardwoods in Arkansas and Mississippi. In bottomland hardwoods, the hydrology at pondberry sites is maintained by either overbank flooding, local rainfall or storage in depressions or at sites with soils that impede drainage independent of overbank flooding, or a combination of the previous two factors. Atlantic or Gulf Coastal Plain depressions storing precipitation typically have subsurface soil or geological features that impede drainage (Service 2007).

The bottomland hardwoods of the lower Mississippi River Alluvial Valley in Arkansas and Mississippi are generally characteristic and similar to bottomland hardwood forest communities elsewhere in the southeastern United States. Bottomland hardwood forests associated with pondberry are generally underlain by hydric soils with poor drainage and seasonally high water tables (Tucker 1984; Hawkins et al. 2009a). Earlier studies of pondberry in Mississippi found the species associated with soils having high silt and clay components (e.g., silty clay, silty clay loam, silt loam, clay loam; USACE 1991; GSRC 2001, 2005). Bottomland hardwood forest types with pondberry are mostly mature forests, with various dominant and codominant trees that include willow oak (*Quercus phellos*), overcup oak (*Q. lyrata*), sweetgum, cedar elm (*Ulmus crassifolia*), American elm (*U. americana*), and winged elm (*U. alata*), box elder (*Acer* negundo), sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), water hickory (*Carya aquatica*), and pecan (*C. illinoensis*) (Tucker 1984; Devall et al. 2001; Hawkins et al. 2005; Gulf South Research Corporation [GSRC] 2001, 2005).

4.7 Conservation Needs and Threats

The primary threats identified when the species was listed included inadequate reproduction, wetland drainage, clearing and conversion of wetland habitat, and certain timber harvest practices (Service 1986). Clearing, conversion, certain silvicultural activities, and inadequate habitat management are persistent threats to pondberry populations (Service 2014, 2021). Incompatible forestry practices, such as clearing can directly destroy plants and degrade habitat by increasing growth of competing vegetation, particularly where hydrologic regimes or habitat management may be inadequate to limit competing vegetation growth.

Draining, ditching, and other hydrological modifications causing wetland habitats to dry out have also resulted in population declines and losses of pondberry (Service 2007, 2014). Conversely, excessive flooding has been implicated in declines of several populations (Service 2014, 2021; U.S. Army Engineer Research and Development Center [ERDC] 2024). While pondberry is a wetland plant and, therefore, adapted to and benefitting from such conditions (e.g., formation of seed banks [Hawkins et al. 2011], ramet production and colony expansion [Wright 1990b; Devall et al. 2013], control of competing species [Wright 1990b; Hawkins et al. 2009b, 2010, 2016; Devall et al. 2013]), recent evidence suggests that prolonged flooding, particularly during the growing season, can be deleterious to pondberry. Pondberry may be most tolerant of flooding while plants are dormant (i.e., winter into early spring), as seasonal flooding during this time is a regular feature within pondberry colonies in bottomland hardwood forests of the Lower Mississippi Alluvial Valley that does not apparently negatively impact mature plants (Wright 1990b; Hawkins et al. 2009b). In contrast, extended flooding (≥30 days) during the growing season has been demonstrated to reduce pondberry growth (Hawkins et al. 2009b). Similarly, while seeds are tolerant of flooding, germinating readily once they are no longer submerged (Wright 1989; Hawkins et al. 2011), seedlings and young plants may be more susceptible to prolonged floods (Devall et al. 2013). Extended flooding was found to reduce pondberry's photosynthetic rate (Lockhart et al. 2017), which may in turn result in reduced growth (Hawkins et al. 2019). Recent monitoring in Mississippi found more robust plants growing in a Mississippi forested wetland that was not exposed to prolonged backwater flooding events when compared with populations on Delta NF that were exposed to such events (ERDC 2024).

Laurel wilt disease (LWD) has the potential to cause substantial mortality among members of the

laurel family (Lauraceae), including pondberry in the southern United States. The disease, which is caused by the fungus *Raffaelea lauricola*, was first observed infecting redbay (*Persea borbonia*) in 2003 in South Carolina and Georgia, although its vector, the non-native redbay ambrosia beetle (*Xyleborus glabratus*), was first discovered in 2002 in Port Wentworth, Georgia (Fraedrich et al. 2008; Harrington et al. 2008). Since then, LWD has spread rapidly throughout the southern United States, occurring in every state within pondberry's range except Missouri. Currently, LWD is known from 23 of pondberry's known counties (9 in Georgia, 7 in South Carolina, 4 in North Carolina, 2 in Alabama, and 1 in Arkansas; LWD distribution map, June 24, 2024 [data dashboard available at https://www.arcgis.com/apps/dashboards/d43391c8fdb741b597e6ccf1236d2a02, accessed August 7, 2024]); however, LWD is not known to occur in the YBA. The disease has only been confirmed in one pondberry population in Effingham County, Georgia (Fraedrich et al. 2008, 2011). While the effects of LWD on pondberry populations are currently small, its potential impacts are great, as the disease is highly lethal to infected plants (Fraedrich et al. 2011) and can readily spread through roots to other plants within colonies (Best and Fraedrich 2018). Laurel wilt disease also has the potential to indirectly affect pondberry populations by killing other Lauraceous species in its associated forested wetlands (Gramling 2010; Beckley 2012).

Pondberry periodically experiences stem dieback (Service 1993, 2007), which can be a natural feature of a mature or senescent plant (Godt and Hamrick 1996; Devall et al. 2001; Gramling 2019). Stem dieback at any plant age or size is also caused by the stem canker fungus *Botryosphaeria ribis*, which causes stem canker, and exacerbated by the stem-borer beetle *Xylosandrus compactus* (Wilson et al. 2004, 2005; Fraedrich et al. 2011). While the presence of dieback on any branch does not necessarily indicate that total dieback will occur, small plants appear to be more susceptible to complete dieback than large ones (Service 2007). Drought stress may also increase the susceptibility of pondberry plants to dieback from stem canker (Service 2007). Long-term impacts of stem dieback on population persistence and dynamics remains poorly understood and further investigation is necessary.

A camera study by Martins et al. (2015) identified various seed and seedling predators, including swamp rabbits and eastern wood rats, among others. These observations added to and/or confirmed earlier observations and speculations of such predators (e.g., Abilio et al. 2008; Leininger et al. 2009; Connor et al. 2012). The study also found that seeds had higher survival rates in plots with lower understory vegetation cover, suggesting that predation increases with understory cover. Excessive seed and seedling predation can reduce pondberry recruitment.

Many pondberry colonies and populations occur in isolation from one another and many suitable habitats are fragmented by agricultural fields or other converted lands (e.g., Service 1993, 2007; Devall et al. 2001; Beckley 2012). Fragmentation of pondberry populations may increase the vulnerability of individual, small populations to succumb to a variety of deleterious biological and environmental factors, such as encroachment of invasive species and reduced sexual reproduction (Devall et al. 2001; Service 2007). No long-range animal seed disperser is known (Devall et al. 2004; Smith et al. 2004) and no other potential long-range seed dispersal mechanism has been confirmed. Furthermore, pondberry flowers are obligately insect-pollinated, requiring insects to transport pollen between male and female flowers for successful pollination and fruit production (Devall et al. 2001, 2004). As distances between populations and suitable habitat increase, the likelihood of either pollinators or seed dispersers traversing these distances

decreases, thus restricting gene flow between populations and limiting new colony establishment (Devall et al. 2001; Devall 2009; Echt et al. 2011).

Large populations are important for survival and recovery for a number of reasons, as indicated by many studies from other species. The size and distribution of plant populations are important factors affecting population viability through demographic, genetic, and metapopulation dynamics. Small populations in fragmented landscapes are more likely to experience the adverse effects of demographic, environmental, and genetic stochasticity, which negatively affect viability (Oostermeijer et al. 2003). Small populations are vulnerable to chance or random demographic events in the rate of growth, reproduction, or survival and are more susceptible to extirpation. Other consequences of small plant populations are inbreeding depression and genetic drift (Ellstrand and Elam 1993). The ability of pondberry to reproduce vegetatively can avoid the adverse effects of demographic stochasticity in small populations, but one of the tradeoffs in the absence of frequent sexual reproduction and recruitment is the susceptibility to inbreeding depression and drift. This is because the number of genetically individual plants in a pondberry population is less than the number of actual clonal shrubs. Currently, no strong evidence for inbreeding depression has been found in pondberry populations (Godt and Hamrick 1996; Echt et al. 2011); however, small, isolated populations and those with sex ratios biased toward males may be at increased risk of inbreeding depression (Echt et al. 2011). Inbreeding depression or the low number of genetically different individuals (genets) in these populations may reduce pondberry's ability to cope with environmental changes, disease, and loss of individuals.

5 ENVIRONMENTAL BASELINE FOR PONDBERRY

This section describes the best available data about the condition of pondberry in the action area without the consequences caused by the proposed Action.

The environmental baseline includes the past and present impacts of all Federal, tribal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The action area is the area affected directly and indirectly by the Federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] § 402.02).

The action area corresponds to the YBA, or lower Mississippi Delta region of Mississippi. It is located on the Mississippi-Yazoo River alluvial plain, in west central Mississippi, between the Mississippi River east bank levee and, on the west, the fall line of upland loess hills. This is the area where backwater flooding will be affected by the Action, and the area within which pondberry occurs.

5.1 Action Area Numbers, Reproduction, and Distribution

The only known pondberry within the action area is found on Delta NF. As of 2007, pondberry surveys by the USFS, Service, USACE, and their contractors encompassed over 31% of Delta NF, including 24% and 43% of the area below and above the 1-year flood frequency (87.0 ft), respectively (as delineated at that time). These surveys revealed 182 pondberry colonies representing

14 populations on the Delta NF with most (over 87%) colonies found above the 1-year flood frequency. However, these surveys included a southeastern portion of the Delta NF that is outside of the action area (i.e., on the other side of the Yazoo Backwater levee and will not be affected by the project). As such, only 177 colonies representing 13 populations were known to occur within the action area with an estimated pondberry size of 35,600 plants (Service 2007). In addition, the Service noted an apparent overall declining population trend for pondberry on the Delta NF during the 5-year period ending in 2005.

Since that time, the USACE reviewed available historical information on previous pondberry surveys and conducted extensive surveys from 2020 to 2023 to document the abundance and distribution of pondberry in the YBA, attempting to revisit most known pondberry colonies in the Delta NF at least twice. USACE identified 313 known pondberry colonies on the Delta NF. As noted in the BA, USACE documented 122 extant pondberry colonies, further noting that only 1 extant colony is below the 90.0 ft elevation, 22 fall within the 90.0 to 93.0 ft elevation range, and remaining extant colonies are found above 93.0 ft. Most colonies are located in the Spanish Fort area (19 extant colonies) and the Delta Depths area (58 extant colonies). The majority (39) of remaining extant colonies are north of the Delta Depths area in the northern portions of the Delta NF.

During the Service's review of the BA and supplementary Excel file provided by USACE, inconsistencies in the determination of colony status (particularly those of supposed extirpated and unknown status) were noted. As such, the Service thoroughly reviewed the data provided in the Excel file to assign current statuses (i.e., extant, extirpated, and uncertain) consistently and clearly to each colony (described in more detail in Appendix 1). During our review, discrepancies in the treatment of two colonies were noted and excluded from some of the Service's analyses (described in more detail in Appendix 2). As such, the Service considers there to be 312 known colonies within Delta NF, 307 of which occur within the YBA. Within the action area, 122 are extant, 144 are extirpated, and 41 are of uncertain status (the 5 Delta NF colonies outside of the action area are all extirpated). Potential populations were then delineated using a 1-mile separation distance for colonies of all statuses, resulting in 15 populations on the Delta NF, 14 of which occur within the action area (Figure 3). Extirpated colonies were then excluded from population delineations, resulting in up to 12 potential populations, 2 of which resulted from fragmentation of a more widespread population (population 2) due to colony extirpation (Figure 4). However, because of their apparently recent fragmentation (compared with populations delineated by Service 2007), the 2 population fragments are treated as 1 population in this BO and, as such, the Service considers there to be 11 potential populations on the Delta NF, all of which occur within the action area. As of 2023, the combined 163 extant and uncertain status colonies within the action area support a total of 20,271 pondberry plants. Three of these populations consist entirely of colonies of uncertain status while one population consists of a single colony. As illustrated by the loss of populations and total number of plants, overall population declines noted by the Service in 2007 and the BA are apparently continuing within the Delta NF.

Using the Service's reevaluated colony statuses, only 24 colonies (1 extant, 6 uncertain, 17 extirpated) occur at elevations less than 90.0 ft, while 46 colonies (15 extant, 6 uncertain, 25 extirpated) occur between 90.0 and 93.0 ft, and 236 (106 extant, 28 uncertain, 102 extirpated)

occur above 93.0 ft within the action area[3]. Most (93.2%) extant pondberry plants in the action area occur above 93.0 ft, nearly 5.6% of plants are located in the 90.0 to 93.0 ft elevation range, while the remaining (1.2%) occur in or below 90.0 ft. Furthermore, this reevaluation resulted in 58 extant and 4 uncertain status colonies in the Delta Depths population (population 1 in Figures 3 and 4) as well as 18 extant and 22 uncertain status colonies in Spanish Fort population (population 3 in Figures 3 and 4).

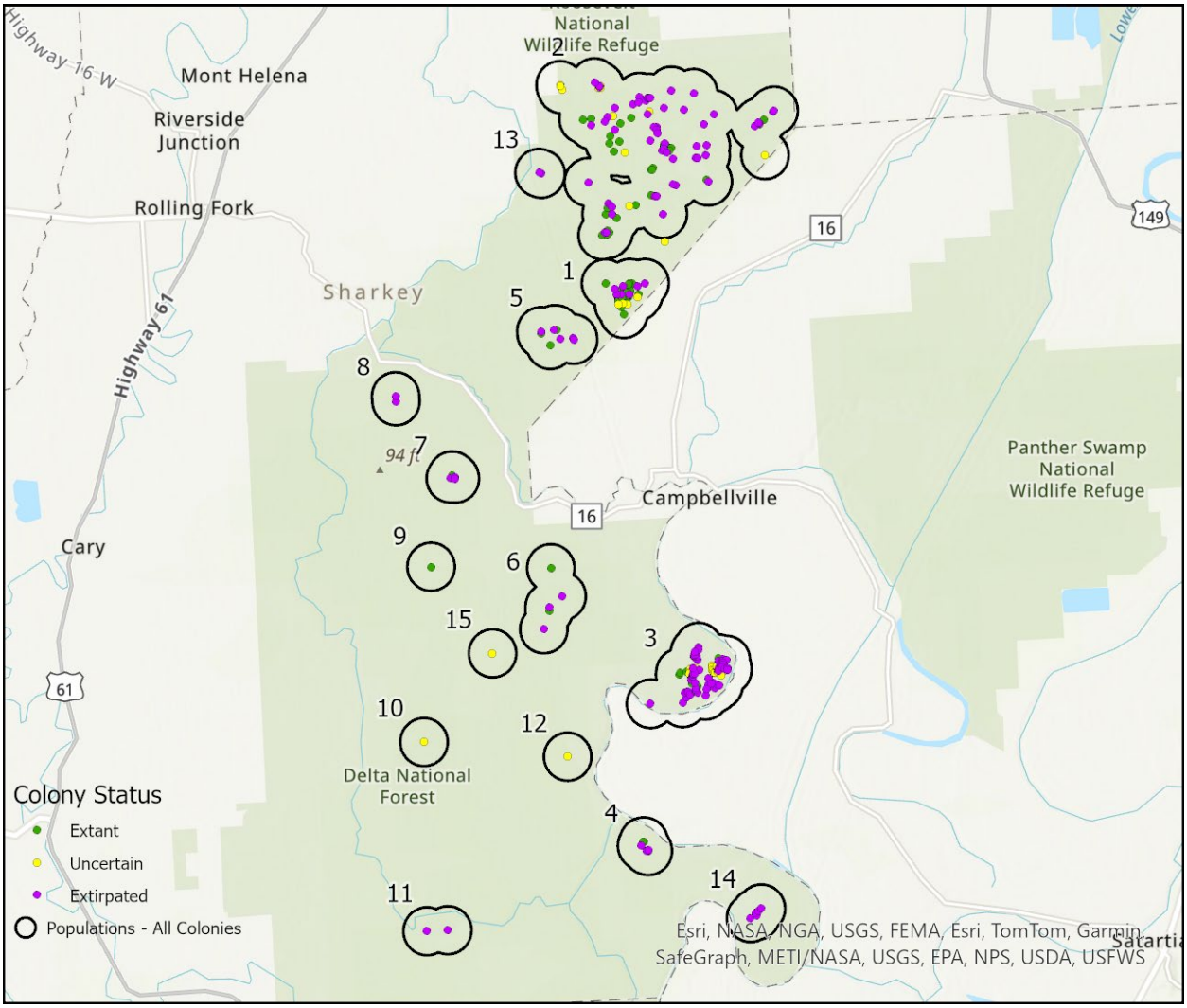

Figure 3. Distribution of known pondberry colonies and populations on Delta NF. Notes: One colony was not used to delineate populations due to its uncertain location (see Appendix 2). Population 14 occurs outside of the action area. Populations 1 and 3 are the Delta Depths and Spanish Fort populations, respectively, referenced in the BA.

[3] Note that the total colonies included in this elevation assessment is 306 rather than 307 because one colony of uncertain status was excluded due to its inaccurate location (see Appendix 2 for more information).

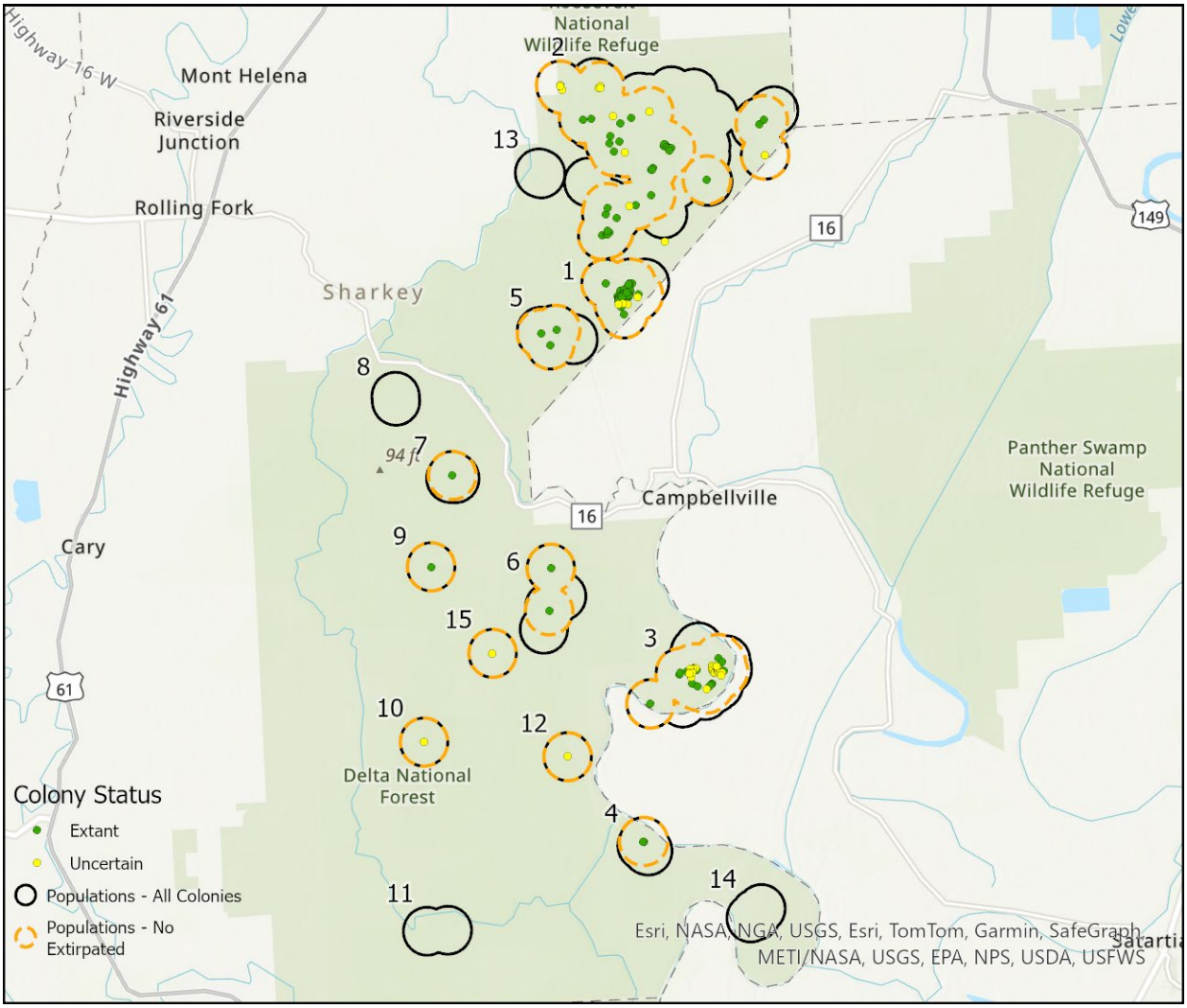

Figure 4. Pondberry population boundaries. Notes: Only extant and uncertain status colonies were used to delineate current populations, excluding one colony of uncertain location (see Appendix 2). Population 14 is located outside of the action area. Populations 1 and 3 are the Delta Depths and Spanish Fort populations, respectively, referenced in the BA.

In the Delta NF, pondberry occurs in mature bottomland hardwood forests dominated by various oaks (*Quercus* spp.), sweetgum (*Liquidambar styraciflua*), and elms (*Ulmus* spp.). The most frequently occurring and locally dominant overstory hardwoods include willow oak, Nuttall oak (*Q. nutallii*), overcup oak, sweetgum, cedar elm, American elm, and winged elm (GSRC 2001, 2005). Other species, which can be dominant and codominant, include box elder (*Acer negundo*), sugarberry, green ash, water hickory, and pecan (Morgan 1983; Tucker 1984; Devall et al. 2001; Hawkins et al. 2009a). While pondberry is not narrowly restricted to a particular bottomland hardwood forest type or community, it does not occur in bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), or swamp tupelo (*N. sylvatica*) forest types (Service 2007).

5.2 Action Area Conservation Needs and Threats

The conservation threats for pondberry in the action area are similar to the threats across its range, including inadequate reproduction, wetland drainage, clearing and conversion of wetland habitat, certain timber harvest practices, competition, disease, and predation.

Previous flood control efforts have substantially altered the natural hydrology of the YBA. Historically, the YBA was inundated by overflow from the Mississippi River, headwater flooding from the Yazoo River and tributaries, and backwater flooding from the Mississippi River (Smith and Klimas 2002). However, the natural frequency and duration of flooding has changed primarily due to the Mississippi River and Tributaries Project, which is considered one of the largest flood control projects in the world (Smith and Klimas 2002). This Project resulted in changes in frequency and duration of flooding as a result of mainline levees, water control structures at Steele Bayou and Little Sunflower River, channel cutoffs, clearing and snagging of the Big Sunflower River, aggradation of the Mississippi River channel, and construction of reservoirs upstream of the YBA. Collectively, these Project features confine floodwaters and accelerate flood discharge from the upper basin to the lower backwater area. Along with the resulting expanded flood protection came conversion of bottomland hardwood forests for agriculture purposes. Of about 6.3 million acres of bottomland hardwood forests in the Lower Mississippi Alluvial Valley of Arkansas, Louisiana, and Mississippi in 1935, about 3.6 million acres were converted to agriculture by 1985 (U.S. Department of the Interior 1988) while overall wetland losses in the region may have reached over 70% (King et al. 2006). Since that time, the Swampbuster provisions of the Food Security Act of 1985 and the Food, Agricultural, Conservation, and Trade Act of 1990 have reduced incentives to convert wetlands to croplands by restricting a landowner's eligibility for federal funds under various agricultural programs. In addition, wetland and bottomland hardwood forest conservation has been supported in the YBA by various programs administered by the U.S. Department of Agriculture Natural Resources Conservation Service, such as the Wetland Reserve Program and related initiatives (data available at https://www.farmers.gov/data/, accessed August 7, 2024), which provide federally funded financial incentives to support wetland conservation and restoration in agricultural landscapes (King et al. 2006).

The USACE also identified deep and long-term duration flooding events, such as those that occurred in 2019 and 2020, as potential threats to the species in the action area. Flooding during these two events alone lasted for a combined 357 days at or above 90.0 ft and 256 days at or above 93.0 ft. They calculated that for a colony with a 30-inch stem length maximum located at elevation 92.5 ft in the YBA, the entire colony was fully inundated for at least 146 days in 2019 and at least 57 days in 2020. USACE further identified 5 flooding events in the action area between 2008 and 2021 that lasted 30 days or more at or above 90.0 ft. USACE's recent (2020 to 2023) monitoring data within the Delta NF and elsewhere in Mississippi, suggest that response of pondberry post-2019 and 2020 included reduced stem counts, stem diameters, and colony extirpation; however, USACE acknowledged that limited monitoring data prior to 2020, prevents conclusive attribution of these observations to the recent floods (ERDC 2024).

USACE identified vines, such as greenbriers (*Smilax* spp.), grapes (*Vitis* spp.), trumpet creeper (*Campsis radicans*), and peppervine (*Ampelopsis arborea*) as having the most likely potential to outcompete or overcome pondberry colonies, noting their presence in many colonies monitored

within the Delta NF. Similarly, USACE identified dwarf palmetto (*Sabal minor*) as a strong competitor of pondberry, as recent monitoring observations suggest that it may have potentially detrimentally impacted some of Delta NF's pondberry colonies (ERDC 2024).

Finally, the USACE provided evidence from surveys and trail camera imagery in the Delta NF suggesting that feral hogs (*Sus scrofa*) are an increasing and potentially significant stressor on pondberry colonies. Hog rooting, wallows, and trampling all have been observed at or near many colonies. They also noted the abundance of palmetto (*Sabal* spp.) in the Delta NF and that many extinct pondberry colonies in the Delta NF were partially or completely overwhelmed with palmetto growth (ERDC 2024).

6 EFFECTS OF THE ACTION ON PONDBERRY

In a BO for a listed species, the effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the action area.

We identified and described the activities included in the proposed Action in section 2.1. We identified and described other activities caused by the proposed Action in section 2.2. Our analyses of the consequences caused by each of these activities follows.

6.1 Pump Station Construction and Operation

The construction of the pump station and its associated structures (e.g., levee, inlet and outlet channels, borrow area, access roads) will directly result in the alteration of lands within their footprints, which includes bottomland hardwood forests. In addition, the construction of 34 proposed low flow wells throughout the Mississippi Delta could directly result in the alteration of up to 42.5 acres of additional land. Operation of the pumping station will result in a reduction in flood extent in the YBA relative to current baseline conditions. This is evaluated as the change in hydrology by altering the frequency, duration, and depth of backwater floods. The USACE used an updated POR, stage-gage data, hydrological models, and other environmental data to assess the extent that the Steele Bayou WCS gate will be closed in the future and how backwater flooding will be altered by the pumping station.

The proposed Action is not designed or intended to hydrologically alter the two-year floodplain (i.e., lands below 90.0 ft), therefore, we do not anticipate adverse impacts to pondberry colonies found below this elevation. According to USACE, there is only one extant colony that falls below 90.0 ft elevation, which is within 15 meters of the 90.0 ft elevation. The Service also identified 17 extirpated and 6 uncertain status colonies below 90.0 ft. USACE further identified four colonies (1 extant and 3 unknown/uncertain status) below 90.0 ft (presumably due to their proximity—i.e., within 15-m—to 90.0 ft elevations) as potentially being impacted by the project (see Table 10 of the BA). Since the pumping station is designed to alter flood frequency, duration, and depth of backwater floods above 90.0 ft, we do not anticipate adverse impacts to pondberry plants below 90.0 ft. Because points used to represent colonies were generally taken from the center of colonies, some plants within a given colony may occur at or above 90.0 ft

elevations. Therefore, some, but likely not all, plants in the four identified colonies may be adversely impacted by the project.

USACE noted that forested wetlands have persisted in the YBA despite changes to flood hydrology due to installation of levees and other water control structures. To better understand local hydrologic dynamics, USACE installed groundwater monitoring wells throughout the YBA in 2021 to 2022, including 58 wells located adjacent to pondberry colonies, and deployed game cameras within the Delta NF beginning in 2020 to monitor surface water. USACE found significant correspondence among local precipitation, monitoring wells, and river gauge data, although surface water was variable across colonies. To better understand the importance of backwater flooding to pondberry above 93.0 ft, the USACE reviewed hydrologic data from 1979 to July 2024 (or nearly 46 years; encompassing most of the POR and beyond) to characterize the frequency of historical backwater flooding events relative to currently extant colonies. USACE selected two river gauges nearest to areas of the Delta NF that included the majority of pondberry colonies (Little Sunflower and Holly bluff), as well as the Steele Bayou WCS that backs up water into the YBA at a relatively flat elevation surface, for their analysis. During this period, backwater flood events above 93.0 ft NGVD were relatively uncommon over the POR (7 of 46 years at the Steele Bayou WCS). USACE further determined that most (100 of 122) extant pondberry colonies occurring above 93.0 ft would not have been subjected to backwater flooding during most (39) of the past 46 years. The relative infrequency of backwater flooding events above 93.0 ft combined with emerging information on local hydrology suggests that it is likely that local precipitation is the dominant hydrologic driver of forested wetlands above 93.0 ft elevation. Therefore, the operation of a pumping station is unlikely to result in adverse impacts to pondberry colonies above 93.0 ft.

Therefore, the focus of our analysis in this opinion are the pondberry populations between 90.0 and 93.0 ft where more pronounced flood frequency and duration changes resulting from the proposed Action are likely to occur and are the most likely to experience potential adverse effects from the project. The USACE identified 27 pondberry colonies (22 extant and 5 unknown status; listed in Table 10 of the BA) occurring directly within or within a 15-m buffer of this zone. However, colonies located within this elevation zone, but occurring in depressions surrounded by higher elevation lands were apparently excluded because they were not anticipated to receive backwater flooding until water levels exceeded these higher elevations. While USACE notes that overland sheet flow dominates water movement in soils associated with pondberry in the Delta NF we are concerned that exclusion of these so-called depressional sites from consideration apparently precludes any consideration of subsurface water flow or its potential to influence flooding within these depressional areas during backwater flooding events. From the available data provided by USACE, we cannot determine which colonies meet the criteria for exclusion from their effects analysis. In addition, as noted previously and discussed in more detail in Appendix 1, the Service reevaluated the status of pondberry colonies, which resulted in status changes to some colonies. Accordingly, the Service has identified 8 colonies in addition to USACE's 27 as potentially being adversely affected by the project. These additional colonies are all of uncertain status and occur directly within or near (within 15-m) the 90.0 to 93.0 ft elevation zone. These 35 colonies, along with pertinent information, are listed in a table in Appendix 3, and are found in 7 populations (3, 5, 6, 9, 10, 12, and 15; depicted in Figure 4) located predominantly in central and southern portions of the Delta NF.

Pondberry colonies located between 90.0 and 93.0 ft are more likely to experience altered hydroperiods when backwater flood levels exceed 90.0 ft in the crop season. During this time, which is also the growing season for pondberry, we can reasonably expect a reduction in potential inundation from the proposed Action. Based on the POR, this would have happened in 20 out of the 43 years with most pump operation occurring predominantly in March through June over the POR: 780 days and 754 days total over this time, under Alternatives 2 and 3, respectively. This reduction in potential inundation—which is about 14.9% and 14.4% of all days or an average of 18.1 and 17.5 days in March through June over the POR—could result in conditions favorable for vines and other plants to outcompete pondberry, with adverse impacts on colony persistence. USACE identified greenbriers, grapes, trumpet creeper, and peppervine as having the most likely potential to outcompete or overcome pondberry colonies, noting their presence in many colonies monitored within the Delta NF. Similarly, USACE identified dwarf palmetto as a strong competitor of pondberry, as recent monitoring observations suggest that it may have potentially detrimentally impacted some of Delta NF's pondberry colonies. The reduction in the frequency of backwater inundation may also reduce soil water moisture and increase the risk of drought stress. Such changes could result in greater susceptibility of pondberry plants to stem dieback from stem canker fungus, and other pathogens.

However, the level of harm that altered hydroperiod will have on these populations is difficult to quantify. For one, the pumping station will allow water levels up to the 93.0 ft elevation during the non-crop season; therefore, inundation events would continue to occur in pondberry populations below 93.0 ft during the non-crop season. Had this pumping operation been in place during the 43-year POR, this would have occurred in 3 of 43 (7%) years. Secondly, local precipitation and possible headwater flooding will continue to influence local hydrology of colonies between 90.0 and 93.0 ft. Since 2021, USACE has been analyzing groundwater monitoring well data from eight colonies in the YBA below 93.0 ft, three colonies between 93.5 to 93.6 ft, and three colonies at much higher elevations outside the YBA (i.e., 155.0-155.1 ft) that are not subject to flooding. The results indicated that colonies in the Delta NF at or below 93.0 ft showed either a cyclic annual spring surface water inundation or an increase in groundwater saturation in the root zone in a cyclic annual pattern. During this same time period, the Steele Bayou WCS never exceeded 90.0 ft, and therefore a pumping station would not have been turned on during this time period, which suggests that the observed hydrology was driven by local hydrology (e.g., precipitation) rather than backwater flooding. In addition, monitoring well data for colonies above 93.0 ft showed cyclic annual spring surface water inundation similar to those colonies below elevation 93.0 ft, indicating the importance of local hydrology on pondberry colonies at all elevations where they occur in Mississippi. Therefore, the role local precipitation and headwater flooding will continue to have on pondberry colonies in the absence of reduced backwater flooding events cannot be discounted.

Finally, a reduction of rare, but extreme, flooding events, such as occurred in 2019 and 2020, which inundated areas above 90.0 and 93.0 ft for a combined 357 and 256 days, respectively, could prove beneficial to pondberry, which can experience reduced growth under such conditions. Such long duration floods may also contribute to colony decline and extirpation. USACE documented pondberry stress to colonies after the 2019 and 2020 flood events. For example, a colony in the YBA at 92.5 ft with a 30-inch maximum stem length would have been completely inundated for 203 days combined during these two events. USACE's data suggest that post-2019 and post-2020 flood response by pondberry included reductions in stem counts,

stem diameters, and in some cases, colony extirpation. However, since no colony monitoring data existed between 2010 and initiation of 2020 surveys, USACE acknowledged that they could not conclusively attribute these flood effects to the status of pondberry in the YBA. USACE also compared the stem heights and diameters between pondberry colonies in the Delta NF and colonies in the Hester Tract, which is north of the YBA and does not receive backwater flooding. Many pondberry stems in the Hester Tract had robust, woody stems, approaching 0.75 inches in diameter, which were almost nonexistent in Delta NF colonies. Although the degree and extent to which long duration flood events influence pondberry population health and survival is not fully understood, the above-mentioned evidence along with comparatively few (7) known extant and uncertain colonies below 90.0 ft, where backwater flooding events are more common, may suggest that these infrequent but long duration flood events could have deleterious effects on pondberry.

Although unlikely, the worst-case scenario is that all 35 colonies (representing 1,417 plants) directly within or near (within 15-m) the 90.0 to 93.0 ft elevation zone will be extirpated as a result of the proposed Action. This would represent a 21.5% loss of extant and uncertain status pondberry colonies and 7% loss of all known pondberry plants on the Delta NF. Furthermore, up to six of Delta NF's populations could be lost while another population would be reduced in extent. Figure 5 depicts this worst-case scenario for the Delta NF. The potential loss of these colonies would also represent a 15% loss of extant and uncertain status colonies and loss of nearly one-third of populations in Mississippi, but only a 1.8% loss of plants. Range-wide, pondberry's populations could be reduced by as much as 8.6%; however, while the total number of plants across the species' range is unknown, the potential loss of 1,417 pondberry plants likely represents less than 1% of the total population.

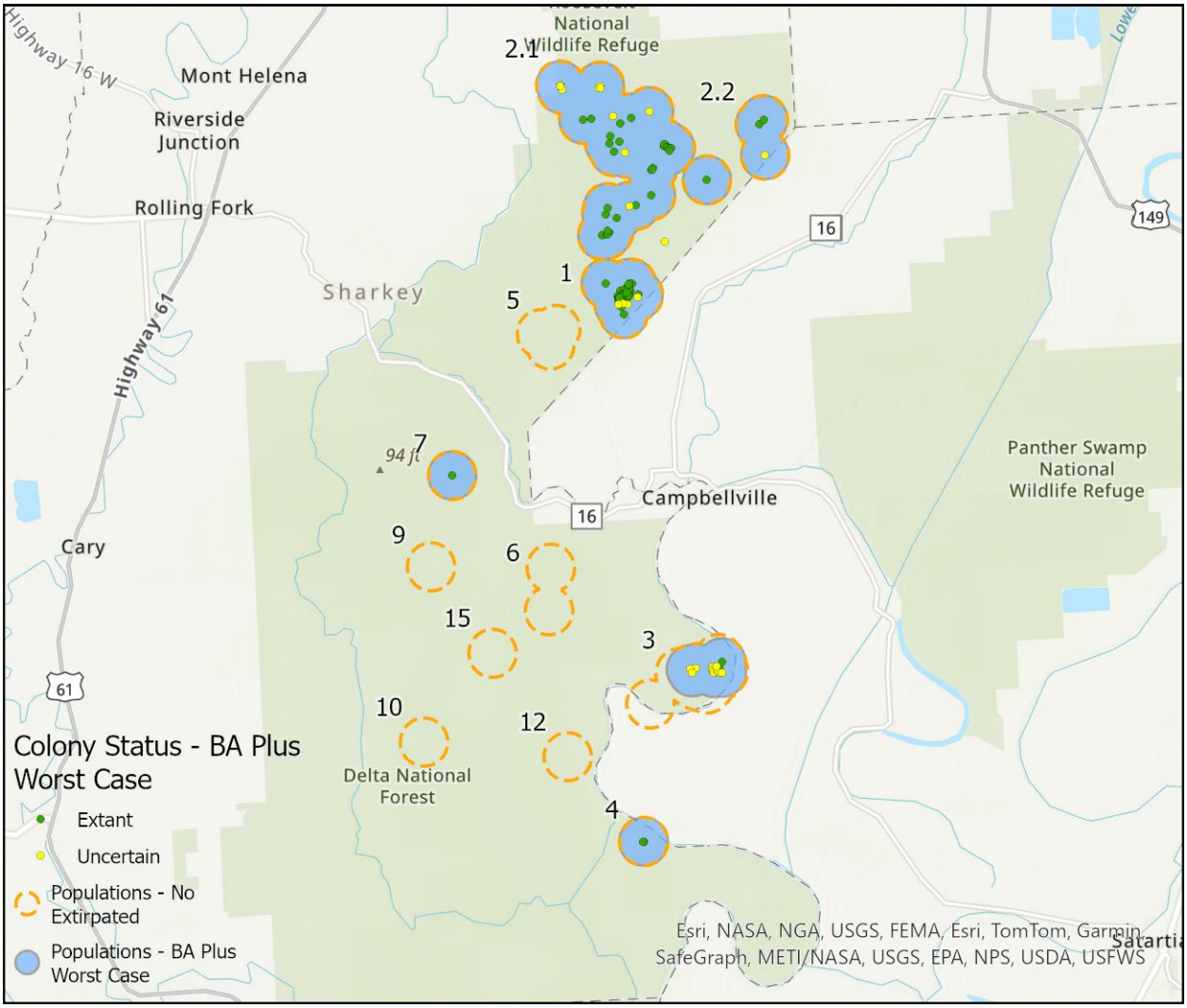

Figure 5. Distribution of pondberry following the potential extirpation of 35 colonies. Notes: 2.1 and 2.2 are considered to comprise one population due to their recent fragmentation. One colony was not used to delineate populations due to its uncertain location (see Appendix 2). Populations 1 and 3 are the Delta Depths and Spanish Fort populations, respectively, referenced in the BA.

In addition to the project's potential beneficial impacts of reducing deep and prolonged flooding events to pondberry, implementation of conservation measures and strategies included in the BA and *Section 7(a)(1) Conservation Plan* are expected to further ameliorate the project's potentially adverse impacts over the long-term by supporting research and activities to reduce impacts from invasive species, improve habitat management, and potentially directly expand existing or establish new populations via propagation and transplantation. These efforts may also have beneficial impacts beyond the YBA by informing and thereby indirectly improving conservation activities throughout pondberry's range.

6.2 Other Activities Caused by the Action

Other activities associated with the proposed Action include management of the Steele Bayou WCS gate to allow free movement of water into and out of the YBA up to an elevation of 75.0 ft, the addition of low-flow wells to improve annual low-flow conditions currently occurring in the

YBA, mandatory and voluntary structure buyout below 93.0 ft, and the acquisition of up to 39,492 acres of land below 93.0 ft from willing landowners. Finally, Clean Water Act (CWA) compensatory mitigation would result in reforestation of agricultural lands within and near the YBA.

The Service has determined these activities would not have adverse effects on existing pondberry populations, and that any land acquisition associated with the Action has the opportunity to provide beneficial effects once lands are reforested and provide potentially suitable habitat conditions favorable for pondberry establishment.

7 CUMULATIVE EFFECTS ON PONDBERRY

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to pondberry are not relevant to formulating our opinion for the Action.

8 CONCLUSION FOR PONDBERRY

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the BO for pondberry, which is to determine whether the Action is likely to jeopardize its continued existence.

There are currently 36 extant populations and 34 populations of uncertain status across pondberry's range, which encompasses parts of 7 states in the southeastern United States. An additional two extant populations have been established in two states. Mississippi is home to 17 of these 70 range-wide natural populations. There are also two extant transplanted populations. Populations range in size from a single pondberry colony to 70,000 or more plants, occupying a fraction of an acre to more than 1,500 acres. Mississippi supports 3 of the largest populations known, which range in size from over 7,600 plants to over 55,000 plants, 2 of which occur within the action area. Other large populations, including the largest, are known from Arkansas, Missouri, and South Carolina.

The current conditions of the action area are a primary result of past flood control projects in the YBA and the resulting conversion of bottomland hardwood forested wetlands to agricultural fields. The conservation threats for pondberry in the action area include inadequate reproduction, wetland drainage, clearing and conversion of wetland habitat, certain timber harvest practices, competition, invasive species, disease, and predation. Deep and long duration flooding events may also have a negative impact on pondberry in the YBA, although additional research is needed to better understand this interaction.

The Service determined that the proposed Action is unlikely to adversely impact pondberry colonies below 90.0 ft elevation, which is the area below which the proposed Action would alter flood frequency and duration. These areas would continue to receive backwater flooding events similar to current conditions. Few pondberry colonies are known to occur in these areas, with only 4.3% of extant or uncertain status colonies and 1.2% of plants within the action area located below this threshold. Likewise, during the 43-year POR, backwater levels have only exceeded 93.0 ft elevation 7 times. Because backwater flooding above 93.0 ft is so infrequent, it is not

likely that pumping operations will have a significant influence on prevailing hydrologic regimes of colonies above elevation 93.0 ft, which appear to be more driven by precipitation and headwater flooding in these elevations. Therefore, we conclude that pondberry populations above 93.0 ft, which collectively represent over 82% of all extant and uncertain status colonies and more than 93% of plants within the action area, are unlikely to be adversely impacted by the proposed Action.

For the 22 remaining extant colonies and 13 colonies of uncertain status found between or within 15-m of the 90.0 to 93.0 ft elevation range, we anticipate potential adverse effects through reduced backwater flood inundation that could cause colony decline and/or extirpation due to increased competition by other plant species. The reduction in the frequency of backwater inundation may also reduce soil water moisture and increase the risk of drought stress, which could increase susceptibility of pondberry to stem dieback from stem canker fungus and other pathogens. If, as a result of such potential adverse effects, all of these 35 colonies become extirpated, 21.4% of Delta NF's colonies and 7% of its plants would be lost, while the state loss would represent 14.9% of colonies and 1.8% of plants. However, the degree to which adverse effects will occur is uncertain due to the fact that these colonies will continue to experience periodic flood inundation during the non-crop season and the fact that local precipitation and headwater flooding will continue to occur and provide some level of hydrologic maintenance to these colonies. Potential positive effects of reduced prolonged flood duration and inundation during extreme flooding events, particularly during the growing (crop) season, resulting from the proposed Action may also offset some of the potential negative effects of reduced flood frequency during the growing season.

After reviewing the status of the species, the environmental baseline for the action area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of pondberry.

9 INCIDENTAL TAKE STATEMENT

This BO evaluated effects of the Action on the endangered pondberry. ESA §7(b)(4) and §7(o)(2), which provide the authority for issuing an ITS, do not apply to listed plant species. However, ESA §9(a)(2) prohibits certain acts with respect to endangered plant species, including:

(a) remove and reduce to possession from areas under Federal jurisdiction;
(b) maliciously damage or destroy on areas under Federal jurisdiction; and
(c) remove, cut, dig up, or damage or destroy on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law.

Regulations issued under ESA §4(d) extend the prohibition under (a) above to threatened plant species (50 CFR §17.71). The damage or destruction of endangered and threatened plants that is incidental to (not the purpose of) an otherwise lawful activity is not prohibited.

10 CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the USACE.

The USACE's intensive survey and monitoring efforts for pondberry in Mississippi have provided valuable information on the status of the species within the action area and state. Installation of groundwater monitoring wells and cameras to further characterize hydrology within the action area that is vital to maintenance of pondberry habitat and other sensitive natural resources. Continuation of these efforts and implementation of remaining items identified in the USACE's *Section 7(a)(1) Conservation Plan*, including expanded research into hydrology, competition, invasive species, and other factors affecting pondberry. We support the efforts of the USACE to establish this program and recommend the following to strengthen it.

1. Important pondberry populations for recovery also occur in the St. Francis River floodway, within and near the St. Francis Sunken Lands WMA, managed by the Arkansas Game and Fish Commission. This may be home to the largest single remaining population throughout pondberry's range. Flood releases regulated by the USACE and frequent flooding probably are important factors affecting the species. The USACE should expand survey, monitoring, and research efforts included in the Section 7(a)(1) Conservation Plan to include these populations.
2. Actively share and communicate findings from research, monitoring, and management activities and work with conservation partners to develop best management practices for pondberry.

We also support USACE's recommendation in the BA to focus future mitigation efforts, including acquisition and reforestation/conservation of agricultural lands through perpetual easements from willing sellers, in the 91.0 to 96.0 ft NGVD elevation range, as this would be the most likely to benefit pondberry.

In addition, we also recommend the following:

3. Conduct surveys for pondberry in potentially suitable habitat within the construction footprint of the pump station and its associated structures to confirm that pondberry does not exist in these areas. Should pondberry be found, consult with the Service to determine appropriate conservation measures.
4. Conduct surveys to confirm that pondberry does not exist in sites proposed for construction of the 34 low flow wells should potentially suitable habitat be identified in in these areas. If alternate locations for these wells are needed, avoid potentially suitable habitat for pondberry, such as bottomland hardwood forests, when selecting sites and conduct pondberry surveys if such habitat cannot be avoided. If pondberry is found, consult with the Service to determine appropriate conservation measures.

11 REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the USACE retains discretionary involvement or control over the Action (or is authorized by law) when:

a. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
b. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
c. a new species is listed or critical habitat designated that the Action may affect.

The Service appreciates the cooperation of the USACE during this consultation. For further coordination please contact David Felder with the Mississippi Ecological Services Field Office at 769/487-6850 or by email david_felder@fws.gov.

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APPENDIX 1. COLONY STATUS RATIONALE.

The Service reevaluated pondberry colony statuses on Delta NF and elsewhere in Mississippi using information provided on stem counts and notes during surveys from 2020 to 2023 ("recent surveys") provided by USACE in a supplementary Excel file. For each colony, this information was first used to determine if they were visited and if pondberry was observed each survey year. Next, total number of visits to and observations of pondberry at each colony over the four years was determined. A colony was considered extant[4] if pondberry was observed during the last year that the colony was surveyed. Colonies were considered extirpated if pondberry was not observed in two or more consecutive years during recent surveys, including the latest survey year[5] (even if a prior recent survey observed pondberry). Colonies were assigned uncertain status if they had not been surveyed during the four survey years, if recent surveys observed pondberry during at least one survey and the most recent follow-up survey did not observe pondberry (except as described above as extirpated), if they were only surveyed once and pondberry was not observed[6], or if there was reason to question the accuracy of colony's location. Questionable location accuracy resulted in uncertain statuses for five colonies: colony 263 (erroneous coordinates described in Appendix 2) and colonies 226, 249, 250, and 251 (potentially erroneous coordinates were noted in the supplementary Excel file). In addition, as described in Appendix 2, colony 252 was excluded from colony status counts, but its five child colonies were included in these counts (i.e., instead of counting 6 colonies, only 5 colonies were counted).

Accordingly, of the 312 known colonies (see Appendix 2 for explanation of count difference from the BA's 313 colonies) on the Delta NF, 122 are considered extant, 149 are extirpated, and 41 are of uncertain status. Within the action area, 122 are extant, 144 are extirpated, and 41 are uncertain. Likewise, applied to all 384 colonies surveyed in Mississippi, 185 are extant, 150 are extirpated, and 49 are uncertain.

[4] Some colonies were identified as components of larger "megacolonies" in the spreadsheet and their stem counts and observation notes were typically grouped and noted for only one of the component colonies. In these cases, all component colonies were considered to have observed pondberry if the primary colony was identified as having pondberry in a given year.

[5] This criterion for extirpated status aligns with that described in section 4.6 of the BA, which stated that colonies were considered "extirpated after thorough survey efforts in two successive years resulted in zero stems found."

[6] This criterion for uncertain status aligns with Figure 9 of the BA, which states, "Colonies noted as not having pondberry present were surveyed at least twice since 2020." In addition, colonies visited only once and where pondberry was not observed during recent surveys are recognized to be potentially extirpated but follow-up surveys are needed to confirm their status without additional evidence indicating extirpation (e.g., site converted to agricultural field).

APPENDIX 2. COLONIES EXCLUDED FROM ANALYSES.

The BA notes a total of 313 known pondberry colonies within the Delta NF, 308 of which occur within the action area. Additional, supplementary data detailing data gleaned from historical and recent (2020 to 2023) surveys of pondberry colonies in Mississippi were provided to the Service by USACE in the form of an Excel file. Two colonies included in the Excel file and assessed in the BA have been excluded from some of the Service's analyses for the following reasons.

- 252 – Discovered in 2022 and split into five separate "child" colonies (381-385) in 2023. Excluded colony 252 from total colony count and colony status counts. Assumed the five child colonies were extant during 2022 when the "parent" colony was discovered. This resulted in 5 colonies included in the Service's assessments, rather than 6 colonies.
- 263 – Coordinates of the colony do not align with the location description provided in the spreadsheet: "Delta NF, Compartment 8. T12N R5W Sec NW/4 SW/4. Last surveyed in year 1990". Specifically, the coordinates do not occur within Compartment 8 of the Delta NF or in the Delta NF. Coordinates occur in T12N R5W, but the description lacks a section number. Within the section that the coordinates are located, they are not within northwest quarter (NW/4) of the southwest quarter (SW/4). Finally, review of readily available historical imagery indicates that the agricultural fields where the point is located existed prior to 1990, therefore precluding the discovery of pondberry in this unsuitable habitat in 1990. Status considered uncertain (see Appendix 1). Included in total colony and status counts but excluded from population delineation and elevation assessments. Location description indicates that this colony falls within population 2 (depicted in Figure 2).

Accordingly, the Service considers the total number of known pondberry colonies to be 312 within the Delta NF as a whole and 307 within the action area. Likewise, the total number of colonies assessed during USACE's recent surveys in Mississippi is considered to be 384.

APPENDIX 3. COLONIES INCLUDED IN EXPANDED EFFECTS ANALYSIS.

Colony ID	USACE Status	FWS Status	Pondberry Observed (2020-2023)	Surveys Since 2020	Most Recent Stems	Flood Frequency Base (2023)	Flood Frequency Alt (2023)	Elevation (ft) 1-m DEM (2024)
27	Extant	Extant	Y	2	537	2	2	91.26
41	Extant	Extant	Y	3	2	2	2	91.88
52	Extant	Extant	Y	4	10	5	5	93.20
54	Extant	Extant	Y	3	7	5	5	91.98
55	Extant	Extant	Y	3	2	5	10	94.69
56	Extant	Extant	Y	3	2	5	5	92.24
58	Extant	Extant	Y	3	3	5	5	92.68
59	Extant	Extant	Y	3	3	2	2	92.07
84	Unknown	Uncertain	Y	3	0	5	10	92.78
88	Extant	Extant	Y	4	234	1	1	89.65
90	Unknown	Uncertain	Y	3	0	1	1	88.21
119	Extant	Extant	Y	3	198	1	1	92.64
130	Extant	Extant	Y	3	9	1	1	92.31
131	Extant	Extant	Y	2	4	2	2	90.23
151	Extant	Extant	Y	2	3	1	1	90.68
200	Extant	Extant	Y	4	63	2	2	92.50
202	Unknown	Uncertain	Y	3	0	5	5	92.01
203	Extant	Extant	Y	3	7	10	10	93.75
204	Extant	Extant	Y	3	13	5	5	94.03
205	Extant	Extant	Y	2	1	10	10	93.84
207	Extant	Extant	Y	3	12	5	5	91.69
216	Extant	Extant	Y	3	218	1	1	92.25
223	Extant	Extant	Y	2	5	5	5	92.71
226	Unknown	Uncertain	Y	2	0	1	1	87.72
257	Unknown	Uncertain	N	1	0	1	1	88.04
338	Extant	Extant	Y	1	12	10	10	94.33
340	Extirpated	Uncertain	N	1	0	10	10	94.25
342	Extirpated	Uncertain	N	1	0	5	5	93.22
344	Extirpated	Uncertain	N	1	0	5	5	93.78
345	Extirpated	Uncertain	N	1	0	5	5	90.60
350	Extirpated	Uncertain	N	1	0	5	10	92.03
353	Extirpated	Uncertain	N	1	0	5	10	92.38
354	Extirpated	Uncertain	N	1	0	5	10	92.19
358	Extirpated	Uncertain	N	1	0	10	50	94.34
375	Extant	Extant	Y	1	72	5	5	92.71

Notes: Colonies highlighted in light gray were not included in USACE's effects analysis (see Table 10 of the BA). Due to only one known survey since 2020, these eight colonies were assigned an uncertain status by the Service (see Appendix 1). As noted in Appendix 1, the location of colony 226 is potentially erroneous and its status is therefore uncertain despite multiple surveys since 2020 failing to observe pondberry. As indicated in the supplementary Excel file provided by USACE, colonies 340, 342, 344, and 358 occur within 15-m of 93.0 ft elevation, which aligns with USACE's selection criteria for inclusion of colonies in its analysis and have therefore been included in the Service's analysis.