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Implications of Declining Ground Water and Water Quality in the Greater Okefenokee Swamp Basin for Survival and Recovery of Federally Endangered and Threatened Marine and Aquatic Species and Critical Habitat in the US Southeastern Coastal Plain Ecoregion —Part 2

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Abstract

The Floridan aquifer system underlies the United States (US) Southeastern Coastal Plain Physiographic Region. Anthropogenic groundwater declines in that regional karst aquifer system, via semi-confining zones, have been documented in published literature for decades. These anthropogenic groundwater declines reduce surfacewater levels and flows, which increases saltwater intrusion and alters the physical, chemical, and biological integrity of the nation's waters, in violation of the US Clean Water Act (CWA) of 1972. Historic groundwater declines from mining and other anthropogenic groundwater withdrawals from this regional karst aquifer system already threaten the survival and recovery of marine and aquatic federally endangered and threatened species, as well as existing and proposed critical habitat for those species within the Southeastern Coastal Plain Ecoregion. Examples of marine and aquatic species and their designated critical habitat adversely affected by groundwater declines in the Greater Okefenokee Swamp Basin of this ecoregion include the federally endangered south Atlantic Distinct Population Segments (DPS) of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), and oval pigtoe mussel (*Pleurobema pyriforme*), as well as the federally threatened Gulf subspecies of the Atlantic sturgeon (*Acipenser oxyrinchus desotoi*) and Suwannee moccasinshell (*Medionidus walkeri*). In 2020, rules were adopted by two federal agen-

cies allowing significant further degradation of the physical, chemical, and biological integrity of the nation's waters that are essential for maintaining federally listed species and their habitat in this Ecoregion. The US Fish and Wildlife Service (USFWS) has acknowledged the harm to these species and critical habitat from mining and additional groundwater alterations, but no comprehensive Areawide Environmental Impact Statement (AEIS), similar to the AEIS required for mining within the Peace River Basin, has been conducted for any of the numerous mining projects that are expanding and proposed within the Greater Okefenokee Swamp Basin to evaluate all indirect and cumulative adverse impacts to all federally listed species.

Keywords

Environmental Laws and Regulations, Federal Water Pollution Control Act, Groundwater Capture, Induced Recharge, Inter-Basin Flow

1. Introduction

The previously published, Part 1, companion case study by Bacchus, Bernardes & Madden (2023) addressed the 1998 case filed in federal court regarding related legal issues of unsustainable groundwater withdrawals from the karst, Edwards Aquifer in Texas for mining and other uses that were jeopardizing the recovery and survival of federally endangered and threatened species. Those species include aquatic animal species, in addition to plant species (Bunton III, 1993a; 1993b; Votteler, 1998). The previously published, Part 1, companion case study (Bacchus et al., 2023) also discussed the Complaint for Declaratory and Injunctive Relief filed by EarthJustice on January 14, 2021. That legal Complaint challenged the legality of the State of Florida's assumption of the Clean Water Act (CWA) Section 404 regulatory authority in 2020 (EarthJustice, 2021), addressing the illegal ramifications not only related to water quality under the CWA, but also on federally endangered and federally threatened species under the Endangered Species Act (ESA). EarthJustice also filed a 59-page Complaint for Declaratory and Injunctive Relief on April 19, 2022 for this case. That complaint also addressed the illegal ramifications not only related to water quality under the CWA and federally endangered and federally threatened species under the ESA. That entire 2022 EarthJustice complaint is included in **Appendix A**.

In 2023, EarthJustice filed the Plaintiffs' Motion for Summary Judgment for that federal case (EarthJustice, 2023), after the initial, Part 1, case study was submitted for publication by Bacchus et al. (2023). That Motion for Summary Judgment also described the illegal ramifications to Florida's water quality under the CWA and on federally endangered and federally threatened species in Florida, designated pursuant to the ESA, which relates directly to this, Part 2, case study and the Part 1, companion case study (Bacchus et al., 2023). More specifically, that Plaintiffs' Motion for Summary Judgment addresses the substantive

claims in EarthJustice's 2021 Complaint regarding the way the agencies consulted regarding impacts to federally endangered and federally threatened species, in addition to the insufficiencies of the State of Florida's program (EarthJustice, 2023). The Federal and Florida Defendants in that case will cross-move and respond on April 26, 2023 and May 10, 2023, respectively. EarthJustice will respond on June 9, 2023 and the Federal and Florida Defendants will reply on June 30, 2023 and July 7, 2023 respectively, with oral argument set for September 8, 2023 (EarthJustice personal communication, C. Reichert, 4/2/23). Issues in that 83-page Motion for Summary Judgment that particularly are relevant to the Part 1 case study (Bacchus et al., 2023) and this Part 2 companion study include the "Preliminary Statement," which references mining specifically, in addition to the following Statement of Facts and Argument sections (EarthJustice, 2023):

"STATEMENT OF FACTS"
"II. Florida's Abysmal Environmental Record.
III. Florida's Pursuit of 404 Assumption.
IV. The Corps' Retained Waters List.
V. Endangered Species Act Consultation.
VI. EPA's Approval of the State's Application."
"ARGUMENT
I. USFWS Violated the ESA by Substituting a Non-Statutory Technical Assistance Process for the ESA's Statutory Framework.
II. EPA Unlawfully Relied on USFWS' Arbitrary and Capricious BiOp and ITS.
III. EPA Arbitrarily and Capriciously Determined "No Effect" to NMFS Species.
IV. EPA Unlawfully Approved a State Program that is Less Stringent Than Federal Law.
V. The Corps Unlawfully Relinquished 404 Jurisdiction Over Certain Waters.
VI. EPA Arbitrarily and Capriciously Determined the State's Inadequate Application Was Complete."

Because of the related legal concerns addressed in the previously published, Part 1, companion case study by Bacchus et al. (2023), scientific support if provided for the urgent need for the US Army Corps of Engineers (USACOE) and the US Environmental Protection Agency (USEPA) to conduct a comprehensive Areawide Environmental Impact Statement (AEIS) to consider the adverse impacts of all mining within the Greater Okefenokee Swamp Basin, including mining currently considered to meet the qualifications of a General Permit before any additional activities related to mining occurs within that area (Bacchus et al., 2023). That AEIS would be similar to the AEIS required by the USEPA for mining by a single company within the Peace River Basin (USACOE, 2011; 2013; USEPA, 2010), but which was arbitrarily limited in geographic scope and failed to consider numerous significant adverse impacts to the human environment

that have occurred as a result of that mining (Bacchus et al., 2023).

The location of the study area for both the Part 1 and Part 2 case studies is the Greater Okefenokee Swamp Basin. That study area is shown within the extent of the regional, karst Floridan aquifer system, in **Figure 1**. Bacchus et al. (2023) summarized the characteristics of karst aquifer systems and specifically the regional karst Floridan aquifer system, in addition to groundwater declines associated with mining throughout that aquifer system, which underlies the entire terrestrial, aquatic, estuarine, and marine ecosystems of the Southeastern Coastal Plain Ecosystem. The implications of those irreversible groundwater declines on

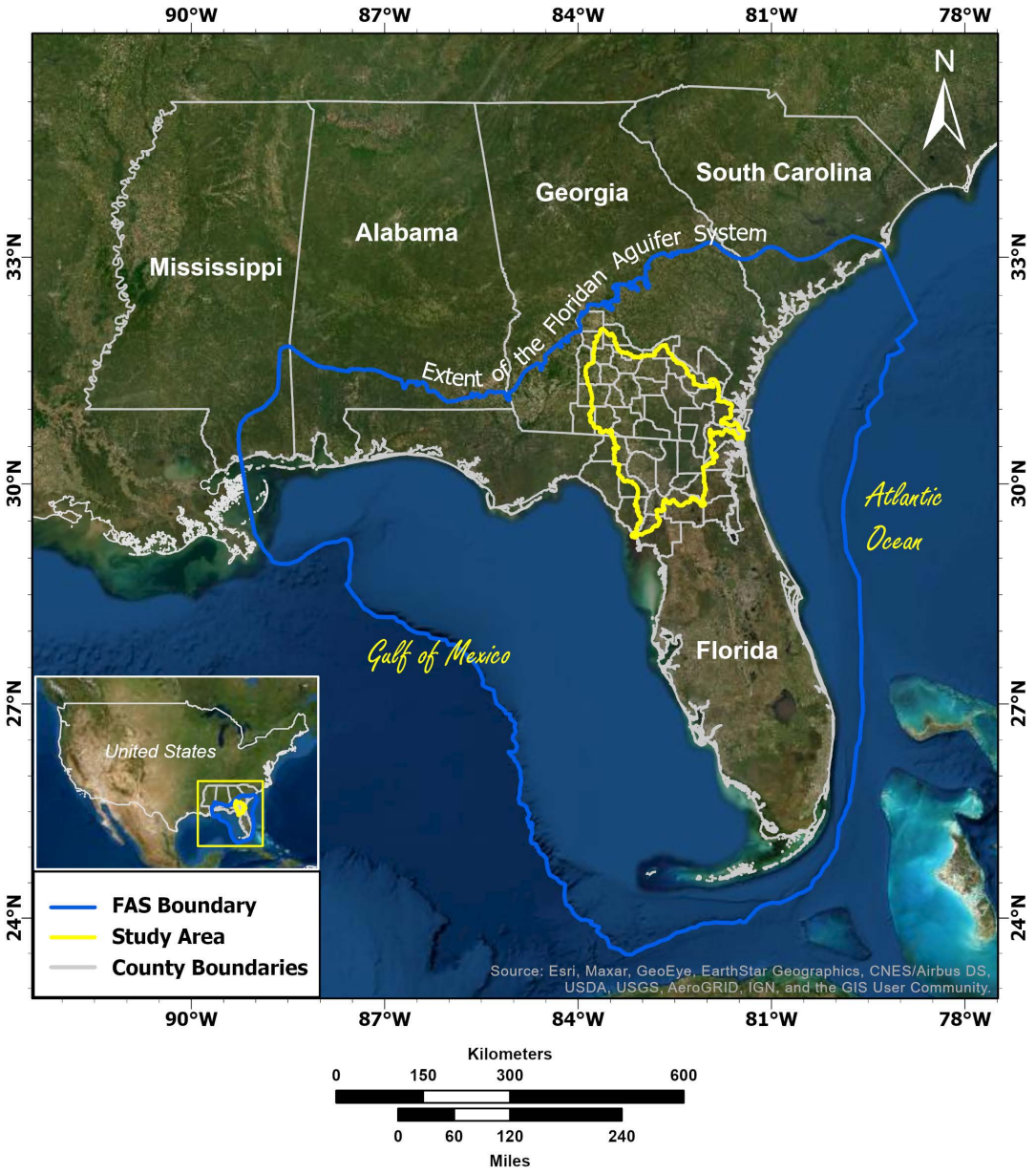

Figure 1. The Greater Okefenokee Swamp Basin study area in northeast Florida and southeast Georgia and the extent of the Floridan aquifer system, from the Atlantic Ocean and Gulf of Mexico, and throughout Florida and the southeastern coastal plain of Mississippi, Alabama, Georgia, and South Carolina.

the survival and recovery of federally endangered and threatened species were considered, including the fact that the assumption of the Section 404 regulatory authority of the federal CWA severs federal regulatory authority for four subbasins within the Greater Okefenokee Swamp Basin study area at the state line between Florida and Georgia, in contradiction to the directives of the 1994 United States Government Accountability Office (USGAO, 1994) Report for Ecosystem Management. This is because the State of Florida assumed the CWA Section 404 regulatory authority in 2020, as described in the Part 1 case study, while CWA Section 404 regulatory authority for the State of Georgia and the other states underlain by the regional Floridan aquifer system remains under federal control. Similarly, the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) relinquished the regulatory duties of those federal agencies under the ESA, related to ensuring no jeopardy of federally endangered and threatened and the survival and recovery of those federally listed species and their habitat to Florida, when that state assumed the CWA Section 404 regulatory authority in 2020, as discussed in more detail in this Part 2 companion study, while those federal agencies maintained federal regulatory authority under the ESA in Georgia and the other states underlain by the regional Floridan aquifer system.

Bacchus et al. (2023) also provided evidence, based on the karst characteristics of the Floridan aquifer system, supporting the fact that Nationwide Permits for Category 44 (NWP-44) for mining are not valid within the Southeastern Coastal Plain Ecosystem because that NWP Category does not meet the requirements of the federal CWA in that ecoregion, as is the case for any General Permits that would result in groundwater alterations within the extent of the Floridan aquifer system. The USACOE (2017) issued and reissued those categories for Nationwide Permits in a Final Rule published in the Federal Register on January 6, 2017.

The objectives of this, Part 2, companion study were to evaluate specific federally listed marine and aquatic species that occur in the Greater Okefenokee Swamp Basin, considering the potential for apparent CWA violations and violations of the federal Endangered Species Act (ESA), in addition to the need for an AEIS to consider all of the adverse direct, indirect, and cumulative impacts to these and other federally listed species within the Greater Okefenokee Swamp Basin. Those adverse direct, indirect, and cumulative impacts would have to include the loss of economic income and services from the impairment and total loss of all of the surface waters, including wetlands, from that mining. Examples of those losses were described by the United States Fish and Wildlife Service (USFWS, 2019a; 2019b).

Both **Figure 1** and **Figure 2** show the submarine extent of the regional Floridan aquifer system, underlying the marine and estuarine habitat of the federally endangered South Atlantic Distinct Population Segments (DPS) of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), as well as the federally threatened Gulf subspecies of the Atlantic

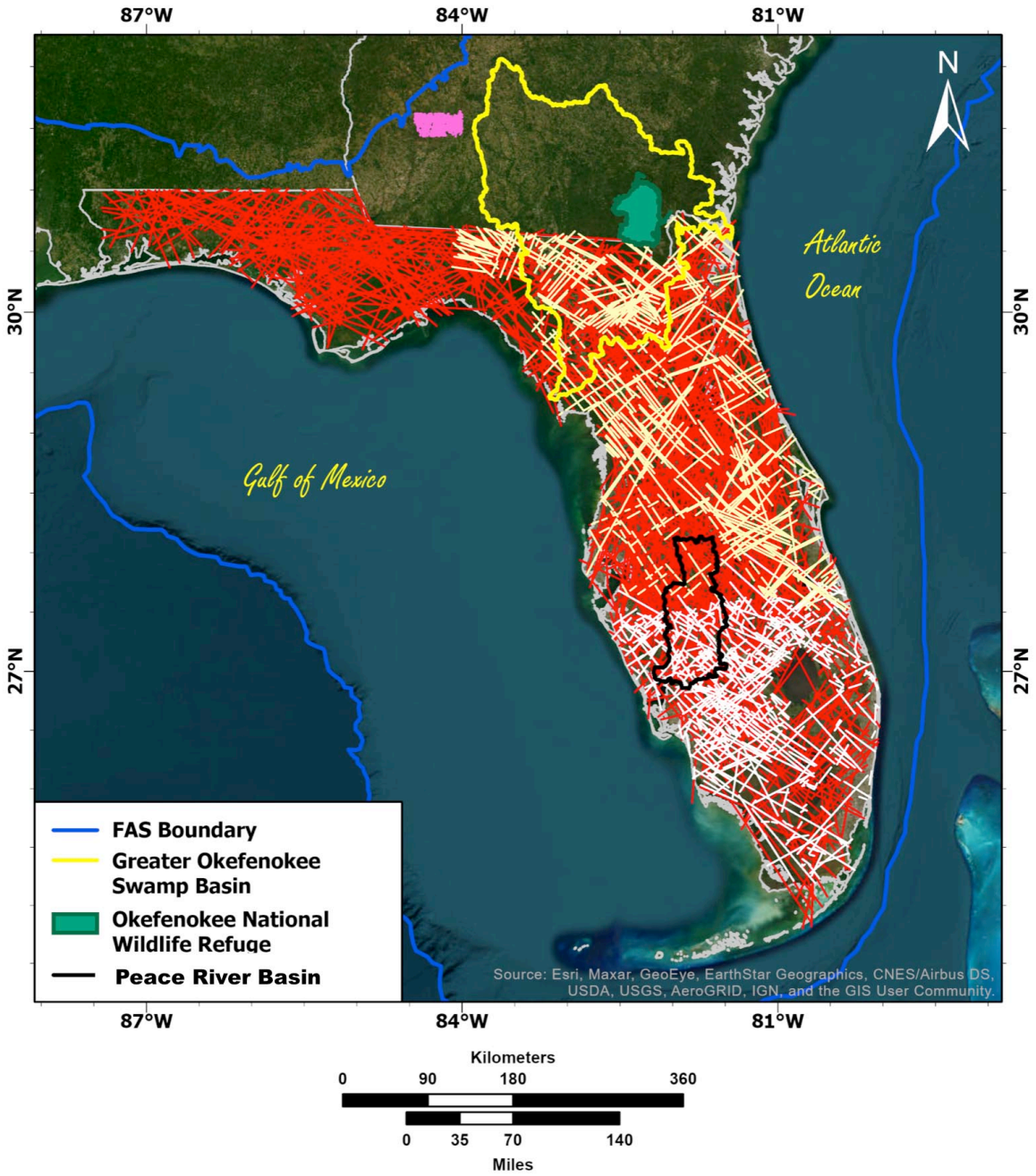

Figure 2. Proximity of the Greater Okefenokee Swamp Basin study area to the Peace River Basin and previously mapped fractures throughout Florida by FDOT 1973 (red diagonal lines); in northeastern Florida by Vernon 1951 (yellow diagonal lines); in southern Florida by USACOE 2004 (white diagonal lines); and in Dougherty County, Georgia (Brook & Allison (1986) pink diagonal lines).

sturgeon (*Acipenser oxyrinchus desotoi*). **Figure 2** also shows the boundaries of the Greater Okefenokee Swamp Basin, in addition to the location of the Okefenokee National Wildlife Refuge (ONWR). The other two species evaluated in this study are the federally endangered aquatic oval pigtoe mussel (*Pleurobema pyriforme*) and the federally threatened aquatic Suwannee moccasinshell (*Medionidus walkeri*).

2. Materials and Methods

2.1. Digital Boundaries, Images, and Other Data Obtained from Agencies and Other Sources

Digital boundaries for the landward extent of the regional Floridan aquifer system in Florida and in parts of Georgia, Alabama, and South Carolina were obtained from Bellino (2011), while the landward extent for that regional aquifer system in Mississippi is consistent with Miller (1991). The submarine boundaries of the regional Floridan aquifer system were digitized at the submerged boundaries of the continental shelf. Boundaries in digital format for the river basins comprising the Greater Okefenokee Swamp Basin were obtained from the United States Geological Survey (USGS) Watershed Boundary Dataset (WBD) at the HUC8 level (USGS, 2018).

The source for **Figure 1** and **Figure 2** was Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. The acquisition and methods for the initial mapped lineaments indicative of fractures in north Florida (Vernon, 1951) and mapped lineaments representing the most extensive fractures throughout the entire State of Florida (FDOT, 1973) were described in Bacchus, Bernardes, Jordan, & Madden (2014), Bernardes, He, Bacchus, Madden, & Jordan (2014), and Lines, Bernardes, He, Zhang, Bacchus, Madden, & Jordan (2012). The extensive networks of fractures in south Florida shown in Figures 3-7 originally were from USACOE (2004), but the vector data in digital format representing those networks of fractures were not available from the USACOE. Therefore, those networks of fractures in analog format were digitized as described in Bacchus, Bernardes, Xu, & Madden (2015a). All three of those fracture datasets, in addition to the previously mapped fractures by Brook & Allison (1986), were included in **Figure 2**. **Figure 3** includes fracture datasets previously mapped by FDOT (1973), Vernon (1951), and the USACOE (2004).

Online searches for Biological Opinions by the USFWS for federally endangered and federally threatened aquatic species issued subsequent to Section 7 Consultations (USFWS, 2020a) were conducted using the Environmental Conservation Online System (ECOS). Similar Biological Opinions for federally endangered and federally threatened marine species issued by the NOAA NMFS from 2017 to the present were searched for using that agency's Environmental Consultation Organizer (ECO) and Biological Opinions issued by that agency prior to 2017 (NOAA NMFS, 2020b; 2016, respectively). The data retrieved from those searches were considered in this Part 2 companion study.

2.2. Literature Reviews

Interdisciplinary literature reviewed for this study included hydrogeological and hydroecological literature, including literature summarized in Bacchus, et al. (2023) related to preferential flow and declines in the regional, karst Floridan aquifer system, particularly in Florida and Georgia and associated with mining.

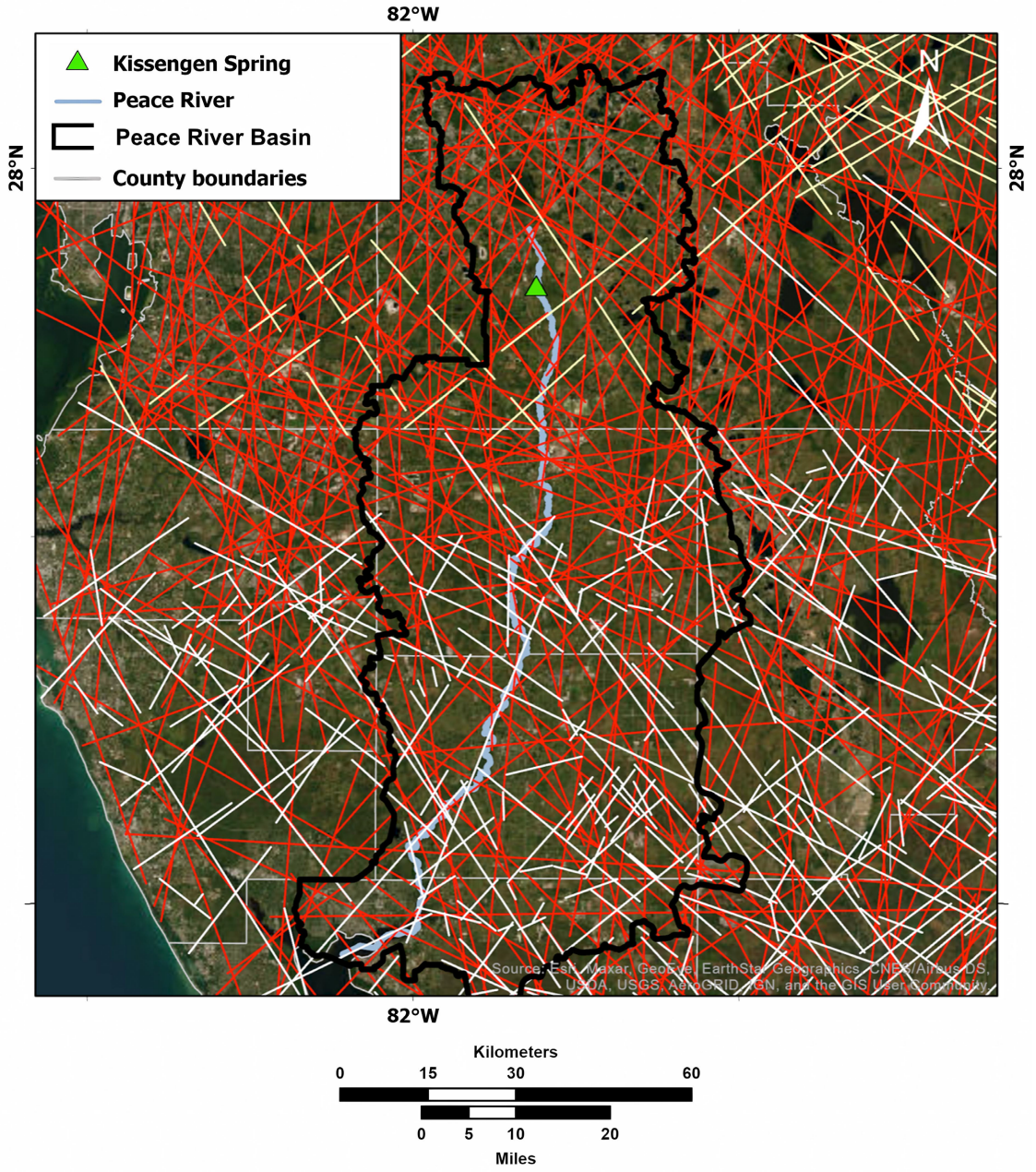

Figure 3. Proximity of Kissengen Spring located in Polk County, Peace River Basin, to previously mapped fractures throughout Florida by FDOT 1973 (red diagonal lines); in northeastern Florida by Vernon 1951 (yellow diagonal lines); and in southern Florida by USACOE 2004 (white diagonal lines).

Literature reviewed also was related to responses of anthropogenic alterations of ground water associated with jeopardizing provisions of the federal CWA and the Antidegradation requirements based on the provisions from the CWA to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." Finally, literature relevant to aspects of the Endangered Species Act (ESA), including published and grey literature from and funded by agencies implementing those laws, in addition to rulings in federal court cases and relevant case law also was reviewed.

3. Results and Discussion

3.1. Adverse Effects of Phosphate Mining on Interconnected Ground Water and Surface Waters in the Peace River Basin

3.1.1. Kissengen Spring and the Peace River Channel Dewatered by Groundwater Withdrawals from Phosphate Mining

This study begins with an example of adverse impacts from phosphate mining in the Peace River Basin, which was the cause of the cessation of groundwater discharge in 1950 from Kissengen Spring, in Polk County, Florida (Rosenau, Faulkner, Hendry, & Hull, 1977). The maximum known discharge for Kissengen Spring, referenced by Rosenau et al. (1977) as "28.2 Mgal/d (43.6 ft^3/s)" occurred in October 1933 (Rosenau et al., 1977). That maximum discharge of "28.2 Mgal/d" (MGD) is equivalent to 106.7 million liters per day. The discharges of ground water from Kissengen Spring flow into that tributary of the Peace River, which then are considered as surface water. **Figure 3** shows the location of Kissengen Spring within the Peace River Basin and all of the previously mapped fractures by FDOT (1973), Vernon (1951), and the USACOE (2004). Following is the full description by Rosenau et al. (1977) of Kissengen Spring in Springs of Florida, regarding the cessation of flow from that spring in 1950 (emphasis added), that presumably also reduced groundwater discharge, including historic vertical discharge of groundwater into surrounding wetlands via fracture flow, extending those unsustainable groundwater withdrawals laterally, in excess of 60 km (37 mi) from the surface footprint of mining sites:

> "Located 4 mi SE of Bartow (fig. 13), **Kissengen Spring was the first known major spring to cease flowing in Florida because of ground-water withdrawal from wells**. **Kissengen Spring ceased flowing in February 1950 after a 40-year flow record of 15 ft^3/s or more**.
> Although declining in average annual flow **when described by Ferguson and others (1947), the spring was an active recreational facility.** Three years later the spring was dry. **Peek (1951) described the cessation of flow to increased pumping of water from the Floridan aquifer, "an example of the capture of natural discharge of ground water by the withdrawal of water from wells."** The accompanying photographs show **the result of such ground water capture**. **The wide expanse of water and attendant bathers shown in the 1947 photograph is in sharp contrast to the hyacinth-patch shown in the 1950 photograph**. The **spring site is no longer (1975) recognizable owing to phosphate mining**. Kissengen Spring discharge measurements have been made by the U.S. Geological Survey (Heath, 1961, p. 18). **The maximum known discharge of 28.2 Mgal/d (43.6 ft^3/s) occurred in October 1933**."

Consequently, the loss of that former groundwater contribution from Kissengen Spring created a comparable permanent reduction of flow downstream in the Peace River and ultimately a permanent reduction of freshwater discharge from the Peace River to the Charlotte Harbor Estuary and Cape Haze Preserve.

That permanent reduction in flow constitutes significant habitat modification and degradation, potentially resulting in "harm" to the critical habitat designated by the USFWS in the Charlotte Harbor Estuary for the federally endangered US Distinct Population Segments of smalltooth sawfish (*Pristis pectinata*). That critical habitat is only one of two areas designated as critical habitat for the US Distinct Population Segments of smalltooth sawfish in the US, becoming effective on October 2, 2009 (USFWS, 2019d). That "harm" could result in unpermitted "take" of the US Distinct Population Segments of smalltooth sawfish, which was listed as federally endangered on April 1, 2003 (USFWS, 2019d). That permanent reduction in historic flow to the Charlotte Harbor Estuary and Cape Haze Preserve also may have caused and continue to cause the death or injury of other associated native aquatic and marine species, including other federally endangered and threatened species. Although the federally endangered US Distinct Population Segments of smalltooth sawfish was not one of the focus species of this study, smalltooth sawfish appears to be another species with an historic range in coastal waters throughout the Southeastern Coastal Plain Ecoregion, currently found only off the coast of Florida. The federally endangered US Distinct Population Segments of smalltooth sawfish apparently relies on shallow estuarine waters to give birth and for the survival of juveniles. Charlotte Harbor is an important nursery area for this species, with juveniles preferring "water that's at least 70˚F and less than 3 feet deep" (USFWS, 2022).

The black and white photograph shown in **Figure 4** illustrates the "wide expanse of water and attendant bathers shown in the 1947 photograph," described by Peek (1951). The three color photographs shown in **Figures 5(a)-(c)**, from May 2002 show the dry, baron, fissured channel of the Peace River near Bartow, from the capture of ground water by the phosphate mining in the Peace River

Figure 4. Historic 1947 photograph showing visitors using the wide expanse of water in Kissengen Spring in Polk County, Florida for recreation (Peek, 1951).

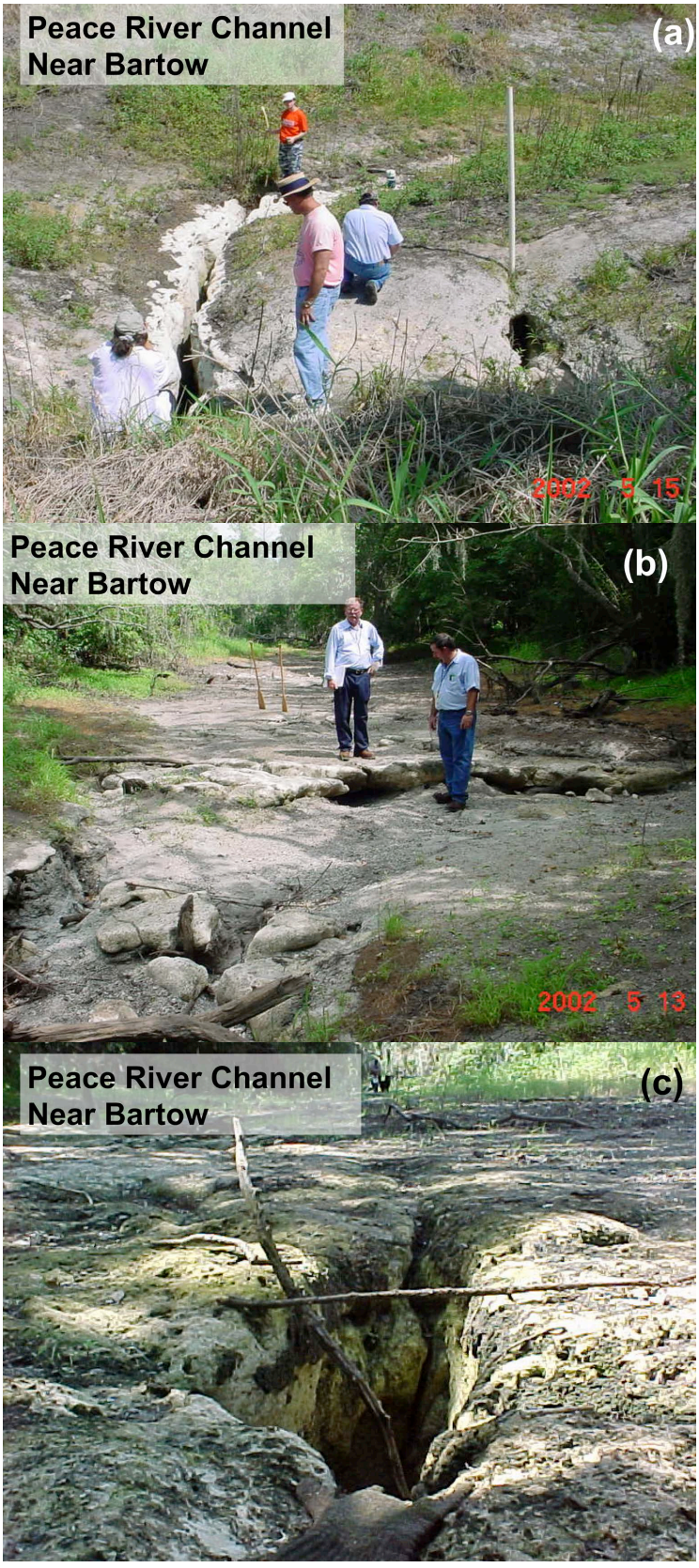

Figure 5. Color photographs (a), (b), and (c), from May 2002, of the dry Peace River channel near Bartow, Florida, from groundwater captured by phosphate mining.

Basin, also known as induced recharge, inter-basin flow and pirating of water. Those photographs illustrate the most severe violations of the CWA antidegradation requirements for the physical, chemical, and biological integrity of the nation's waters, as the entire flow of those surface waters was captured for phosphate mining. Those photographs also illustrate the total destruction of the "fishable, swimmable" standard for surface waters described in the CWA. The irony of the dewatering of that Peace River channel by phosphate mining is the two wooden canoe paddles standing upright in the dewatered channel in the background. Clearly canoeing no longer can occur in that part of the Peace River. Those photographs were included in an undated Power Point presentation by Gregg Jones, Director of Resource Conservation and Development Department for the Southwest Florida Water Management District (SWFWMD), which was provided by Robert Knight, Executive Director of the Florida Springs Institute.

In the late 1990s, the USGS also identified phosphate mining as the primary cause of the reduction in flow for the entire Peace River, during its assessment of the hydraulic connection between ground water and the Peace River, in west-central Florida (Lewelling, Tihansky, & Kindinger, 1998). That assessment also included the dewatered Kissengen Spring. Bacchus, Masour, Madden, Jordan, & Meng (2011) also provide evidence that phosphate mining in the Peace River Basin decreased focused groundwater discharges into the natural terrestrial depressional wetlands, converting these natural wetlands into areas of induced recharge to the underlying Floridan aquifer, degrading and destroying those depressional wetlands considerable distances from the surface footprint of mining. Reductions in flow also increases the concentrations in streams of chemical pollutants, such as those described by Kyla Bennett, Director of New England's Public Employees for Environmental Responsibility (PEER) in a recent interview about her legal representation of Chemists employed with the USEPA who were not being allowed to do their job (Curwood & Bennett, 2022).

3.1.2. Groundwater Withdrawals for Phosphate Mining in the Peace River Basin

The reduced groundwater withdrawals reportedly authorized by the SWFWMD in the integrated Water Use Permit (iWUP) number 11400 (currently modified approximately 36 times) for phosphate mining by The Mosaic Company (Mosaic) in the Peace River Basin is "69.6 MGD" (approximately 263.5 million liters per day) for average daily withdrawals and approximately "87 MGD" (329.3 million liters per day) for peak withdrawals. Those permitted withdrawals also represent approximately 2.5 times and 3.1 times the maximum known discharges for Kissengen Spring, respectively. Those allegedly reduced permitted average and peak groundwater withdrawals for phosphate mining for Mosaic in the Peace River Basin also represent approximately 8.7 times and 10.9 times, respectively, the reduced, 40-year flow record for Kissengen Spring. The expiration date for the recent modifications of that iWUP permit (e.g., since the 11400.026 modification issued on December 13, 2013) is October 20, 2032, and the use of

that groundwater extracted by Mosaic, from the regional Floridan aquifer system, a public resource, occurs at no cost to Mosaic.

The 263.5 million liters per day (69.6 MGD) for average daily withdrawals authorized by the iWUP suggests that is all of the water used by Mosaic related to that phosphate mining. That is not the case. At least since the 26th "letter modification" for permit 11400.026 from SWFWMD's Bartow office for operations in Lithia (issued in 2013 and with an expiration date of October 20, 2032), that amount only covered that water use in the "Four Corners" area (i.e., Hardee, Hillsborough, Manatee, and Polk Counties). For example, it did not include any of the water uses by Mosaic that: a) were reported as for "agriculture" use; or b) were reported as for "recreation" use; or c) for "Streamsong" (a golf course "resort" that Mosaic constructed on mined property in Bowling Green, Florida, with all of the open mine pits still not "reclaimed" to former land elevations); or d) for the Bartow Phosphate Complex (reported as "Average Gallons Per Day (GPD) 1,665,000" – "Peak GPD 2,515,500"); or e) for the CF Industries mining facility acquired by Mosaic (reported as "Average GPD 4,240,200" and "Peak GPD 7,721,600"); or f) for Mosaic's Riverview Plant, which withdraws water from Lithia Major Spring and Buckhorn Main Spring (reported as "Average GPD 5,985,000" and "Peak GPD 6,300,000") for plant operations and will violate the SWFWMD's proposed "minimum flows." The Lithia area now "augments" the flow of the Alafia River to replace water used by that Mosaic Riverview Phosphate Plant ("Average GPD 4,250,000" and "Peak GPD 6,000,000"). Ironically, the additional groundwater withdrawals for "augmentation" of surface waters dewatered by unsustainable groundwater withdrawals for phosphate mining not only completely alter the physical, chemical, and biological integrity of the dewatered surface waters that are being "augmented" with ground water, in violation of the CWA, but exacerbate the dewatering of all of the additional depressional wetlands and other surface waters in the vicinity by increasing the flow between all of the layers of the Floridan aquifer system, including the surficial aquifers.

Comparison of the estimated predevelopment potentiometric surface of the Tertiary Floridan aquifer system (Johnston, Krause, Meyer, Ryder, Tibbals, & Hunn, 1980) to the declines in the potentiometric surface, based on groundwater data available in 1980 for that regional karst aquifer system (Johnston, Healy, & Hayes, 1981), reveals the magnitude of those declines throughout the extent of that aquifer system, including in the Peace River Basin at that point in time. For example, the potentiometric surface levels at the "Four Corners" area declined from approximately 21 meters (70 ft) to 11 meters (35 ft) during that period (a total decline of 10 - 11 m (35 ft). Declines at Bartow were more severe, from approximately 34 meters (110 ft) to 18 meters (60 ft), during that same period of time (a total decline of 15 - 16 m (50 ft)). The dewatered Kissengen Spring, located approximately 6 km (4 mi) southeast of Bartow, experienced approximately the same declines during that period as those shown for Bartow. Although the mapped data for Johnston et al. (1980; 1981) are shown in Figure 4a

and Figure 4b of Bacchus, Bernardes, & Madden (2023), those figures do not include the area of the Peace River Basin. It is important to note that the SWFWMD and none of the other regulatory agencies stopped issuing new permits and renewing existing permits for groundwater withdrawals in 1980 or 1981, when the results of Johnston et al. (1980; 1981) were released. Although our study did not attempt to determine the exact magnitude of increase in those permitted groundwater withdrawals within the Peace River Basin or the Greater Okefenokee Swamp Basin since 1980, the increases have been extensive.

Bacchus et al. (2023) also evaluated the July 2003 SWFWMD report that addressed long-term variation in rainfall and its effect on Peace River flow in west central Florida (Basso & Schultz, 2003). Two color photographs were included in that report that did not appear to provide any information regarding dates or locations. The upper photograph depicted extensive flooding that was similar to the flooding associated with the Santa Fe River, attributed to excessive mining-related wastewater discharges upstream by Chemours/DuPont (Bernardes, Manglass, Bacchus, & Madden, 2019). The lower photograph exhibited a dry streambed, clearly neither "fishable" nor "swimmable" and mature cypress trees in a severe state of premature decline, with the remaining canopies covered in Spanish moss and the bases of those trees exhibiting significant subsidence of historic organic sediments, signs of chronic water stress from unsustainable groundwater withdrawals. The Introduction of that report by Basso & Schultz (2003) noted that, "Previous studies attribute this flow decline primarily to anthropogenic factors, mainly loss of baseflow contribution due to groundwater withdrawals or stormwater capture resulting from land-use alterations (Hammett, 1990; Lewelling et al., 1998)." Despite that acknowledgement, the Summary of that report concluded their rainfall analysis revealed that only the Lakeland and Clermont stations "did not reflect drier conditions during the most recent 30-year period." The similar analysis of precipitation for three 30-year periods (1928-1957, 1958-1987, 1988-2017), prior to and after the cessation of flow from Kissengen Spring, conducted by Bacchus et al. (2023), suggested that declines in rainfall were not a factor in the cessation of flow from Kissengen Spring.

3.2. Antidegradation Requirements and Protecting Existing Uses Required by the Federal Clean Water Act Essential for Compliance with the Endangered Species Act

Chapter 4 of the USEPA's Water Quality Standards Handbook states on page 1, "[T]he Clean Water Act (CWA) provisions and the EPA regulations described in this document contain legally binding requirements" (USEPA, 2012). Page 2 of that document further clarifies that, "[A]ntidegradation implementation is an integral component of a comprehensive approach to protecting and enhancing water quality." While page 5 of that document confirms that, "[T]he State antidegradation policy and implementation procedures must be consistent with the components detailed in 40 CFR 131.12." The following two excerpts from Chap-

ter 4 of the Water Quality Standards Handbook clearly state the antidegradation requirements of the CWA:

> "Antidegradation was originally based on the spirit, intent, and goals of the Act, especially the clause"...**restore and maintain the chemical, physical and biological integrity of the Nation's waters**" (101(a)) and the provision of 303(a) that made water quality standards under prior law the "starting point" for CWA water quality requirements. Antidegradation was explicitly incorporated in the CWA..." (page 3, emphasis added)
>
> "4.2 Summary of the Antidegradation Policy
>
> Section 131.12(a)(l), or "Tier 1," protecting "existing uses," provides the absolute floor of water quality in all waters of the United States. This paragraph applies a minimum level of protection to all waters. Section 131.12(a)(2), or "Tier 2," applies to waters whose quality exceeds that necessary to protect the section 101(a)(2) goals of the Act. **In this case, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing uses** and may be lowered even to those levels only after following all the provisions described in section 131.12(a)(2)." (page 3, emphasis added)
>
> "4.4 Protection of Existing Uses-40 CFR 131.12(a)(1)
>
> This section requires the protection of existing uses and the level of water quality to protect those uses. An "existing use" can be established by demonstrating that:
>
> *fishing, swimming, or other uses have actually occurred since November 28, 1975; or
>
> *that the water quality is suitable to allow the use to be attained—unless there are physical problems, such as substrate or flow, that prevent the use from being attained.
>
> An example of the latter is an area where shellfish are propagating and surviving in a biologically suitable habitat and are available and suitable for harvesting although, to date, no one has attempted to harvest them. Such facts clearly establish that shellfish harvesting is an "existing" use, not one dependent on improvements in water quality. To argue otherwise would be to say that the only time an aquatic protection use "exists" is if someone succeeds in catching fish.
>
> Full protection of the existing use requires protection of the entire water body with a few limited exceptions such as certain physical modifications that may so alter a water body that species composition cannot be maintained (see section 4.4.3, this Handbook), and mixing zones (see section 4.4.4, this Handbook). For example, an activity that lowers water quality such that a buffer zone must be established within a previous shellfish harvesting area is inconsistent with the antidegradation policy." (page 6)

Formal public comments in the form of a 27-page letter prepared and signed by 85 scientists with broad knowledge and expertise in the physical structure,

chemistry, and biology of stream ecosystems in more than 40 states was submitted to the USEPA on April 10, 2003 (Aquatic Scientists, 2003). Those comments were submitted in response to the "Advanced Notice of Proposed Rulemaking (ANPRM) on the Clean Water Act Regulatory Definition of "Waters of the United States" (Docket ID No. OW-2002-0050). Those scientists included "members of the National Academy of Sciences and its scientific Boards, individuals who have been or who are President of national scientific organizations, and leading researchers on the ecology, water quality, and biota of streams and rivers." That letter included 86 citations of peer-reviewed, scientific publications supporting the conclusion that "ecological processes in large rivers reflect what is occurring in their headwaters as well as in adjacent floodplains, tributaries, and even downstream ecosystems" (Aquatic Scientists, 2003). This statement particularly is relevant to mining activities being conducted throughout the regional extent of the Floridan aquifer system and Southeastern Coastal Plain Ecoregion, which occur extensively in headwater wetlands, tributaries, and adjacent floodplains. Colvin, Sullivan, Shirey, Colvin, Winemiller, Hughes, Fausch, Infante, Olden, Bestgen, Denehy, & Eby (2019) and Peterson, Wolheim, Mulholland, Webster, Meyer, Tank, Marti, Bowden, Valett, Hershey, McDowell, Dodds, Hamilton, Gregory, & Morral (2001) also addressed similar concerns as those by Aquatic Scientists (2003) regarding the critical role of headwater streams for sustaining fish, fisheries, ecosystem services, and nitrogen cycles for all downstream waters. The following excerpts from Aquatic Scientists (2003) include the five points identified and discussed in that letter as the scientific basis for their statement that "removing ephemeral, intermittent and other small headwater streams from Clean Water Act jurisdiction will adversely impact our Nation's waters" (emphasis in original):

> "We focus our comments on ephemeral, intermittent, and other headwater tributaries. These headwater streams provide essential goods and services; their elimination from Clean Water Act jurisdiction would have an adverse impact on downstream ecosystems. Rivers are networks, and their downstream navigable portions are inextricably linked to small headwaters just as fine roots are an essential part of the root structure of a tree or our own circulatory system is dependent on the function of healthy capillaries. The small ephemeral stream is not isolated from the mighty river." (page 1)
>
> "Scientific research on rivers and streams over the past several decades has been founded on the concept of the longitudinal connectivity of river networks, i.e. that ecological processes in large rivers reflect what is occurring in their headwaters as well as in adjacent floodplains, tributaries, and even downstream ecosystems (e.g. Hynes, 1975; Vannote et al., 1980; Minshall et al., 1985; Junk et al., 1989; Ward, 1989; Pringle, 1997; Fausch et al., 2002). **Considering navigable rivers to be isolated from their ephemeral and intermittent headwaters (as implied in the ANPRM) stands in direct contradiction to long standing and robust scientific evidence."** (page 1)

"In the following five points, we discuss the scientific basis for our statement that removing ephemeral, intermittent and other small headwater streams from Clean Water Act jurisdiction will adversely impact our Nation's waters and make it less likely that we can achieve the goal of the Clean Water Act, which is "to restore and maintain the chemical, physical and biological integrity of the Nation's waters." (pages 1 and 2)

"1. A large fraction of the channels in a stream network do not flow year round. Because of limitations of current databases, the total length of small streams is seriously underestimated in the U.S. Therefore the proposed rulemaking will impact a much greater extent of critical aquatic habitat than currently estimated." (page 2)

"2. Human activities in the watershed have resulted in significant loss of small streams." (page 3)

"3. Ephemeral, intermittent and small headwater streams contribute to the physical integrity of the river network." (page 4)

"4. Ephemeral, intermittent and headwater tributaries are essential to the maintenance of the chemical integrity of navigable rivers." (page 5)

"5. Ephemeral, intermittent and headwater tributaries contribute to the biotic integrity of river networks by supplying food resources to downstream and riparian ecosystems and providing thermal refuges, spawning areas, nursery areas, and critical habitats for unique and economically valuable species."

"a. Small streams supply food resources to riparian and downstream ecosystems." (page 6)

"b. Small streams provide a thermal refuge at critical life history stages or during critical times of the year." (page 6)

"c. Small streams serve as vital spawning habitats." (page 7)

"d. Small streams serve as nursery habitat for juvenile fishes." (page 7)

"e. Small streams provide critical habitat for unique and threatened species." (page 7)

It appears that the 2003 comment letter from those 85 scientists was convincing, considering that neither Chapter 4 of the Water Quality Standards Handbook (USEPA, 2012), nor the 2018 Code of Federal Register (CFR) § 230.3 Definitions use the adjectives "**ephemeral," "intermittent," or "headwater"** to describe tributaries. Additionally, CFR § 230.3(o)(1) states that "All tributaries, as defined in paragraph (o)(3)(iii) of this section, of waters identified in paragraphs (o)(1)(i) through (iii) of this section" are "waters of the United States." In this 2018 set of definitions, the adjectives "**ephemeral"** and **"intermittent"** are applied only to ditches, as they should be, which are not "waters of the United States" in CFR § 230.3(o)(2)(iii)(A) and (B), which state, respectively (CFR, 2018):

"(A) Ditches with ephemeral flow that are not a relocated tributary or excavated in a tributary.

(B) Ditches with intermittent flow that are not a relocated tributary, exca-

vated in a tributary, or drain wetlands."

Compliance with the antidegradation component of the CWA is essential for compliance with the ESA, particularly for marine and aquatic species. The Supreme Court ruling in Babbitt, Secretary of the Interior et al. v. Sweet Home Chapter of Communities for a Great Oregon et al. (1995) confirmed that "take" and "harm" include "significant habitat modification or degradation where it actually kills or injures wildlife." Mining-related activities involving groundwater withdrawals and impoundments described in Bacchus, et al. (2023), including those being authorized as NWP-44 mining activities, result in "harm" from "significant habitat modification or degradation where it actually kills or injures wildlife." For mining-related activities involving groundwater withdrawals and impoundments described in that paper, the "harm" results in irreversible "significant habitat modification or degradation where it actually kills or injures wildlife" extends many kilometers (km) from the surface boundaries of those mining activities, due to preferential flow through fractures and other karst conduits. **Figure 2** illustrates the density and extent of previously mapped fractures throughout Florida and in a single county in Georgia, within the northern extent of the regional Floridan aquifer system. Also included in **Figure 2** are the boundaries of the Peace River Basin, where the previous AEIS was conducted for phosphate mining (USACOE, 2011; 2013). It also is important to note that the standard claims for "mitigation" of those irreversible adverse mining impacts in the Southeastern Coastal Plain Ecoregion are impossible to implement because of all of those karst conduits, as described in Bernardes et al. (2014).

3.3. Relevance of Recent Attempts to Eliminate Federal Regulation of Endangered Species and Wetlands under the Clean Water Act in the Southeastern Coastal Plain Ecoregion

3.3.1. The USACOE and USEPA 2020 Revised Clean Water Act Rule

On April 21, 2020, the USACOE and USEPA published what was referenced as the "Navigable Waters Protection Rule" (revised CWA rule), which became effective on June 22, 2020 (USACOE & USEPA, 2020). The US Congress passed the CWA in 1972 to regulate the quality of surface waters, including wetlands, to reduce flood damage from the alarming rate of filling and other destruction of wetlands, and to provide invaluable wildlife habitat. At that time most waters in the US were so polluted they were unsafe for fishing or swimming, and fish and other wildlife in those contaminated waters were dying en masse. The single objective for the CWA, as stated in 33 USC § 1251(a), was "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The CWA is one of the most important environmental laws in the country and regulates the discharge of pollutants into "navigable waters," which the CWA defines broadly in 33 USC § 1362(7) as "the waters of the United States." Numerous legal challenges to the revised CWA rule have been filed in federal courts, including the complaint filed on April 29, 2020, by the Plaintiffs, Conservation Law Foundation, Connecticut River Conservancy, Clean Wisconsin, Massachusetts Audubon So-

ciety, Inc., Merrimack River Watershed Council, Natural Resources Defense Council, Inc., New Mexico Wilderness Alliance, & Prairie Rivers Network, Plaintiffs, v. USEPA, Wheeler, A.R., Administrator of the USEPA, USACOE, & James, R.D., Assistant Secretary of the Army (Civil Works), Defendants (Conservation Law Foundation et al. v. USEPA & USACOE, 2020). That legal complaint alleged that the revised CWA rule "purports to define the phrase 'waters of the United States,' and thus, the scope of the Clean Water Act's reach," adopting an "unreasonably narrow interpretation of the Clean Water Act" and violating the CWA. **Appendix B** includes detailed legal information regarding: a) the background of the CWA; b) concerns about protection of aquatic ecosystems during Congressional creation of the CWA; c) the history of connectivity of "waters of the United States" regulated under the CWA; and d) components of the original CWA rule (Conservation Law Foundation et al. v. USEPA and USACOE, 2020).

This promulgated rule also is known as the "WOTUS Rule," because it re-defines "the waters of the United States." The Conservation Law Foundation et al. v. USEPA and USACOE (2020) legal complaint provided excerpts from the recently revised CWA rule defining "waters of the United States" (paragraph 79), including "Tributaries" (paragraphs 80 through 85), and "Adjacent Wetlands" (paragraphs 86 through 91). Paragraphs 92 through 127 of that complaint provided legal justification for why that revised CWA rule is arbitrary and capricious. Categories of alleged arbitrary and capricious aspects of that revised CWA rule described in that complaint included: a) the failure of the USEPA and USACOE to consider the impacts of the recently promulgated rule on the nation's water quality (paragraphs 92 through 97); b) the agencies' findings in that rule contradict their prior findings without justification (paragraphs 98 through 102); c) the agencies' claim that the rule is "informed" by science runs counter to the evidence (paragraphs 103 through 111); d) the agencies do not reasonably explain their decision to exclude certain waters from the definition of "waters of the United States" (paragraphs 112 through 116); e) the agencies claim that the rule promotes "clarity," but the newly promulgated rule is riddled with unclear terms that will create confusion, unpredictability, and uncertainty (paragraphs 117 through 127).

The revised CWA rule violates Section 7(a)(2) of the ESA by taking an action that "may affect" ESA-listed species without having first engaged in mandatory consultation under the ESA (16 USC § 1536(a)(2)). A "consultation" under the ESA requires one of more written documents from the relevant federal ESA agency (e.g. USFWS). Any implementation of that rule prior to the conclusion of consultation activities constitutes a violation of Section 7(d) of the Act, which prohibits the "irretrievable commitment of resources" pending the completion of consultation (16 USC § 1536(d)). Therefore, the USEPA and ACOE are required to consult under the ESA prior to taking any action those agencies fund, authorize, or carry out to "insure" [sic] that the action "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of designated critical habitat (16

USC § 1536(a)(2)). By finalizing the revised CWA rule before complying with the requirements of the ESA, the federal agencies failed to ensure its actions will not jeopardize the survival and recovery of federally listed species. This undermines the purpose of the ESA of providing "a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" (16 USC § 1531(b)). This requirement also has been confirmed by the US Courts for the Ninth Circuit, located in the US west coast, in the Thomas v. Peterson (1985) determination, "[I]f anything, the strict substantive provisions of the ESA justify more stringent enforcement of its procedural requirements, because the procedural requirements are designed to ensure compliance with the substantive provisions." Although this example does not involve mining activities, the National Environmental Policy Act (NEPA, Public Law 91-190) and ESA apply to all activities authorized by federal agencies, despite the fact that the adverse environmental impacts described in this example from the US Forest Service seem insignificant when compared to the adverse impacts related to mining in the Greater Okefenokee Swamp Basin referenced in Bacchus et al. (2023) and in this Part 2 case study. The following quoted excerpts from that Appeals Court ruling, confirming that the US Forest Service had failed to comply with the requirements of the NEPA, are tantamount to each of the individual mining projects within the Greater Okefenokee Swamp Basin referenced in the Part 1 (Bacchus et al., 2023) and in this Part 2 case study that proceeded without even a single Environmental Impact Study (EIS), much less a regional AEIS and failed to consider all of the adverse impacts to all of the federally endangered and federally threatened species in the Southeastern Coastal Plain Ecoregion:

> "We conclude that: (1) The National Environmental Policy Act (NEPA) requires the Forest Service to prepare an Environmental Impact Statement (EIS) that analyzes the combined environmental impacts of the road and the timber sales that the road is designed to facilitate... (3) The Endangered *756 Species Act (ESA) requires the Forest Service to prepare a biological assessment to determine whether the road and the timber sales that the road is designed to facilitate are likely to affect the endangered Rocky Mountain Gray Wolf, and construction of the road should be enjoined pending compliance with the ESA."
>
> "Section 102(2)(C) of NEPA requires an EIS for "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C) (1982). While it is true that administrative agencies must be given considerable discretion in defining the scope of environmental impact statements, see Kleppe v. Sierra Club, 427 U.S. 390, 412-415, 96 S.Ct. 2718, 2731-2733, 49 L.Ed.2d 576 (1976), there are situations in which an agency is required to consider several related actions in a single EIS, see id. at 409-410, 96 S.Ct. at 2729-2730. Not to require this would permit dividing a project into multiple "actions," each of which individually has an insignifi-

cant environmental impact, but which collectively have a substantial impact. See Alpine Lakes Protection Society v. Schlapfer, 518 F.2d 1089, 1090 (9th Cir.1975).

Since the Supreme Court decided the Kleppe case, the Council on Environmental Quality (CEQ) has issued regulations that define the circumstances under which multiple related actions must be covered by a single EIS. The regulations are made binding on federal administrative agencies by Executive Order. See Exec. Order No. 11991, 3 C.F.R., 1977 Comp. 123 (1978); Andrus v. Sierra Club, 442 U.S. 347, 357-58, 99 S.Ct. 2335, 2340-41, 60 L.Ed.2d 943 (1979). The CEQ regulations and this court's precedents both require the Forest Service to prepare an EIS analyzing the combined environmental impacts of the road and the timber sales."

"A. CEQ Regulations

1. Connected actions The CEQ regulations require "connected actions" to be considered together in a single EIS. See 40 C.F.R. § 1508.25(a)(1) (1984). "Connected actions" are defined, in a somewhat redundant fashion, as actions that

'(i) Automatically trigger other actions which may require environmental impact statements.

(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.

(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.' Id."

"We conclude, therefore, that the road construction and the contemplated timber sales are inextricably intertwined, and that they are "connected actions" within the meaning of the CEQ regulations."

"2. Cumulative Actions

The CEQ regulations also require that "cumulative actions" be considered together in a single EIS. 40 C.F.R. § 1508.25(a)(2). "Cumulative actions" are defined as actions "which when viewed with other proposed actions have cumulatively significant impacts." Id. The record in this case contains considerable evidence to suggest that the road and the timber sales will have cumulatively significant impacts. The U.S. Fish & Wildlife Service, the Environmental Protection Agency, and the Idaho Department of Fish & Game have asserted that the road and the timber sales will have significant cumulative effects that should be considered in an EIS. The primary cumulative effects, according to these agencies, are the deposit of sediments in the Salmon River to the detriment of that river's population of salmon and steelhead trout, see E.R. 41-44, and the destruction of critical habitat for the endangered Rocky Mountain Gray Wolf, see id. at 48-50. These agencies have criticized the Forest Service for not producing an EIS that considers the cumulative impacts of the Jersey Jack road and the timber sales. See id. at 57-58, 60, 62-64. For example, the Fish & Wildlife Service has written, "Separate documentation of related and cumulative potential impacts may

be leading to aquatic habitat degradation unaccounted for in individual EA's (i.e., undocumented cumulative effects)... Lack of an overall effort to document cumulative impacts could be having present and future detrimental effects on wolf recovery potential." Id. at 57-58. These comments are sufficient to raise "substantial questions" as to whether the road and the timber sales will have significant cumulative environmental effects. Therefore, on this basis also, the Forest Service is required to prepare an EIS analyzing such effects. See Foundation for North American Wild Sheep v. United States Dept. of Agriculture, 681 F.2d 1172, 1178 (9th Cir.1982); City & County of San Francisco v. United States, 615 F.2d 498, 500 (9th Cir.1980)."

"C. Timing of the EIS

The Forest Service argues that the cumulative environmental effects of the road and the timber sales will be adequately analyzed and considered in the EA's and/or EIS's that it will prepare on the individual timber sales. The EA or EIS on each action, it contends, will document the cumulative impacts of that action and all previous actions. [3]

We believe that consideration of cumulative impacts after the road has already been approved is insufficient to fulfill the mandate of NEPA. A central purpose of an EIS is to force the consideration of environmental impacts in the decisionmaking process. See, e.g., Columbia Basin Land Protection Ass'n v. Schlesinger, 643 F.2d 585 (9th Cir.1981); City of Davis v. Coleman, 521 F.2d 661 (9th Cir.1975); Lathan v. Brinegar, 506 F.2d 677, 693 (9th Cir.1974) (en banc); Calvert Cliffs' Coordinating Committee v. AEC, 449 F.2d 1109, 1113-1114 (D.C.Cir.1971). That purpose requires that the NEPA process be integrated with agency planning "at the earliest possible time," 40 C.F.R. § 1501.2, and the purpose cannot be fully served if consideration of the cumulative effects of successive, interdependent steps is delayed until the first step has already been taken.

The location, the timing, or other aspects of the timber sales, or even the decision whether to sell any timber at all affects the location, routing, construction techniques, and other aspects of the road, or even the need for its construction. But the consideration of cumulative impacts will serve little purpose if the road has already been built. Building the road swings the balance decidedly in favor of timber sales even if such sales would have been disfavored had road and sales been considered together before the road was built. Only by selling timber can the bulk of the expense of building the road be recovered. Not to sell timber after building the road constitutes the "irrational" result that Trout Unlimited's standard is intended to avoid. Therefore, the cumulative environmental impacts of the road and the timber sales must be assessed before the road is approved."

The purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved [and] a program for the conservation of such endangered species and threatened

species..." (16 USC §§ 1531-1544; 16 USC § 1531(b)). "Conservation" is defined in the ESA as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 USC § 1532(3)). Section 2(c) of the ESA states that "all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this [Act]" (16 USC § 1531(c)(1)).

Under Section 7 of the ESA each federal agency is required to engage in consultation with the USFWS and/or the National Marine Fisheries Service (NMFS) to "insure [sic] that any action authorized, funded, or carried out by such agency...is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species...determined...to be critical" (16 USC § 1536(a)(2)). After completion of the consultation, the USFWS and/or NMFS is required to issue a Biological Opinion (BO) determining if the agency action is likely to jeopardize any affected species. If the BO determines that the agency action is likely to jeopardize any federally listed species, the BO must specify "Reasonable and Prudent Alternatives" that will avoid jeopardy before the agency can proceed with the action (e.g., implementation of the revised CWA rule). During the course of consultation, the USFWS and/or NMFS also may suggest modifications to the action (i.e., "Reasonable and Prudent Measures") to "avoid the likelihood of adverse effects" to the listed species even if those modifications are not necessary to avoid jeopardizing the recovery and survival of the listed species (29 50 CFR § 402.13).

Section 7(d) of the ESA also specifies that after federal agencies initiate consultation for a proposed action under the ESA, the agencies "shall not make any irreversible or irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate subsection (a)(2) of this section" (16 USC § 1536(d)). The purpose of Section 7(d) is to maintain the environmental status quo until the consultation is completed. The prohibitions under Section 7(d) remain in effect throughout the consultation period, until the federal agency has satisfied its obligations under Section 7(a)(2) that the agency action will not result in jeopardy to the species or adverse modification of its critical habitat. The courts have addressed this ESA requirement in Natural Resources Defense Council v. Houston (1998) and Sierra Club v. Marsh (1987). Additionally, Section 7(a)(1) of the ESA requires that all federal agencies "shall in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of [listed] species" (16 USC § 1536(a)(1)). In conclusion, the ESA requires all federal agencies to conserve threatened and endangered species. The Appeal's court ruling in favor of the Sierra Club in Sierra Club v. Marsh (1987), reversing the district court's ruling and granting an in-

junction, contained the following requirements of federal law for: a) what constitutes both direct and indirect effects of "an action on the species or critical habitat," that will be added to the environmental baseline, b) what past and present impacts are included in the environmental baseline, and c) what cumulative effects are (emphasis added):

> "[15] '***Effects of the action***' refers to the **direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or inter-dependent with that action, that will be added to the environmental baseline. 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 section 7 consultation**, and **the impact of State or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration**.
> 50 C.F.R. § 402.02.
> [16] '***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 C.F.R. § 402.02."

There was no evidence that the USACOE and/or USEPA engaged in a consultation with the USFWS and/or NMFS or that the USFWS and/or NMFS issued a Biological Opinion regarding if or how the revised CWA rule would jeopardize federally listed species prior to the publication date or the effective date of the revised CWA rule. Additionally, the USACOE appears to have implemented the provisions of the revised CWA rule in the Florida portion of the Greater Okefenokee Swamp Basin even before the revised CWA rule was published or became effective and, also, without an ESA Section 7 consultation. This occurred by the USACOE signing a seven-page "Coordination Agreement" with the FDEP. That agreement allowed that state agency to determine that mining activities in wetlands within the Greater Okefenokee Swamp Basin in Florida that resulted in significant and irreversible dewatering of those wetlands and associated, unmined wetlands, that should have required "Individual Permits" from the USACOE and Biological Opinions, apparently were determined by FDEP to require only "General Permits" from FDEP.

Searches for Biological Opinions conducted by the USFWS and/or the NOAA NMFS, to consider potential adverse impacts from the existing and proposed mining in the Greater Okefenokee Swamp Basin on the marine and aquatic spe-

cies addressed in our study, resulted in no Biological Opinions. That suggests those existing and proposed mining activities included no federal oversight from those agencies for the three federally endangered species and the two federally threatened species considered in our study, in addition to the critical habitat for those species. The "Department of the Army Permit State Programmatic General Permit (SPGP V) State of Florida," signed by Jason A. Kirk, P.E., USACOE Jacksonville District Engineer, on July 26, 2016 (USACOE, 2016), may have played a role in the absence of those Biological Opinions, resulting in an outcome tantamount to enactment of the revised CWA rule several years prior to the publication of that revised rule on April 21, 2020. As an example, page 78 of the 165-page agreement included a map of the critical habitat for the oval pigtoe mussel on the Santa Fe River and New River, both of which incurred significant adverse impacts from discharges of mining wastewater described by Bernardes et al. (2019). A map of the critical habitat for the Gulf sturgeon also is included on page 85 of that agreement. Map 7.1, on page 101 of that agreement shows an enlargement of a section of the Suwannee River critical habitat for the Gulf sturgeon that is located south of White Springs, where phosphate mining near that location already has dewatered the spring that town in Hamilton County, Florida was named after. A 7-page interagency coordination agreement between the USACOE Jacksonville District and the FDEP for the SPGP V was signed by John A. Coates, P.E. for FDEP and the USACOE on July 25, 2016 and July 26, 2016, respectively (USACOE, 2016). **Figure 6** shows the proximity of White Springs, in the greater Okefenokee Swamp basin, to the boundaries of the Okefenokee Swamp/ONWR (outlined in green).

On June 8, 2021, the USEPA and the USACOE issued a 5-p. "MEMORANDUM FOR THE RECORD," the subject of which was, "Review of U.S. Army Corps of Engineers ORM2 Permit and Jurisdictional Determination Data to Assess Effects of the Navigable Waters Protection Rule." That document referenced the Presidential Executive Order signed on April 20, 2021 (EO 13990) declaring the Administration's policy "to listen to the science..." Based on that policy, "agency staff reviewed available data to assess the potential effects of the [2020 WOTUS] rule, informed by nearly a full year of implementation," and "identified numerous clear and consistent indicators of a substantial reduction in waters covered under the NWPR compared to previous rules and practice."

On August 30, 2021, an 11-page Order was issued by Judge Rosemary Marquez in the US District Court for the District of Arizona (2021) granting the Defendants' Motion for Voluntary Remand of that 2020 "WOTUS Rule." That Order also stated, "the Navigable Waters Protection Rule is vacated and remanded for reconsideration to the United States Environmental Protection Agency and the United States Army Corps of Engineers." [emphasis in original] That Order was not appealed by the mining company involved in that case, however, an unrelated WOTUS case in Idaho was appealed to the US Supreme Court. That Sackett v. USEPA case involves homeowners in Idaho who the USEPA claimed discharged fill material in Priest Lake wetlands without obtaining a permit from

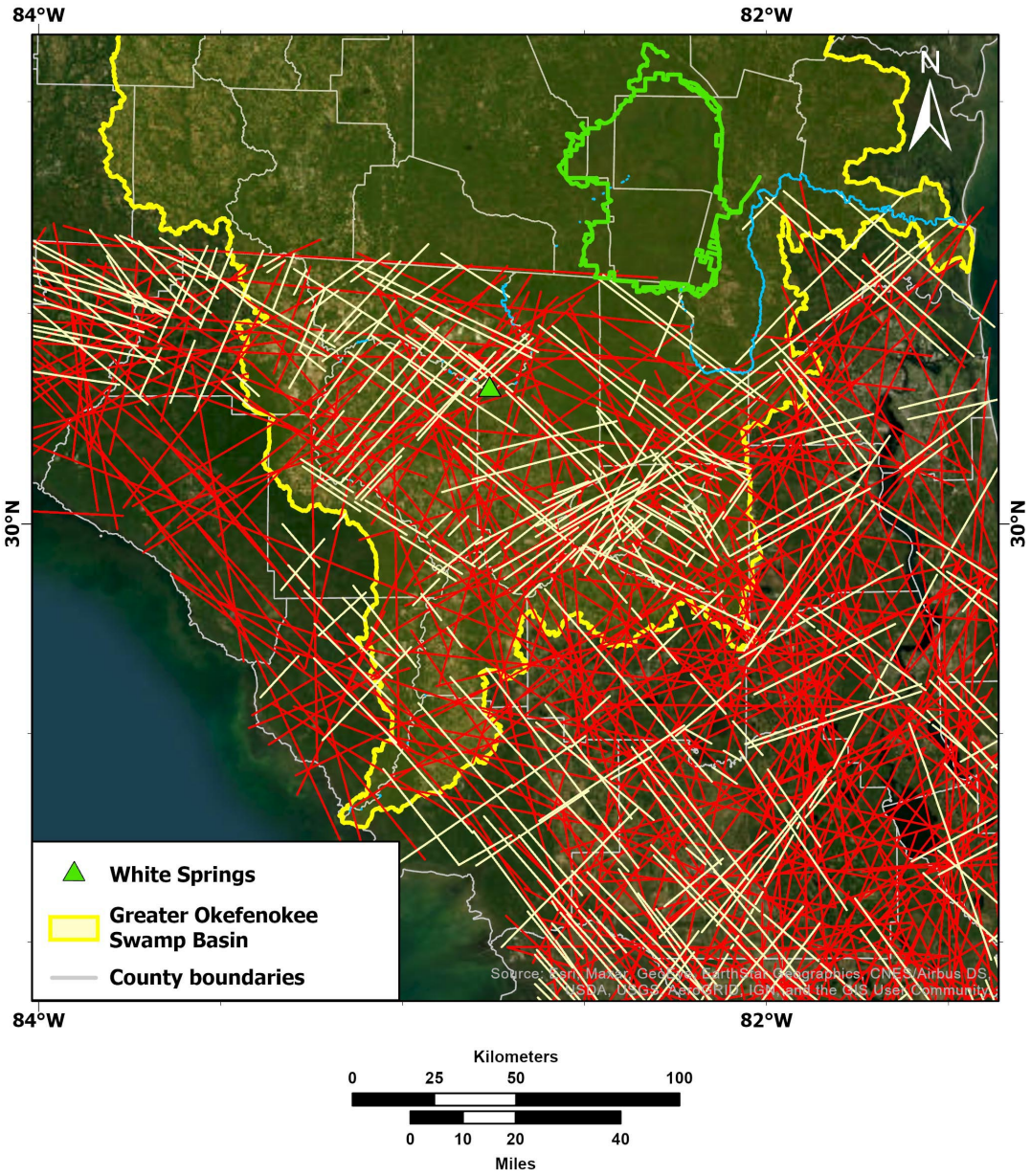

Figure 6. Proximity of White Springs located in Hamilton County, Greater Okefenokee Swamp Basin, to previously mapped fractures throughout Florida by FDOT 1973 (red diagonal lines) and in northeast Florida by Vernon 1951 (yellow diagonal lines).

that agency. The decision on that case by the US Supreme Court is expected in the spring of 2023. The fact that the US Supreme Court agreed to hear that case was unusual, considering that the USEPA and the USACOE currently are in the process of trying to finalize a new rule that would address those WOTUS issues, which should have been sufficient for the US Supreme Court to have stayed that case and waited for the new rule to be published, according to Patrick Parenteau, Professor of Environmental Law at the Vermont Law School (Bascomb & Parenteau, 2022). More detailed discussions and possible ramifications of that high-profile CWA WOTUS case are provided by both Professor Parenteau

(Bascomb & Parenteau, 2022) and Albert Lin, Professor of Law at the University of California, Davis (Lin, 2022).

3.3.2. USEPA's Transfer of the CWA Section 404 Regulatory Authority to the State of Florida

The second recent attempt to eliminate federal regulation of endangered species and wetlands previously considered as Waters of the US under the CWA in the Southeastern Coastal Plain Ecoregion was the USEPA's approval of the State of Florida's application for the FDEP to assume jurisdiction over the CWA's Section 404 permitting program (the 404 Program), which regulates the dredging and filling of WOTUS. That includes wetlands essential to water quality, storm and climate resiliency, threatened and endangered species, and the economy. On December 17, 2020, the current USEPA Administrator, Andrew Wheeler, announced that approval at a press conference in Washington, D.C. The USEPA published its decision in the Federal Register on December 22, 2020 and six days later, the USEPA General Counsel David Fotouhi sent a letter claiming that the transfer was effective upon publication, despite a requirement by Administrative Procedure Act (APA) of publication not less than 30 days before the effective date. Prior to that transfer of federal regulatory authority to the State of Florida, the USACOE was the federal agency that reviewed and if appropriate, approved permits under the federal 404 program.

The transfer of Section 404 federal regulatory authority to the State of Florida was challenged promptly by filing a 51-page Complaint for Declaratory and Injunctive Relief filed by EarthJustice in the US District Court for the District of Columbia on January 14, 2021. The complaint was filed on behalf of seven plaintiffs in Florida and the US, listed 12 federal defendants and included nine Claims for Relief, but was not addressed by the court as promptly, possibly because of delays related to COVID (EarthJustice, 2021). Although FDEP was not a named Defendant, that state agency intervened in the case. The FDEP also continues to apply the vacated Trump administration WOTUS Rule, despite being informed by both the USEPA and the USACOE that was not legal. Additionally, unlike the vacated Trump administration WOTUS Rule, the USEPA has not yet volunteered to vacate this delegation of federal authority to FDEP that occurred during the final days of the Trump administration (EarthJustice personal communication, B. Malloy, 7/14/22).

On April 19, 2022, EarthJustice filed the 77th document in the Complaint for Declaratory and Injunctive Relief case, adding four additional Claims for Relief, for a total of 13 Claims for Relief. The new Claims for Relief included: 10th "EPA'S UNLAWFUL RELIANCE ON THE PROGRAMMATIC BIOLOGICAL OPINION VIOLATES ENDANGERED SPECIES ACT;" 11th "EPA'S FAILURE TO CONSULT WITH NMFS VIOLATE [sic] THE ENDANGERED SPECIES ACT;" 12th "EPA'S FAILURE TO CONSULT ON CERTAIN SPECIES AND CRITICAL HABITATS UNDER USFWS JURISDICTION VIOLATES THE ENDANGERED SPECIES ACT," and 13th "USFWS' CREATION OF THE

TECHNICAL ASSISTANCE PROCESS IS AN UNLAWFUL ULTRA VIRES ACTION" (**Appendix A**). Following are four paragraphs that were included in that EarthJustice document filed on April 19, 2022 that are relevant to those claims related to the ESA:

> "24. On September 2, 2020, the EPA submitted an "ESA Biological Evaluation for Clean Water Act Section 404 Assumption by the State of Florida" to USFWS to initiate formal consultation on Florida's application. It was dated August 2020." (page 8)
> "25. Also, on September 2, 2020, the EPA sent a letter to NMFS summarily concluding that approval of the state program would have "no effect" on NMFS' jurisdictional marine and anadromous species. The EPA's conclusion was solely based on an April 15, 2020, letter by NMFS to Florida, stating that no species in NMFS' exclusive jurisdiction would be present "in assumable waters." NMFS then concurred with the EPA's determination." (page 8)
> "26. The EPA's biological evaluation was largely a cut and paste of a biological assessment drafted by the state and was not independently assessed by the EPA." (page 8)
> "257. On September 2, 2020, EPA submitted a biological evaluation to USFWS to initiate formal consultation on the state's application. The biological evaluation was largely a cut and paste of the biological assessment drafted by the state." (page 50)

The initial hearing for that case, related to the USEPA's violation of the "30-day rule," has been rescheduled more than once and currently is set for October 17, 2022 (EarthJustice personal communication, B. Malloy, **8/4/22**). At one point, the hearing was scheduled for July 22, 2022, if the USEPA did not reverse its decision prior to that date and immediately resume federal authority over Section 404 of the CWA (EarthJustice personal communication, B. Malloy, **7/14/22**).

Ironically, or not, a notice was published in the Bradford County Times newspaper on June 11, 2022, stating that FDEP had issued a "Section 404" permit to DuPont/Chemours, on June 6, 2022, for another new mining project in Bradford and Clay Counties (FDEP State 404 permit No. ST404 137482-022). The normal protocol for published notices is for the notice to be published in a local newspaper prior to FDEP's actual issuance of a permit, providing a specified period of time (e.g., 30 days) for anyone with formal objections to the permit an opportunity to file objections to the proposed permit and to request a hearing. In this case, FDEP already had received formal notice from numerous residents and non-profit organizations objecting to any additional mining, including specifically to DuPont/Chemours, which had numerous violations associated with other FDEP mining projects in the northeast Florida vicinity of the Greater Okefenokee Swamp Basin. If the USEPA had reversed the transfer of federal regulatory authority to FDEP under the final days of the prior federal administration prior to the earlier hearing date of July 11, 2022, for the EarthJus-

tice (2021) case, the USEPA and USACOE would have re-assumed that federal jurisdiction immediately and the pending DuPont/Chemours new mining project in Baker and Clay counties would have been reviewed by those federal agencies, in addition to the USFWS and NOAA NMFS (EarthJustice personal communication, B. Malloy, **7/14/22**).

Also, ironically, in the rush to issue that state "Section 404" permit to DuPont/Chemours for new mining in Bradford and Clay Counties, FDEP failed to include documentation of any "consultation" with the USFWS and NOAA NMFS regarding any of the numerous federally listed species that would suffer adverse effects from the permit that FDEP had issue on June 6, 2022, five days prior to any published public notice. Those adverse effects will occur from the continued unsustainable groundwater withdrawals and open mining-related pits, all of which alter the physical, chemical, and biological integrity of the nation's waters, in violation of the CWA, destroying essential habitat for those federally listed species.

After FDEP received complaints and objections to that issued "Section 404" permit, the agency issued a "Notice of Intent to Modify" that permit on July 25, 2022, after the previous date of July 11, 2022 for the hearing on the EarthJustice (2021) suit had been rescheduled for September 2022. The FDEP "Notice of Intent to Modify" that DuPont/Chemours mining permit was not published in the local newspaper. The modification of that "Section 404" permit included a reference to a Biological Opinion, dated July 29, 2020, which was issued by the USFWS to the USACOE (USFWS, 2020b) that was being used by FDEP as after-the-fact justification for issuance of that "Section 404" permit on June 6, 2022.

That 32-page Biological Opinion was identified as for the "Trail Ridge Mine," despite the fact that DuPont/Chemours had countless mining projects spanning decades, all along Trail Ridge in the northeast vicinity of the Greater Okefenokee, without any apparent other USFWS Biological Opinions. That Biological Opinion was used as the sole example of that agency's analysis of impacts from extensive mining occurring and proposed within the Greater Okefenokee Swamp Basin, including in northeast Florida and southeast Georgia. That 2020 BO and accompanying 2-page cover letter (identified as FWS Log No. 04EF1000-2020-F-0507) were prepared by Jay Herrington, Field Supervisor of the USFWS's North Florida Ecological Services in Jacksonville, Florida for USACOE's Mining Team Leader, John P. Fellows, in the Jacksonville District's Tampa, Florida office. It is important to note that formal BO dated July 29, 2020 predated the 2020 Programmatic Biological Opinion that the USFWS signed on November 17, 2020 for the transfer of the CWA Section 404 authority to the FDEP.

3.3.3. Failure of USFWS and the National Marine Fisheries Service (NMFS) to Ensure No Jeopardy to Federally Listed Species Related to the Transfer of the CWA Section 404 Regulatory Authority to the State of Florida

Congress enacted the Endangered Species Act of 1973 (ESA) because human activities had caused the extinction of many species and other species "[had] been

so depleted in numbers that they are in danger of or threatened with extinction." (16 U.S.C. § 1531(a)(1)-(2)). The USFSW, within the US Department of the Interior (DOI), has joint delegated responsibilities of administering and implementing the ESA with the NMFS. On September 2, 2020, the EPA submitted an "ESA Biological Evaluation for Clean Water Act Section 404 Assumption by the State of Florida," dated August 2020, to the USFWS to initiate formal consultation on Florida's application. On the same day, the USEPA sent a letter to the NMFS summarily concluding that approval of the state program would have "no effect" on the NOAA NMFS jurisdictional marine and anadromous species. That conclusion was based solely on a letter dated April 15, 2020 by NOAA NMFS to FDEP. The USEPA's biological evaluation was almost identical to a biological assessment drafted by the state, rather than an independent assessment by the USEPA (**Appendix A**). The following excerpts from that April 15, 2020 letter to FDEP are relevant to streams and federally listed marine and aquatic species addressed in our study (emphasis added):

> "**On November 22, 2019, the National Marine Fisheries Service (NMFS) received your request for input on a draft species list for Florida's assumption of Clean Water Act Section 404 permitting from the U.S. Army Corps of Engineers (USACE)**. Through subsequent communications with you and your staff, a review of state mapping products, NMFS' own mapping analysis, and a review of state-provided documents about the assumption, **we conclude that Endangered Species Act (ESA)-listed species under NMFS' jurisdiction do not occur in waters that are assumable by the state.**
>
> We specifically analyzed the possible spatial overlap of the assumption with waters used by **shortnose sturgeon, Atlantic sturgeon, smalltooth sawfish, and Gulf sturgeon**. Based on that analysis, **shortnose sturgeon and Atlantic sturgeon occur in the St. Marys and St. Johns Rivers, which are included on the USACE retained waters list**. **Smalltooth sawfish occur in waters "subject to the ebb and flow of the tide" which will also remain under the USACE's jurisdiction, per the draft State 404 Program Applicant's Handbook definition of "Retained Waters."** Therefore, the USACE will retain ESA Section 7 responsibility for proposed Section 404 actions in the waterways where NMFS's trust resources are most likely to occur.
>
> For **Gulf sturgeon, which has shared jurisdiction between NMFS and the U.S. Fish and Wildlife Service**, the **U.S. Fish and Wildlife Service is responsible for all consultations regarding Gulf sturgeon and critical habitat in riverine habitat units** (**final rule designating critical habitat for the Gulf sturgeon 68 FR 13370**). Rivers in Florida that include riverine critical habitat units (i.e., Escambia, Yellow, Choctawhatchee, Apalachicola, and **Suwannee rivers**) and river areas where **Gulf sturgeon** are known to occur (e.g., lower Ochlockonee River) are all listed by the USACE as re-

tained waters."

The July 20, 2020 cover letter for the USFWS' Biological Opinion of that same date stated that on January 30, 2020, the USFWS received a letter from the USACOE (Applicants) "to provide a permit to the Applicant to discharge fill material for the purpose of mining for mineral sands in Bradford County, Florida" (USFWS, 2020b). That cover letter also stated that the USFWS and the Applicant agreed that the Action is likely to adversely affect the eastern indigo snake (*Drymarchon couperi*). The second page of that cover letter included the following statement (emphasis added):

> "Reinitiating consultation is required if the Applicants retains discretionary involvement or control over the Action (or is authorized by law) when:
> **a. the amount or extent of incidental take is exceeded;**
> **b. 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;**
> c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
> d. a new species is listed or critical habitat designated that the Action may affect."

The first page of that July 29, 2020 USFWS (2020b) Biological Opinion, for additional mining of Trail Ridge stated, "**The Action does not affect designated critical habitat**, therefore, this BO does not address critical habitat." The first page of the cover letter for that BO also included the following statement (USFWS, 2020b, emphasis added):

> "The Applicant also determined that the Action is not likely to adversely affect the Florida scrubjay (*Aphelocoma coerulescens*) and the red-cockaded woodpecker (*Picoides borealis*) and would have no effect on the, wood stork (*Mycteria americana*) and the oval pigtoe (*Pleurobema pyriforme*). The Service concurs with these determinations, based on the implementation of the proposed conservation measures and the findings of the corresponding determination keys presented in the consultation request."

None of the statements in the preceding paragraph are supported by scientific facts, because the USFWS arbitrarily confined that Biological Opinion to the surface footprint of the proposed mining and ignored all indirect and cumulative adverse impacts to all of the federally endangered and threatened species that will be subject to "harm" from that proposed mining, as legal requirements described previously in the quoted excerpts from Sierra Club v. Marsh (1987). First, the indirect and cumulative effects of that proposed action, of additional Trail Ridge mining, will result in additional adverse effects to the designated critical habitat of the federally endangered oval pigtoe mussel population in the headwaters of the Santa Fe River and the New River headwaters tributary to the upper Santa Fe River. Second, the indirect and cumulative effects of that pro-

posed action, addressed in that USFWS (2020b) Biological Opinion, also will result in additional adverse effects to the critical habitat of the federally threatened Atlantic Sturgeon, Gulf subspecies in the Gulf of Mexico, in the vicinity of the Santa Fe River. Third, the indirect and cumulative effects of that proposed action also will result in additional adverse effects to the designated critical habitat of the federally threatened Suwannee moccasinshell proposed by the USFWS on November 27, 2019 (USFWS, 2019e). Fourth, the indirect and cumulative effects of that proposed action also will result in additional adverse effects to the critical habitat of the St. Marys River, designated by NOAA NMFS (2017) for the federally threatened south Atlantic Distinct Population Segments of Atlantic sturgeon. This study does not address all of the federally listed terrestrial species that will be harmed by this additional mining of Trail Ridge, such as the federally endangered red-cockaded woodpecker, federally threatened Florida scrubjay, federally threatened wood stork, and federal candidate species (e.g., gopher tortoise, gopher frog, and striped newt), and their habitat.

On November 19, 2020, the USFWS transmitted to the USEPA a programmatic Biological Opinion dated November 17, 2020, regarding Florida's application. Neither the NMFS' April 2020 determination nor the USFWS' November 2020 Biological Opinion was made part of Florida's application or otherwise presented to the public for an opportunity to comment before the EPA acted on the state's application. On December 17, 2020, the USEPA Administrator Andrew Wheeler announced the approval of Florida's assumption application at a press conference in Washington, D.C. and that approval was published on December 20, 2020 in the Federal Register, with an immediate "applicable" date as of publication (**Appendix A**).

3.4. Adverse Effects of Mining and the 2020 Revised Clean Water Act Rule in the Greater Okefenokee Swamp Basin and Southeastern Coastal Plain Ecoregion on Ground Water, Resulting in Degradation of the Physical, Chemical, and Biological Integrity of Surface Waters on Which Federally Endangered and Threatened Marine and Aquatic Species Depend

In 1995, the USFWS prevailed in a federal suit based on what constituted "take" and "harm" to federally endangered and threatened species (Babbitt, Secretary of the Interior et al. v. Sweet Home Chapter of Communities for a Great Oregon et al., 1995). Approximately two years later, that legal ruling presumably was a factor in DuPont's withdrawal of the original proposed plans to mine Trail Ridge adjacent to the east side of the Okefenokee Swamp/ONWR, following a negative response from Secretary of the Interior, Bruce Babbitt. The following, relevant excerpts from that ruling address the legal underpinnings of that "harm" in the form of "significant habitat modification or degradation where it actually kills or injures wildlife" (emphasis added):

"**As relevant here, the Endangered Species Act of 1973 (ESA or Act)**

makes it unlawful for any person to "take" endangered or threatened species, § 9(a)(1)(B), and defines "take" to mean to "harass, harm, pursue," wound," or "kill," § 3(19). In 50 CFR § 17.3, **petitioner Secretary of the Interior further defines "harm" to include "significant habitat modification or degradation where it actually kills or injures wildlife." Respondents, persons and entities dependent on the forest products industries and others, challenged this regulation on its face, claiming that Congress did not intend the word "take" to include habitat modification**.

Held: **The Secretary reasonably construed Congress' intent when he defined "harm" to include habitat modification.** Pp. 696-708. (a) The Act provides three reasons for preferring the Secretary's interpretation. **First, the ordinary meaning of "harm" naturally encompasses habitat modification that results in actual injury or death to members of an endangered or threatened species. Unless "harm" encompasses indirect as well as direct injuries, the word has no meaning that does not duplicate that of other words that § 3 uses to define "take." Second, the ESA's broad purpose of providing comprehensive protection for endangered and threatened species supports the reasonableness of the Secretary's definition.** Respondents advance strong arguments that activities causing minimal or unforeseeable harm will not violate the Act as construed in the regulation, but their facial challenge would require that the Secretary's understanding of harm be invalidated in every circumstance. **Third, the fact that Congress in 1982 authorized the Secretary to issue permits for takings that § 9(a)(1)(B) would otherwise prohibit,** "if such taking is incidental to, and not for the purpose of, the carrying out of an otherwise lawful activity," **§ 10(a)(1)(B), strongly suggests that Congress understood § 9 to prohibit indirect as well as deliberate takings. No one could seriously request an "incidental" take permit to avert § 9 liability for direct, deliberate action against a member of an endangered or threatened species.** Pp. 696-701."

Federally endangered and threatened species that require any type of surface-water habitat associated with the Southeastern Coastal Plain Ecoregion for survival and recovery are the most obvious federally listed species that will suffer adverse impacts and unpermitted "taking" from activities that result in additional declines in water quantity and quality. Therefore, examples of those federally listed species and their habitat were selected to address in this study. The selected examples of the three federally endangered species and designated critical habitat for those species include the South Atlantic Distinct Population Segments of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), and oval pigtoe mussel (*Pleurobema pyriforme*). Examples of the two federally threatened species and designated critical habitat for those species include the Gulf subspecies of the Atlantic sturgeon

(*Acipenser oxyrinchus desotoi*) and Suwannee moccasinshell (*Medionidus walkeri*). Our evaluation focuses on existing and proposed mining activities in the Greater Okefenokee Swamp Basin that result in the types of adverse environmental impacts on these species and habitat due to declines in groundwater, which result in degradation of the physical, chemical, and biological integrity of surfacewater quality described by Bacchus & Barile (2005), Bacchus et al. (2014), Bacchus et al. (2015a; 2015b), and Bernardes, Manglass, Bacchus, & Madden (2019), in addition to declines in groundwater discharges to surface waters, including wetlands, as described by Bacchus (1990; 1995a; 1995b; 1997a; 1997b; 1999; 2000; 2006; 2007), Bacchus, Archibald, Britton, & Haines (2005), Bacchus, Archibald, Brook, Britton, Haines, Rathbun, & Madden (2003), Bacchus et al. (2015a; 2015b), Bacchus, Hamazaki, Britton, & Haines (2000), Bacchus et al. (2011), Bernardes et al. (2014), and Bernardes et al. (2019).

3.4.1. Federally Endangered Atlantic Sturgeon (*Acipenser oxyrinchus*)

Background and Threats—In March 1998, the Atlantic States Marine Fisheries Commission released the Atlantic Sturgeon Stock Assessment Peer Review Report (Atlantic States Marine Fisheries Commission, 1998). Excerpts from the rivers within Georgia and Florida addressed in that Peer Review Report are included, as follows (emphasis added):

> "**3.7.1.7 Savannah River, SC/GA**
>
> This river on the border of South Carolina and Georgia supports a reproducing population of Atlantic sturgeon (Collins and Smith 1997). The lowest dam, at the city of Augusta, probably isolates fish from some spawning habitat, and discharge fluctuations (primarily from reservoirs above Augusta) may impact spawning success, etc. **The lower river at the city of Savannah, GA is heavily industrialized and a major shipping port. The vicinity of the age 1-4 nursery habitat in the lower river has been heavily impacted by diminished water quality and channelization, but effects on juveniles have not been determined. Dredging is frequent, and port expansion and extensive channel deepening are planned to begin in 1998. Reduced DO levels and upriver movement of the salt wedge may result.** The status of the population of Atlantic sturgeon is not known. **The bycatch of the commercial shad gillnet fishery during 1989-91 included more of the endangered shortnose sturgeon than juvenile Atlantic sturgeon, which is considered unusual** (unpub. data). **It has been recommended that the Army Corps of Engineers and the Georgia Ports Authority immediately begin a 5-year study of sturgeons in the river to determine whether planned actions (i.e., channel deepening) affect the populations.** NMFS (S-KProgram) has funded a stock ID (molecular genetics) study of Atlantic sturgeon in the, and the Savannah River is presently being sampled for age 0 - 1 juveniles as a part of that study. Life history information is also being collected on all sturgeons captured."

"**3.7.1.8 Altamaha River, GA**

The Altamaha River drainage basin is the largest east of the Mississippi River. Although the **two major tributaries are impounded, all dams are well upriver at or above the fall line**. Based simply on abundance of young juveniles, this river appears to support one of the healthiest Atlantic sturgeon populations in the Southeast. The ecology of juveniles was studied rather extensively (e.g., Rogers et al. 1994). Although the drainage basin is dominated in a real extent by silviculture and agriculture, two paper mills and over two dozen other industries or municipalities discharge effluent into the river. **Nitrogen and phosphorus concentrations are increasing; eutrophication, and possible loss of thermal refugia are concerns (see Ogeechee River),** as is bycatch of juveniles in the shad fishery."

"**3.7.1.9 Ogeechee River, GA**

Although a population of Atlantic sturgeon apparently persists in this river, **results of recent sampling efforts (including 1997 efforts to collect age 1 juveniles as part of the genetics study described for the Savannah River) suggest that the population is highly stressed. Scarcity of young juveniles in general, and apparent absence of age 1 fish in some years, are indicative of spawning or recruitment failure. Rogers et al. (1994) hypothesized that reduced DO levels** from nonpoint source pollution **and loss of thermal refugia from lowering of the aquifer have compromised the function of the nursery habitat during hot, dry summers.** Bycatch in the shad fishery is a concern."

"**3.7.1.10 Satilla River, GA**

Recent sampling suggests that the shortnose sturgeon population may have been extirpated and the Atlantic sturgeon population is highly stressed (see possible causes under Ogeechee River) (Rogers and Weber 1995). Bycatch in the shad fishery is not presently a concern in this river because the greatly diminished shad population has virtually eliminated the fishery."

"**3.7.1.11 St. Mary's River, GA/FL**

This river once supported a commercial sturgeon fishery. Recent standardized sampling through the appropriate salinity regime resulted in no catches of sturgeons of either species, suggesting that both populations have been extirpated from this river (Rogers and Weber 1995). The cause is thought to be reduced DO levels during summer in the nursery habitat, probably due to eutrophication from nonpoint source pollution."

"**3.7.1.12 St. John's River, FL**

Indications are that **populations of both species have been extirpated from this river** (if indeed a population of Atlantic sturgeon was truly present, which has not been documented). **It is theorized that the primary cause was dam construction (Rodman Reservoir on the Oklawaha River tributary) which blocked access to spawning habitat**. This **dam is sche-**

duled for removal in the near future. Agencies in Florida have expressed interest in re-establishing a shortnose sturgeon population by stocking cultured fish. It is possible that the same interest would apply to Atlantic if broodfish were available as they are for shortnose sturgeon."

"**3.7.1.13 Rivers Farther South**

Although Atlantic sturgeon have been recorded from locations to the south of the St. Johns River, including the St. Augustine (unpub. data) and the St. Lucie River (ASMFC 1990), **apparently there is no evidence for the previous or current existence of Atlantic sturgeon populations in these rivers.**"

It is important to note that more than 24 years after the statement by the Atlantic States Marine Fisheries Commission (1998) that the Rodman Reservoir dam on the Oklawaha River tributary "is scheduled for removal in the near future," that dam still has not been removed. The reference in the 1998 Peer Review Report (Atlantic States Marine Fisheries Commission, 1998) that "reduced DO levels...and loss of thermal refugia from lowering of the aquifer have compromised the function of the nursery habitat during hot, dry summers" particularly is relevant to the existing and proposed mining of Trail Ridge in northeast Florida and southeast Georgia. The dry stream channel in **Figures 5(a)-(c)** adequately conveys the fact that there is no "dissolved oxygen" (DO) or thermal refugia possible in streams where mining has occurred.

Current Range and Critical Habitat—The NOAA NMFS is the lead agency for the federally endangered Atlantic Sturgeon, despite the fact that this federally endangered species relies on streams discharging to the Atlantic coast for reproduction (NOAA NMFS, 2017). Also, despite that claim, in the April 20, 2020 letter to the FDEP, the NOAA NMFS stated, in part (NOAA NMFS, 2020a, emphasis added):

"...**Endangered Species Act (ESA)-listed species under NMFS' jurisdiction do not occur in waters that are assumable by the state."**

"We specifically analyzed the possible spatial overlap of the assumption with waters used by **shortnose sturgeon, Atlantic sturgeon, smalltooth sawfish, and Gulf sturgeon**. Based on that analysis, **shortnose sturgeon and Atlantic sturgeon occur in the St. Marys and St. Johns Rivers, which are included on the USACE retained waters list**."

On August 17, 2017 the NOAA NMFS published a final rule in the Federal Register designating critical habitat for Distinct Population Segments (DPS) of the Atlantic sturgeon for: a) the endangered New York Bight DPS; b) the endangered Chesapeake Bay DPS; c) the endangered Carolina DPS; and d) the endangered South Atlantic DPS of Atlantic sturgeon pursuant to the ESA. That rule became effective on September 18, 2017 (NOAA NMFS, 2017). The final published rule states that maps are available as the web link included in the final rule, but that link does not redirect to the current web link for the critical habitat

designated in the rule. This study addresses only the endangered South Atlantic Distinct Population Segments of Atlantic sturgeon and the summary of the written descriptions of that designated critical habitat provided by NOAA NMFS are included in our study.

Specific occupied areas designated as critical habitat for the South Atlantic Distinct Population Segments of Atlantic sturgeon include the following rivers and NOAA-assigned numbers in Georgia, and Florida: (27) Savannah; (28) Ogeechee; (29) Altamaha, Ocmulgee, and Oconee; (30) Satilla; and (31) St. Marys Rivers (NOAA NMFS, 2017). Of those rivers, the critical habitat designated in the lower St. Marys River is the most likely to be dewatered or otherwise destroyed by the mining of Trail Ridge proposed by Twin Pines Minerals, LLC (Twin Pines) in southeast Georgia. Additionally, the critical habitat designated for the endangered South Atlantic Distinct Population Segments of the Atlantic sturgeon in the Satilla and the lower Altamaha Rivers also risk being dewatered or otherwise destroyed by mining of Trail Ridge permitted by the USACOE as NWP-44, without any consideration for irreversible destruction of the critical habitat for the endangered South Atlantic DPS of the Atlantic sturgeon.

Summary—Of the rivers in Georgia and Florida that NOAA NMFS (2017) designated critical habitat in, for the federally endangered South Atlantic Distinct Population Segments of the Atlantic sturgeon, the lower St. Marys River is the most likely to have been dewatered and/or the critical habitat otherwise destroyed by the mining of Trail Ridge proposed by Twin Pines in southeast Georgia. Additionally, the critical habitat designated for the federally endangered South Atlantic Distinct Population Segments of the Atlantic sturgeon in the Satilla and lower Altamaha Rivers also risk being dewatered or that critical habitat otherwise destroyed by mining of Trail Ridge permitted by the USACOE as NWP-44 general permit mining. Those NWP-44 permits were issued by the USACOE without any consideration for irreversible destruction of the critical habitat for the endangered South Atlantic Distinct Population Segments of the Atlantic sturgeon.

3.4.2. Federally Endangered Shortnose Sturgeon (*Acipenser brevirostrum*)

Background and Threats—The USFWS placed the shortnose sturgeon on the original Endangered Species List in 1967 and continued to meet the criteria of "endangered" under subsequent definitions in the 1969 Endangered Species Conservation Act and in the ESA passed in 1973. The NMFS completed the first team in 1977 for a recovery plan for this species. Instead the NMFS chose to complete a Status Review for the shortnose sturgeon prior to publishing a final recovery plan, which was drafted in 1987 (NOAA NMFS, 1998). The NMFS currently is the lead agency for the federally endangered shortnose sturgeon, despite the fact that this federally endangered species also relies on streams discharging to the Atlantic coast for reproduction and spends the majority of its life in those streams. The preceding excerpts from the March 1998 report by the At-

lantic States Marine Fisheries Commission (1998) also include information about the background and threats for the federally endangered shortnose sturgeon that are or were associated in those rivers in Florida and Georgia.

The Final Recovery Plan for the shortnose sturgeon, prepared by the "Shortnose Sturgeon Recovery Team" for the NOAA NMFS, was released in December 1998. Although that report included no specific reference to ground water and groundwater withdrawals, numerous references addressed the harm from increased water temperatures, which decrease dissolved oxygen (DO). That 1998 report also referenced the Gulf sturgeon, which were "reported to fast at high water temperatures and occupy river reaches of the Suwannee River (Florida) near flowing spring heads."

That statement acknowledges that natural groundwater discharge from flowing springs in the Southeastern Coastal Plain Region is an important factor in maintaining cool thermal refugia for the survival and recovery of all federally listed sturgeon in the Southeastern Coastal Plain Region, including the shortnose sturgeon. The following references were included in that report regarding the importance of thermal refugia to the survival and recovery of the shortnose sturgeon (NOAA NMFS, 1998, emphasis added):

> "**Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adults and juveniles congregate** (Flouronoy et al. 1992; Rogers and Weber 1994; Rogers and Weber 1995b; Weber 1996)." (page 28)
>
> "**Projects that may adversely affect sturgeon include dredging, pollutant or thermal discharges**, bridge construction/removal, dam construction, removal and relicensing, and **power plant construction and operation**." (page 44)
>
> "**Thermal refuges**
>
> **During summer months, especially in southern rivers, shortnose sturgeon must cope with the physiological stress of water temperatures that often exceed 28˚C.** Flournoy et al. (1992) **suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress**. In **southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods** (Flournoy et al. 1992; Rogers and Weber 1994; Weber 1996). **Gulf sturgeon (A. o. desotoi) are reported to fast at high water temperatures and occupy river reaches of the Suwannee River (Florida) near flowing spring heads** (Mason and Clugston 1993). Flournoy et al. (1992) suggest that, in the **Altamaha River, shortnose sturgeon also seek deep, artesian spring-fed habitats which provide thermal refugia.**
>
> **Although a relatively new finding, the loss and/or manipulation of these discrete habitats may limit or be limiting population survival, particularly in southern river systems. For instance, Krause and Ran-**

> **dolph (1989) report that subterranean aquifers are severly** [sic] **depleted in the Savannah and Ogeechee Rivers (Georgia) and Satilla and St. Marys Rivers (Florida). These systems either exhibit signs of juvenile mortality (Savannah**: Collins and Smith 1993; Ogeechee: Rogers and Weber 1994, Rogers and Weber 1995b, Weber 1996) or **no longer appear to support shortnose sturgeon populations (Satilla and St. Marys**: Rogers and Weber 1995b)." (page 56)
>
> "**1.2.2 Criteria for essential habitat identification**
>
> Specific criteria must be established for all essential shortnose sturgeon habitats: spawning and rearing sites, feeding locations, and overwintering/summering concentration areas. Recent research indicates that these criteria may differ for southern and northern populations or even for individual drainages. **For example, deep thermal refuges may be important habitat for southern population segments but are not necessary for survival of northern populations. Shortnose sturgeon make seasonal movements between spatially separated, but distinct, habitats**." (pages 67 and 68)
>
> "Point and nonpoint sources of contaminants, nutrient loads, or **thermal effluents that significantly lower dissolved oxygen in shortnose sturgeon habitat** (i.e., pulp and paper mills, silvicultural and agricultural runoff, power plants, municipal wastewater, etc.) **should be reduced or, if possible, removed**." (page 78)

Current Range and Critical Habitat—For Georgia and Florida, each of the following rivers is considered as a Distinct Population Segments of the federally endangered shortnose sturgeon, as designated in Table 1 of the 1998 Recovery Plan (NOAA NMFS, 1998): Savannah River (Georgia, South Carolina, and hatchery stocks); Ogeeche River (Georgia); Altamaha River (Georgia), Satilla River (Georgia); St. Marys River (Florida); and St. Johns River (Florida). No critical habitat has been designated by the NOAA NMFS for the shortnose sturgeon, however, the critical habitat designated for the Atlantic sturgeon, where these two species co-occur, provides some additional provision for the survival and recovery of the shortnose sturgeon, assuming that enforcement of those critical habitat provisions are enforced. That aquifer depletion would eliminate baseflow to the St. Marys River and the other rivers referenced above during the dry season, when baseflow is the only natural source of water to streams (White, 1988).

Summary—The preceding excerpts from the NOAA NMFS (1998) report, referencing the 1989 findings of Krause and Randolph that the severe depletion of the Floridan aquifer system occurred in the Satilla and St. Marys Rivers, strongly suggest that the mining of Trail Ridge by DuPont/Chemours for decades prior to 1989, was a key factor in that aquifer depletion, at least for the St. Marys River. That severe aquifer depletion for the St. Marys River also is the most likely factor responsible for the apparent inability of the St. Marys River to continue supporting the population of federally endangered shortnose sturgeon, which oc-

curred there prior to the 1998 Recovery Plan (NOAA NMFS, 1998).

That aquifer depletion not only would have reduced water levels and depths in the St. Marys River, but also reduced dissolved oxygen and increased temperatures in any water that remained in the St. Marys River after that aquifer depletion. Each of those factors is known to constitute "harm" to the habitat that is essential for the recovery and survival of both the federally endangered shortnose sturgeon and the federally endangered south Atlantic Distinct Population Segments of the Atlantic sturgeon. The preceding excerpts also acknowledge that "[P]rojects that may adversely affect sturgeon include dredging" (NOAA NMFS, 1998). Mining of Trail Ridge, in addition to phosphate mining, and other related mining in the Southeastern Coastal Plain Ecoregion are recognized as "dredging" by the federal regulatory agencies and the discharge of mining related material is considered as dredged material in permitting under Section 404 of the CWA.

Despite all of those facts, no documents could be located confirming that the USACOE or the USEPA requested any formal consultation from the NOAA NMFS or the USFWS pursuant to the ESA, to consider the "harm" from any of those mining projects in the Southeastern Coastal Plain Ecoregion to habitat essential for the recovery and survival of the shortnose sturgeon or to the designated critical habitat for the south Atlantic Distinct Population Segments of the Atlantic sturgeon. Considering all of those factors and the fact that not even the following Priority 1, Priority 2, and Priority 3 tasks described in the 1998 Recovery Plan (NOAA NMFS, 1998) have been implemented regarding the multiple deadly "harm" to sturgeon populations in the Southeastern Coastal Plain Ecoregion, the following "Recovery Strategy" included in the 1998 Recovery Plan (NOAA NMFS, 1998) is incapable of being achieved at least for the St. Marys River Distinct Population Segments of the federally endangered shortnose sturgeon and the federally endangered south Atlantic DPS of the Atlantic sturgeon because of the mining of Trail Ridge in northeast Florida and which is expanding in southeast Georgia (emphasis added):

> "**IMPLEMENTATION SCHEDULE**
>
> The Implementation Schedule for the Shortnose Sturgeon Recovery Plan is summarized in the following two relational tables (Table 5 and 6). The first matrix (Table 5) lists all recovery tasks described in the Recovery Objectives section and identifies the agencies with primary responsibility for conducting each task... Recovery tasks that must be conducted for each population segment or group of population segments are listed in Table 6 and referenced in the 'priority' column of Table 5. The priority ranking assigned to each recovery task was based on NMFS Recovery Planning Guidelines, which defines the established priority system (55 FR 24296). **Priority 1 tasks are actions 'that must be taken to prevent extinction or to identify those actions necessary to prevent extinction.' Priority 2 tasks are actions 'that must be taken to prevent a significant decline in population**

numbers, habitat quality, or other significant negative impacts short of extinction." **Priority 3 tasks are 'all other actions necessary to provide for full recovery of the species.**'" (page 103)

"**Recovery Strategy**

The long-term **recovery objective for the shortnose sturgeon is to recover all discrete population segments to levels of abundance at which they no longer require protection under the ESA.**" (page 57)

It is important to note that groundwater contributions are critical to surface-water habitats for shortnose sturgeon (and the other aquatic and marine species discussed in this case study), but are not discussed by the NOAA NMFS or the USFWS, or included in any Biological Opinions for the Greater Okefenokee Swamp Basin. This failure is despite the fact that previous studies have addressed the importance of both "thermal refugia", which result from groundwater discharges to surface waters, and "spring discharges." Examples, which occur as adverse impacts from mining described by Bacchus et al. (2023) and in this companion case study, are provided in the previous quoted excerpts attributed to previous studies that were referenced by NOAA NMFS (1998). Additionally, it is impossible to "Restore flows," in compliance with Table 6, 3.1.D of that report or to "reduce loading" of contaminants, in compliance with Table 6, 3.1.G of that report, with additional mining, particularly based on the "post-development groundwater declines described in Bacchus et al. (2023), which will concentrate contaminants in streams essential to the recovery and survival of the shortnose sturgeon and other species described in this case study.

3.4.3. Federally Endangered Oval Pigtoe Mussel (*Pleurobema pyriforme*) and Designated Critical Habitat

Background and Threats—The oval pigtoe mussel was listed as a federally endangered species in the March 16, 1998 issue of the Federal Register (USFWS, 1998). The publication of the Rules and Regulations for that federal listing included the listing of designated critical habitat for the federally endangered oval pigtoe mussel and other federally listed species. The Background and Introduction for the listing of that species was included on page 12665 of that Federal Register issue. Relevant excerpts from the Description of the listing of the federally endangered oval pigtoe mussel, in addition to the Previous Federal Action related to the oval pigtoe mussel are provided below, with emphasis on the Suwannee, Santa Fe and New Rivers (USFWS, 1998, emphasis added):

"**Oval Pigtoe—*Pleurobema Pyriforme*** (Lea, 1857)

...The **oval pigtoe** was also known from **a single Suwannee River mainstem site and the confluent SantaFe River system,** and in Econfina Creek (Clench and Turner 1956, Butler 1993). Once a species of localized abundance... The species was found at...one site in the **New River (upper Santa Fe River system)**, and two sites in Econfina Creek. The **oval pigtoe** has apparently been extirpated from the Chattahoochee River system in Ala-

bama and much of the Chipola River system... **Oval pigtoe** density at the five new sites never exceeded 0.4 specimens per meter square (J. Brim Box, USGS, pers. comm.). **The smallest individual collected during or subsequent to the status survey was 26 mm (1.0 in) in length, indicating that juveniles were not present in these collections**." (page 12668)

"Previous Federal Action

The fat threeridge, shinyrayed pocketbook, **oval pigtoe**, and purple bankclimber first appeared as category 2 species in the Service's notices of review for animal candidates that were published on January 6, 1989 (54 FR 554) and on November 21, 1991 (56 FR 58804). At that time, a category 2 species was one that was being considered for possible addition to the Federal List of Endangered and Threatened Wildlife. Designation of category 2 species was discontinued in the February 28, 1996, Federal Register notice (61 FR 7596) (see also Issue 103 in the "Summary of Comments and Recommendations" section). The Service determined that these four species plus the Gulf moccasinshell, Ochlockonee moccasinshell, and Chipola slabshell qualified as candidate species at the time of proposal for listing. A candidate species is a species for which the Service has sufficient information to propose it for protection under the Act. All seven species have been recommended for conservation status by Williams et al. (1992a) and Williams and Butler (1994)." (page 1266)

Pages 12680-12683 of that Federal Register publication also included a Summary of the Factors Affecting the Species, in five categories (A through E). The first category included the following two factors affecting that species: 1) "**oval pigtoe were absent downstream of the dam**" and 2) "**in-stream and near-stream** gravel **mining**." That suggests the federally endangered oval Pigtoe mussel (and other federally endangered species of mussels) may be eliminated from their limited habitat by physical, chemical, and/or biological changes associated with altered stream flow, in addition to "i**n-stream and near-stream...mining**." The federally endangered oval Pigtoe mussel populations in the **Suwannee, Santa Fe,** and **New Rivers** have been subjected to physical, chemical, and biological changes due to "**in-stream and near-stream...mining**" from previously described mining activities south of the Okefenokee, without any apparent USACOE permits or USFWS authorizations. The additional mining proposed south and east of the Okefenokee Swamp would increase the severity of those physical, chemical, and biological changes in those river systems. Excerpts from that Summary of the Factors Affecting the Species are as follows (note that the reference to "ACF" is the Apalachicola, Flint, and Chattahoochee Rivers, emphasis added):

"Summary of Factors Affecting the Species

After a thorough review and consideration of all information available, the Service has determined that the fat threeridge, shinyrayed pocketbook, Gulf

moccasinshell, Ochlockonee moccasinshell, and **oval pigtoe** should be classified as endangered species, and the Chipola slabshell and purple bankclimber should be classified as threatened species...

These factors and their application to the fat threeridge (*Amblema neislerii*), shinyrayed pocketbook (*Lampsilis subangulata*), Gulf moccasinshell (*Medionidus penicillatus*), Ochlockonee moccasinshell (*Medionidus simpsonianus*), **oval pigtoe (*Pleurobema pyriforme*)**, Chipola slabshell (*Elliptio chipolaensis*), and purple bankclimber (*Elliptoideus sloatianus*) are as follows."

"*A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range*

...The shinyrayed pocketbook, Ochlockonee moccasinshell, and **oval pigtoe were absent downstream of the dam**. Only occasional populations of the purple bankclimber were found in this portion of the river...

...**In-stream and near-stream** gravel **mining** has occurred in various portions of the Apalachicolan Region. Jenkinson (1973) recorded the shinyrayed pocketbook, **oval pigtoe,** Gulf moccasinshell, and ten other species in Little Uchee Creek, a tributary of the Chattahoochee River in Alabama...

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

C. Disease or Predation

D. The Inadequacy of Existing Regulatory Mechanisms

E. Other Natural or Manmade Factors Affecting Its Continued Existence

...The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by these seven mussels in determining to make this final rule. Based on this evaluation, the **preferred action is to list the** fat threeridge, shinyrayed pocketbook, **oval pigtoe**, Gulf moccasinshell, and Ochlockonee moccasinshell **as endangered species**, and the Chipola slabshell and purple bankclimber as threatened species.

...The fat threeridge, shinyrayed pocketbook, **oval pigtoe**, Gulf moccasinshell, and Ochlockonee moccasinshell are in danger of extinction throughout all or a significant part of their range as follows:

...

***Oval pigtoe*:** This species was historically found throughout the ACF, Chipola, Ochlockonee, and **Suwannee River systems,** and in Econfina Creek. It occurred at one-third of the historical sites sampled. It has been extirpated from the mainstem of the Chattahoochee River, representing a significant portion of its historical range; **occurrences in the** Flint and **Suwannee River systems have decreased from 32 to 12.** The species is currently known to occur at 26 sites, **with no evidence of recruitment.**"

There was no apparent review under section 7(a)(2) of the ESA for the federally endangered oval pigtoe mussel populations related to any of the previously

referenced mining activities south or east of the Okefenokee Swamp. There also was no apparent review under section 7(a)(2) of the ESA for the federally endangered oval pigtoe mussel populations related to the federal funds provided by the USDA/NRCS to Bradford County, Florida that resulted in "**impacts on stream channel geometry, bottom substrate composition, water quantity and quality,** and **stormwater runoff**" and "**in-stream and near-stream**" and dredging in tributaries of the **Santa Fe River**. That federal funding, provided to Bradford County by the USDA/NRCS, was used to accommodate the industrial wastewater discharges in Bradford County into tributaries of the **Santa Fe River**. Specifically, those "**impacts on stream channel geometry, bottom substrate composition, water quantity and quality,** and **stormwater runoff**" were to increase the rate of flow in those tributaries to accommodate those industrial wastewater discharges that exceed the daily discharge volumes (e.g., more than 50 million gallons per day) of the industrial wastewater discharges from the heavy mineral sands/titanium mining authorized by the FDEP under the NPDES permit to Chemours/DuPont/Twin Pines. That federally funded accommodation of "**impacts on stream channel geometry, bottom substrate composition, water quantity and quality,** and **stormwater runoff**" for industrial wastewater discharges by Chemours/DuPont/Twin Pines occurred south of the Okefenokee Swamp. Those industrial wastewater discharges are "**similar in nature**" to the discharges that would occur from the proposed Twin Pines mining east of the Okefenokee Swamp.

Subsection 3.4.5 provides a more detailed discussion of USFWS information regarding how mining and groundwater withdrawals, which are significant for mining activities such as those associated with Trail Ridge in the Greater Okefenokee Swamp Basin, result in irreversible "harm" to habitat essential for the survival and recovery of the federally threatened Suwannee moccasinshell and other mussels (e.g., the federally endangered oval pigtoe mussel populations). Despite that information provided by the USFWS (2016), four years later, the USFWS (2020b) issued a Biological Opinion for expansion and continuation of mining Trail Ridge in the headwaters of the Santa Fe River in Bradford County, which will magnify the irreversible "harm" to that designated critical habitat for any remaining federally endangered oval pigtoe mussels that still exist in the headwaters of the Santa Fe River and the New River tributary to the Santa Fe River. See also discussions of the "harm" to that critical habitat described in Bernardes et al. (2019).

Current Range and Critical Habitat—Page 12684 of that Federal Register publication described the Critical Habitat listing for the federally endangered oval pigtoe mussel populations, as well as the federal regulation required for that critical Habitat. Those requirements apply to all federal agency actions. Specifically, "[F]ederal actions that might affect these species and their habitats include those with impacts on stream channel geometry, bottom substrate composition, water quantity and quality, and stormwater runoff. Such activities would be sub-

ject to review under section 7(a)(2) of the Act, whether or not critical habitat was designated. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat."

The current range extent and critical habitat of the federally endangered oval pigtoe mussel populations within the lower portion of the Greater Okefenokee Swamp Basin and west of the Greater Okefenokee Swamp Basin are shown in Figure 7. Figure 7 also shows the proximity of that range extent and critical habitat to previously mapped fractures in that vicinity of Florida and to White

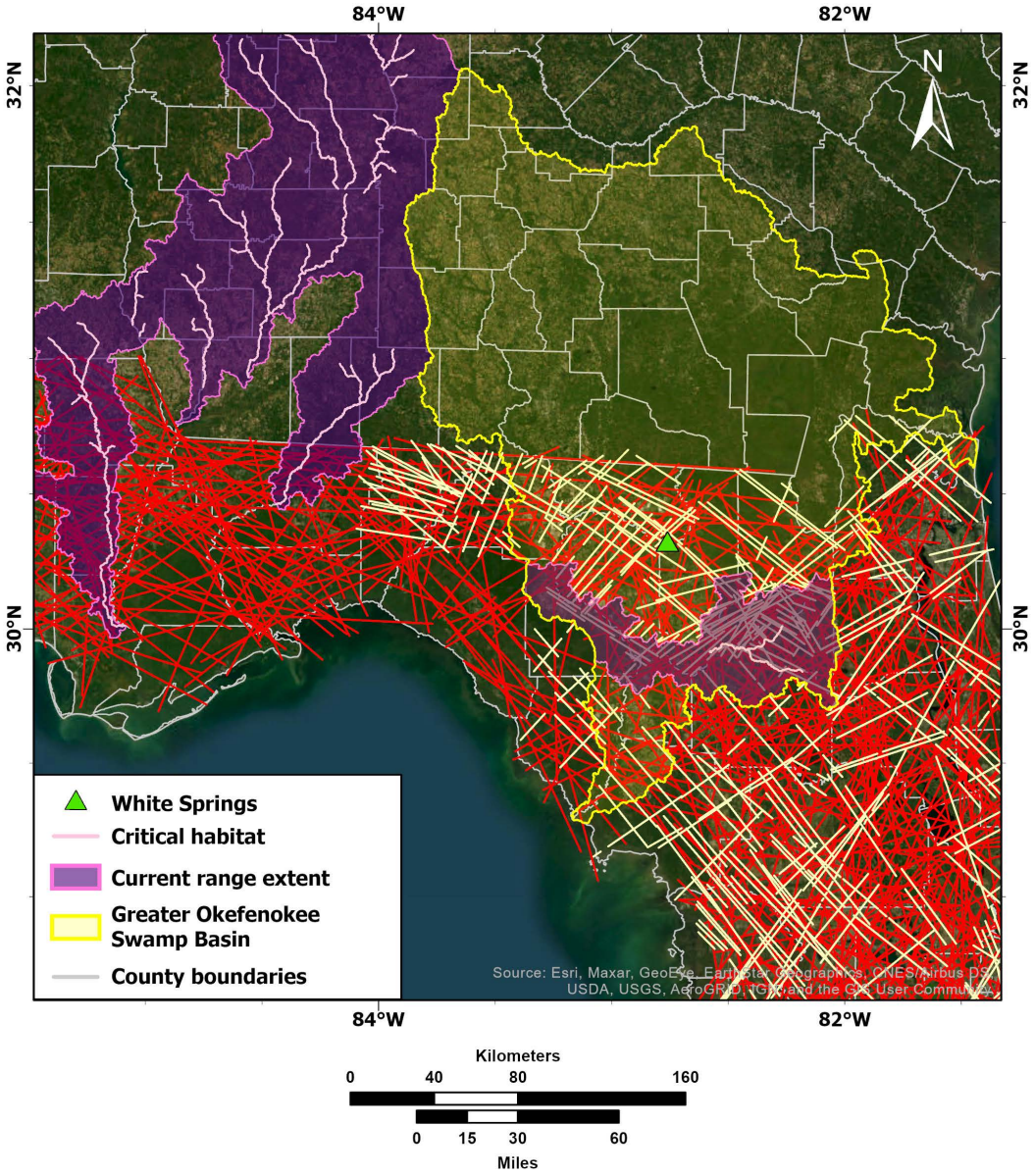

Figure 7. Current range and critical habitat of the endangered Oval Pigtoe Mussel in proximity to the Greater Okefenokee Swamp Basin in Florida and Georgia, White Springs, and fractures previously mapped in Florida by FDOT 1973 (red diagonal lines) and in northeastern Florida by Vernon 1951 (yellow diagonal lines).

Sulpher Springs (also known as White Spring), which was dewatered by adjacent phosphate mining at that location. The only designated critical habitat for that species within the Greater Okefenokee Swamp Basin is the headwaters of the Santa Fe River and the New River headwaters tributary to the upper Santa Fe River (**Figure 7**), which converge downstream of the industrial wastewater discharges of Chemours/DuPont/Twin Pines in Bradford County, Florida. Both of those streams have experienced extensive irreversible "harm" from the mining of Trail Ridge by Chemours/Dupont/Twin Rivers, and unpermitted site preparation for proposed phosphate mining in Bradford and Union Counties. Bernardes et al. (2019) described the mining-related "harm" from the unpermitted discharges of mining-related wastewater.

In the March 16, 1998 issue of the Federal Register, the USFWS (1998) designated the federally endangered oval pigtoe mussel and critical habitat for that federally endangered oval pigtoe mussel. Excerpts from the Critical Habitat section related to the federally endangered oval pigtoe mussel include the following (page 12684, emphasis added):

> "**Critical Habitat**
> Critical habitat is defined in section 3 of the Act as: **(i) the specific areas within the geographical 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** (I) **essential to the conservation of the species** and (II) that may require special management considerations or protection; and (ii) **specific areas outside the geographic 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. "Conservation" means the use of all methods and procedures needed to bring the species to the point at which listing under the Act is no longer necessary.**
> Section 4(a)(3) of the Act, as amended, requires that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time a species is determined to be endangered or threatened. The Service's regulations at 50 CFR 424.12(a)(1) state that designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other activity and the identification of critical habitat can be expected to increase the degree of threat to the species or (2) such designation of critical habitat would not be beneficial to the species. The Service finds that designation of critical habitat is not prudent for these species. Such a determination would result in no known benefit to these species, and designation of critical habitat could further pose a threat to them through publication of their site-specific localities.
> Critical habitat designation, by definition, directly affects only Federal agency actions. **Since these seven mussel species are aquatic throughout their life cycles, Federal actions that might affect these species and their habitats include those with impacts on stream channel geometry, bot-**

> **tom substrate composition, water quantity and quality, and stormwater runoff. Such activities would be subject to review under section 7(a)(2) of the Act, whether or not critical habitat was designated. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat.** The fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, **oval pigtoe**, Chipola slabshell and purple bankclimber **have become so restricted in distribution that any significant adverse modification or destruction of their occupied habitats would likely jeopardize their continued existence.** This would also hold true as the species recovers and its numbers increase. **As part of the development of this final rule, Federal and State agencies were notified of the mussels' general distributions, and they were requested to provide data on proposed Federal actions that might adversely affect the species. Should any future projects be proposed in areas inhabited by these mussels, the involved Federal agency will already have the general distributional data needed to determine if the species may be impacted by their action, and if needed, more specific distributional information would be provided.** Therefore, habitat protection for these seven species can be accomplished through the section 7 jeopardy standard and there is no benefit in designating currently occupied habitat of these species as critical habitat.
>
> **Recovery of these species will require the identification of unoccupied stream and river reaches appropriate for reintroduction. The Service is currently working with the State and other Federal agencies to periodically survey and assess habitat potential of stream and river reaches for listed and candidate aquatic species within the** ACF and Ochlockonee river systems and the Yellow and **Santa Fe river**s..."

More specific designation of critical habitat for the federally endangered oval pigtoe mussel was addressed in the 56-page USFWS Rules and Regulations published on November 15, 2007 (USFWS, 2007). That critical habitat for the federally endangered oval pigtoe mussel includes the Santa Fe River and the New River. The five Primary Constituent Elements (PCE) are provided on pages 64298-64302 of that Federal Register publication. The previously described existing and proposed mining south and east of the Okefenokee Swamp have violated and/or will violate the conditions of one or more of those five PCEs. Excerpts from those PCEs are as follows (USFWS, 2007, emphasis added):

> "**Primary Constituent Elements**
>
> ...we consider those physical and biological features that are essential to the conservation of the species, and within areas occupied by the species at the time of listing, that may require special management considerations or protection. The physical and biological features essential to the conserva-

tion of the species are the primary constituent elements (PCEs) laid out in an appropriate quantity and spatial arrangement for recovery. These include, but are not limited to:

(1) **Space for individual and population growth and for normal behavior;**

(2) **Food, water, air, light, minerals, or other nutritional or physiological requirements;**

(3) **Cover or shelter;**

(4) **Sites for breeding, reproduction, or rearing (or development) of offspring;** and

(5) **Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.**

Space for individual and population growth and normal behavior, and sites for reproduction and development of offspring are provided for the seven mussels on and within the streambed of stable channels with a suitable substrate, which we have captured in the PCEs regarding channel stability, substrate quality, and flow regime. Because the seven mussels are dependent on fish to complete their larval life stage, the PCE regarding fish hosts is a further requirement for successful reproduction. Various nutritional and physiological requirements are captured in the PCEs regarding flow regime and water quality. These PCEs are explained in additional detail below.

Based on our current knowledge of the life history, biology, and ecology of the seven mussels, and the habitat requirements for sustaining their essential life history functions, we have determined that the seven mussels require the PCEs described below.

PCE 1. **A geomorphically stable stream channel** (a channel that maintains its lateral dimensions, longitudinal profile, and spatial pattern over time without a consistent aggrading or degrading bed elevation).... In addition to the direct effects above, channel instability indirectly affects mussels and their fish hosts in several ways. Channels becoming wider and shallower via bank erosion develop more extreme daily and seasonal temperature regimes, which affects dissolved oxygen levels and many other temperature-regulated physical and biological processes. Mussels in wider and shallower channels are likely more susceptible to predation. Erosive channels lose the habitat complexity provided by mature bank-side vegetation, which reduces diversity and abundance of fish species. Fewer fish means lower probability of mussel recruitment. The many direct and indirect adverse effects of channel instability on mussels and their fish hosts strongly suggest that channel stability is a habitat feature essential to their conservation.

PCE 2. A predominantly sand, gravel, and/or cobble stream substrate with **low to moderate amounts of silt and clay**...

PCE 3. **Permanently flowing water**...

PCE 4. **Water quality (including temperature, turbidity, dissolved oxygen, and chemical constituents)** that meets or exceeds the current aquatic life criteria established under the Clean Water Act (CWA) (33 U.S.C. 1251-1387).

The temperature, dissolved oxygen (DO), pH, and conductivity ranges that define suitable habitat conditions for the seven mussels have not been specifically investigated... Most mussels are considered sensitive to low DO levels and high temperatures (Fuller 1974, p. 245)... The **oval pigtoe demonstrated moderate, but significantly higher than average, mortality when DO was less than 5 mg/L...**

Water temperature affects the amount of oxygen that can be dissolved in water and the toxicity of various pollutants. The toxic effects of ammonia are more pronounced at higher temperatures and at higher pH (Mummert et al. 2003, p. 2545, 2550; Newton 2003, p. 2543). **High temperatures or decreasing pH may increase the toxicity of metals to unionids** (Havlik and Marking 1987, p.14)...

Ammonia is lethal to juveniles at concentrations as low as 0.7 ppm total ammonia nitrogen, normalized to pH 8, and lethal to glochidia at concentrations as low as 2.4 ppm (Augspurger et al. 2003, p. 2569-2575). **In streams, ammonia may occur at highest concentrations in substrate interstitial spaces where juvenile mussels live and feed** (Whiteman et al. 1996, p. 794; Hickey and Martin 1999, p. 38; Augspurger et al. 2003, p. 2569-2575).

PCE 5. Fish hosts (such as largemouth bass, sailfin shiner, brown darter) that support the larval life stages of the seven mussels....Host-fish specificity has been examined in laboratory tests for five of the seven mussels: The fat threeridge, Gulf moccasinshell, **oval pigtoe,** purple bankclimber (O'Brien and Williams 2002, p. 151), and shiny-rayed pocketbook (O'Brien and Brim Box 1999, 136)...

The **oval pigtoe** releases rigid white to pinkish conglutinates, which passively drift in the current and may resemble the food organisms of small-bodied fishes. O'Brien and Williams (2002, p. 152) tested 11 fish species as hosts, finding that glochidia transformed on the gills of fish such as the sailfin shiner (*Pteronotropis hypselopterus*) and eastern mosquitofish. **They considered only the sailfin shiner as a primary host,** as it was the only species upon which the transformation rate exceeded 50 percent."

Summary—The USACOE, USFWS, USDA and other agencies have failed to comply with the requirements of NEPA and other federal laws, including the failure of those and other agencies to enforce the ESA for the federally endangered oval pigtoe mussel and its designated critical habitat in the same "Suwannee River Basin" of the Greater Okefenokee Swamp Basin as is proposed for the Suwannee moccasinshell. The failure of those agencies is described in our study. The federally endangered oval pigtoe mussel and its designated critical habitat

provide relevant examples of the need for the USFWS, the USACOE, and other federal agencies to comply with the requirements of NEPA and enforce the ESA.

Confirmation of the most recent failure of those federal agencies to comply with the requirements of NEPA and other federal laws, including the failure of those and other agencies to enforce the ESA for the federally endangered oval pigtoe mussel and its designated critical habitat, was provided in the February 6, 2020 issue of the Bradford County Telegraph newspaper. That article confirmed the USDA authorized an additional $867,000 in federal funds for dredging and channelizing in headwaters/tributaries of federally designated critical habitat for the federally endangered oval pigtoe mussel. Specifically, the areas covered by those federal funds from the USDA to ensure more rapid dispersal of discharged industrial wastewater from heavy mineral sands/titanium mining activities by Chemours/DuPont/Twin Pines in Baker, Bradford, Clay, and Duval Counties, involve both the New River and Santa Fe River in Bradford County, as confirmed in that Bradford County Telegraph article (Crawford, 2020, emphasis added):

> "**Bradford County took on a similar project in 2018 with $2.5 million from the USDA to clean out the portion of Alligator Creek from Chemours to the Santa Fe River.**
>
> ...
>
> 'We call it the big ditch,' Harley said of the Lawtey project area. **'It's where everything flows into the Alligator Creek tributary.** It goes from the east side of town, all the way out to Alligator Creek.'
>
> **Eventually the water flows into New River,** she said."

Those industrial wastewater discharges exceeded volumes authorized by the NPDES permit issued by FDEP to Chemours/DuPont/Twin Pines for those heavy mineral sands/titanium mining activities. As indicated in that Bradford County Telegraph article, the USDA initially provided $2.5 million in federal funds to Bradford County for similar dredging and channelizing in headwaters/tributaries for flooding allegedly caused by the Hurricane Irma, despite any lack of proof for those claims. Bernardes et al. (2019) also refuted those allegations prior to the subsequent release of federal funds by USDA for flooding allegedly caused by Hurricane Irma.

3.4.4. Federally Threatened Atlantic Sturgeon, Gulf Subspecies (*Acipenser oxyrinchus desotoi*)

Background and Threats—On April 11, 2019, the USFWS published a notice in Volume 84, Number 70 of the Federal Register announcing that the agency was conducting the 5-year status review on the federally threatened Atlantic sturgeon, Gulf subspecies, as required by the ESA (USFWS, 2019c). That public notice preceded the "State 404" permit issued on June 6, 2022 by FDEP to Chemours/DuPont for expanded mining of Trail Ridge in the headwaters of the Santa Fe River. That permit was modified approximately a month later, to in-

corporate the two-year old Biological Opinion by the USFWS (2020b).

That Biological Opinion made no reference to the federally threatened Atlantic sturgeon, Gulf subspecies and the "harm" to its aquatic and marine habitat from the adverse indirect and cumulative effects of mining and related groundwater withdrawals. Those activities reduce flows, increase sedimentation, increase water temperatures, and permanently alter the chemical and physical (e.g., stream channel instability) characteristics of the habitat that is essential for the survival and recovery of the federally threatened Atlantic sturgeon, Gulf subspecies.

The USFWS' failure to discuss that "harm" to essential and critical habitat of the federally threatened Atlantic sturgeon, Gulf subspecies in that 2020 Biological Opinion, from the mining of Trail Ridge in the headwaters of the Santa Fe River, was despite the fact that the USFWS acknowledged those impacts four years prior to that Biological Opinion, in the final rule designating the Suwannee moccasinshell as a federally threatened species (USFWS, 2016). That is because the critical habitat designated for the federally threatened Suwannee moccasinshell occurs both upstream and overlaps with the upper reaches of the critical habitat designated for the Atlantic sturgeon, Gulf subspecies. That "harm" is discussed in more detail in the following subsection addressing the federally threatened Suwannee moccasinshell.

Current Range and Critical Habitat—The current range extent and critical habitat of the threatened Atlantic sturgeon, Gulf subspecies within the lower portion of the Greater Okefenokee Swamp Basin, including in the Gulf of Mexico and west of the Greater Okefenokee Swamp Basin are shown in **Figure 8**. **Figure 8** also shows the proximity of that range extent and critical habitat to previously mapped fractures in that vicinity of Florida and to White Sulpher Springs (also known as White Spring), which was dewatered by adjacent phosphate mining at that location. Although **Figure 8** shows that the Santa Fe River is not included as a critical stream habitat for the federally threatened Atlantic sturgeon, Gulf subspecies because of its recent degradation, the Santa Fe River is a significant tributary to the Suwannee River and the downstream critical habitat for the threatened Atlantic sturgeon, Gulf subspecies in the Gulf of Mexico. Further degradation of the Santa Fe River will occur from FDEP's recently issued "State 404" permit to Chemors/DuPont for expanded mining of Trail Ridge. That degradation will result in "harm" to the critical habitat of the threatened Atlantic sturgeon, Gulf subspecies in both the lower Suwannee River and Gulf of Mexico, as discussed in more detail in the following subsection addressing the federally threatened Suwannee moccasinshell and as shown in **Figure 9**.

Although the mapping of the fractures shown in **Figure 8** was confined to the state boundaries of Florida, those fractures, other karst conduits and bedding planes do not stop at the Florida/Georgia state line. They continue into Georgia, including under the channel of the St. Marys River, where the most recent mining of Trail Ridge in southeast Georgia is proposed by Twin Pines. Therefore, if

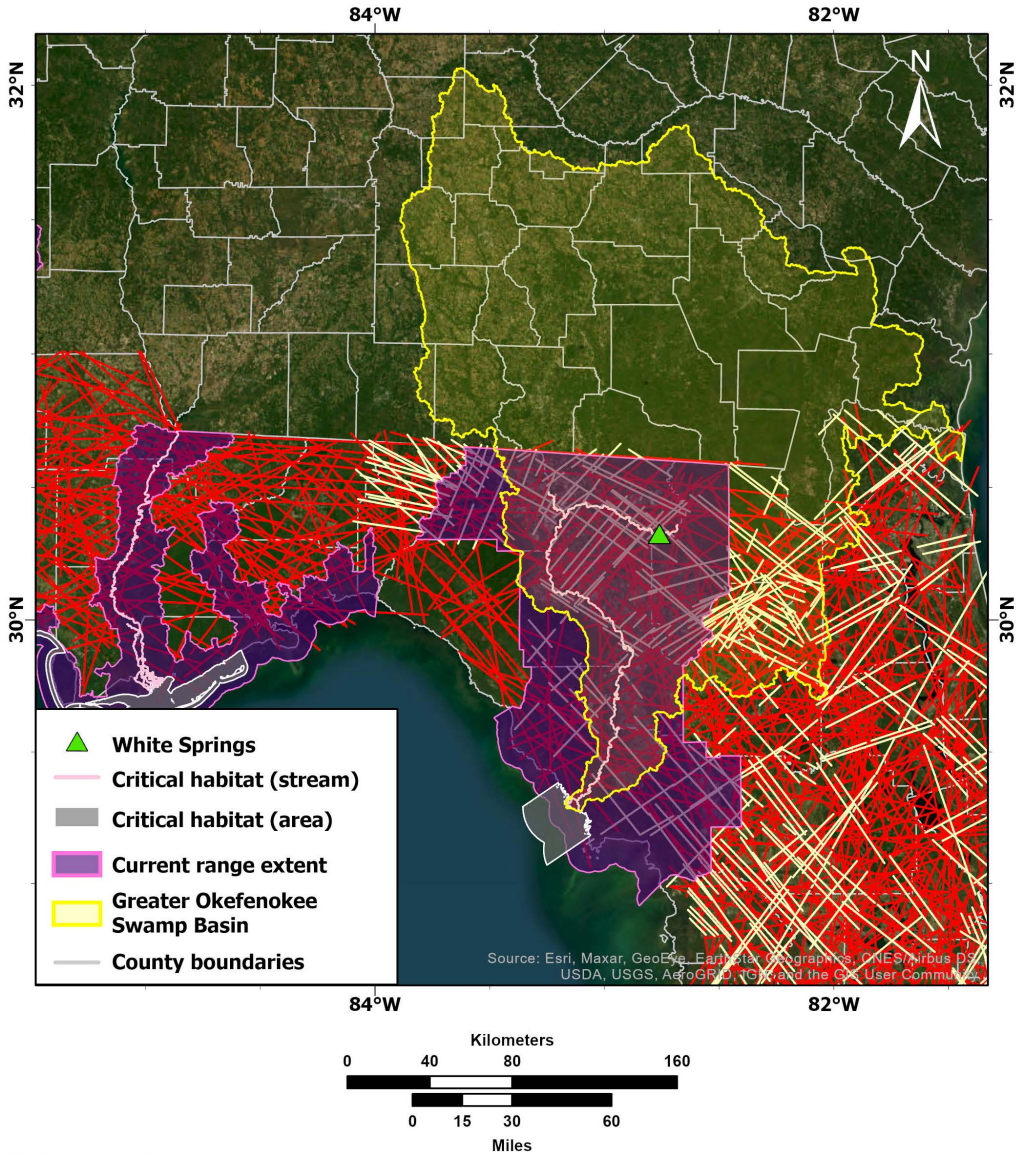

Figure 8. Critical stream and marine habitats and current range of the threatened Gulf subspecies of the Atlantic Sturgeon in proximity to the Greater Okefenokee Swamp Basin in Florida and Georgia, White Springs, and fractures previously mapped in Florida by FDOT 1973 (red diagonal lines) and in northeastern Florida by Vernon 1951 (yellow diagonal lines).

that proposed mining of Trail Ridge by Twin Pines is permitted, that mining also would contribute adverse indirect and cumulative effects resulting in "harm" to the federally threatened Atlantic sturgeon, Gulf subspecies and that critical habit in the Suwannee River and Gulf of Mexico, without any means of "mitigating" that irreversible harm. The location and more detailed discussion of the proposed mining of Trail Ridge by Twin Pines in southeast Georgia is provided in the following subsection addressing the federally threatened Suwannee moccasinshell.

That "harm" from mining, to both the federally threatened Atlantic sturgeon, Gulf subspecies and the federally threatened Suwannee moccasinshell, was ad-

dressed in that final rule (USFWS, 2016) and is exemplified by the mining of Trail Ridge. That USFWS (2016) discussion predated the USACOE's public notice requesting comments on the proposed Twin Pines mining of Trail Ridge east of the Okefenokee Swamp by several years. The 5-year status review on the federally threatened Atlantic sturgeon, Gulf subspecies (USFWS, 2019c) also preceded that same USACOE public notice for additional mining of Trail Ridge in southeast Georgia (USACOE, 2019) by approximately three months. Despite that available information regarding the irreversible "harm" from mining to those federally threatened aquatic and anadromous (requiring both marine and freshwater habitats for survival) species, respectively, neither the preliminary comments by the USFWS (2019a) in Athens, Georgia, regarding the proposed Trail Ridge mining by Twin Pines, nor the Biological Opinion by the USFWS (2020b) from Jacksonville, Florida, regarding the continued expansion of mining of Trail Ridge in the headwaters of the Santa Fe River acknowledged irreversible "harm" to either of those federally listed species.

The final rule to list the Suwannee moccasinshell as federally threatened (USFWS, 2016), identifying groundwater withdrawals and mining as the greatest threats to aquatic species such as the federally threatened Suwannee moccasinshell and dewatering streams that are essential for the survival and recovery of listed aquatic species, also preceded the public's knowledge of the southward expansion mining of Trail Ridge by the Mission Mine (SAS-2012-01042) and the Indian Boundary Mine (SAS-2017-00669). Both of those mining activities east of the Okefenokee Swamp, were authorized by the USACOE under the NWP 44 – Mining Category and both are "similar in nature" and in "harm" to the proposed Twin Pines mining, also east of the Okefenokee Swamp. This dewatering of surface waters can occur for long distances, through fractures, similar to the dewatering of essential habitat for Florida panthers described by Xu, Bernardes, Bacchus, & Madden, (2018).

Mining activities authorized under the NWP 44 Mining Category do not have to meet the public notice requirements of mining activities considered under applications for "Individual" USACOE mining permits, such as the proposed Twin Pines mining east of the Okefenokee Swamp. Therefore, public comments regarding the "take" and "harm" that would result from those individual mining activities and cumulative mining activities to all of the numerous species listed as federally threatened, federally endangered, and federal candidate species could not be submitted by concerned citizens. The USFWS, however, should have known about all of the existing and proposed mining referenced in our study and should have intervened on behalf of the protection of those species and the habitat essential for the survival and recovery of those species.

Summary—The 2001 Field Guide to the Rare Animals of Florida provides an excellent summary regarding the federally threatened Gulf subspecies of the Atlantic sturgeon. That information, provided by the Florida Natural Areas Inventory (FNAI) and consolidated on two pages, includes a map of the counties in Florida where the Gulf subspecies of the Atlantic sturgeon occurs. Those coun-

ties include counties within the Greater Okefenokee Swamp Basin, where the permanent and irreversible adverse impacts from the mining activities, discussed in this study, will be most severe. Relevant excerpts from that field guide include the following (FNAI, 2001, emphasis added):

> "**Habitat:** Forages in Gulf of Mexico and associated estuaries; **spawns in most major coastal rivers in areas with limestone outcrops.**
> **Seasonal Occurrence:** Gulf sturgeon is anadromous; adults and subadults spend the coldest three to four months in the Gulf and t**he remainder of the year in rivers where spawning occurs.** Spawning typically takes place February-April.
> **Florida Distribution:** Reproducing populations in Gulf of Mexico and major panhandle rivers eastward to the **Suwannee River. Non-breeding animals observed in Tampa Bay and Charlotte Harbor...**
> **Conservation Status:** Due to the damming of many of north Florida's tributaries to the Gulf of Mexico, the **Suwannee,** Choctawhatchee and Yellow **rivers appear to be the last high-quality spawning areas for the Gulf sturgeon..."**

Relevant excerpts from the USFWS notice summarizing dates and contact information for the 5-year status review on the federally threatened Atlantic sturgeon, Gulf subspecies were provided by the USFWS (2019c). That public notice for the 5-year status review on the federally threatened Atlantic sturgeon, Gulf subspecies stated, "we are requesting submission of new information no later than June 10, 2019." That public notice also stated, "**However, we will continue to accept new information about any listed species at any time**." **Support documents that were provided as comments also were provided to Mike Oetker, Acting Regional Director, Southeast Region of the USFWS in response to categories "B" and "E"** of "**What information do we consider in our review?**" Excerpts from "B" and "E" include the following (emphasis added):

> **"B. Habitat conditions, including but not limited to amount, distribution, and suitability;**
> **E. Other new information, ...and/or copies of any pertinent publications, reports, or letters by knowledgeable sources."**

That public notice specifically referenced Florida and Alabama as two of the four Gulf Coast states where the federally threatened Gulf subspecies of the Atlantic sturgeon is known to occur. The Gulf Coast areas of those two states are associated with the regional Floridan aquifer system, which is described in detail in our study as essential for all marine and aquatic habitats for federally threatened and endangered species and species native to the Southeastern Coastal Plain Ecoregion, including the habitat of the federally threatened Gulf subspecies of the Atlantic sturgeon.

The preceding information from the FNAI (2001) indicates that the federally

threatened Gulf subspecies of the Atlantic sturgeon spawns and spends the majority, approximately eight to nine months, of its life in the few remaining undammed rivers flowing into the Gulf of Mexico in only four states. That additional information by FNAI emphasizes the importance of the Suwannee River as only one of three rivers in Florida where breeding individuals of the federally threatened Gulf subspecies of the Atlantic sturgeon have been observed. The most likely factor in the lack of breeding individuals in the central and south west counties of Florida, where the federally threatened Gulf subspecies of the Atlantic Sturgeon still occur, is that extensive permanent and irreversible adverse impacts already have occurred in that area from the extensive mining activities associated with those rivers.

3.4.5. Federally Threatened Suwannee Moccasinshell (*Medionidus walkeri*) and Proposed Designated Critical Habitat

Background and Threats—On October 6, 2016, the USFWS published the final rule listing the Suwannee moccasinshell (*Medionidus walkeri*) as threatened, stating that the reason for the rule, pursuant to the ESA, was because this species was threatened throughout all or a significant portion of its range. That final rule described federal actions related to this species prior to October 6, 2016. The specific reasons for that listing were provided in the Executive Summary of that final rule, as follows (USFWS, 2016, emphasis added):

> "We have determined that the Suwannee moccasinshell is threatened by the degradation of its habitat due to polluted runoff from agricultural lands, **pollutants discharged or accidentally released from industrial** and municipal wastewater **sources and mining operations, decreased flows due to groundwater extraction** and drought, **stream channel instability,** and excessive sedimentation (Factor A); **State and Federal water quality standards that are inadequate to protect sensitive aquatic organisms like mussels** (Factor D); the potential of contaminant spills as a result of transportation accidents (Factor E); increased drought frequency and degraded water quality as a result of changing climatic conditions (Factor E); **greater vulnerability to certain threats because of small population size and range** (Factor E); and competition and disturbance from the introduced Asian clam (Factor E)"

During the comment period for that rule, the USFWS received comments from peer-reviewers specifically related to threats to the population of Suwannee moccasinshells in the Santa Fe River. The following comments, which were documented to occur in response to releases of wastewater from Trail Ridge mining by Chemours/DuPont in the headwaters of the Santa Fe River (Bernardes et al., 2019), and the USFWS responses to those comments included (USFWS, 2016, emphasis added):

> "*(3) Comment*: One peer reviewer commented that spate flows (*e.g.*, **sudden fast flows with high sediment loads**) **in the upper Santa Fe River**

should be listed as a threat.

Our Response: We agree and have added this threat to the Factor A discussion under the heading of ***Stream Channel Instability***.

(4) Comment: One peer reviewer commented that **deadhead logging**, though probably past its heyday, **is still a potential threat to the Suwannee moccasinshell as it can cause destabilization of microhabitat occupied by freshwater mussels**...

Our Response: We appreciate this information, and we have added a discussion of both activities to the Factor A discussion under the heading of *Stream Channel Instability*."

The Summary of Threats for the final rule for the federally threatened Suwannee moccasinshell (USFWS, 2016) states, "[P]erhaps **the most significant threat to Suwannee moccasinshell populations is flow reduction due to the withdrawal of groundwater**" (emphasis added). Additionally, the Summary of the Biological Status for the final rule for the federally threatened Suwannee moccasinshell (USFWS, 2016) emphasized the rapid decline of that species, particularly in the Santa Fe River subbasin. More specifically, that summary included the following excerpt, combined with the previous statement, supports the conclusion that the longterm expansion of the mining of Trail Ridge by DuPont/Chemours/Twin Pines not only is a major contributor to that decline, but that mining also reached a tipping point decades ago (emphasis added):

> "...it does seem clear from museum collections that **Suwannee moccasinshell numbers have declined over time, especially in the Santa Fe River subbasin where it has declined dramatically in recent decades** (see our discussion on page 60339 of the proposed rule (80 FR 60335 (/citation/80-FR-60335) October 6, 2015)."

The Summary of Threats provided in that final rule further addresses the threats to the federally threatened Suwannee moccasinshell and its habitat related to "t**he withdrawal of groundwater**." The following specific details (USFWS, 2016) describe precisely how those groundwater withdrawals degrade the physical, chemical, and biological integrity of the nation's waters, in violation of the CWA (emphasis added):

> **"Flow declines of approximately 30 percent have been observed in the lower Santa Fe and lower Suwannee Rivers; the upper Santa Fe River, once a perennial system, has gone dry multiple times since 2000** (Johnson et al. in Press). **Reduced flows** may exacerbate drought conditions (**elevating temperature, pH, and pollutant concentrations (causing biotic die-off, and reducing dissolved oxygen), which in turn may have lethal or other harmful effects (prematurely aborting glochidia, reduced growth rates) to the species, or may cause stranding mortality."**

The preceding statement by Johnson, McLeod, Holcomb, Rowe, & Williams

(2016), contained in the USFWS published the final rule listing the Suwannee moccasinshell (*Medionidus walkeri*) as threatened, is an alarming description of significant habitat modification and degradation that kills and injures the Suwannee moccasinshell. Even more alarming is the fact that only four years after that statement was published by the USFWS, that same agency failed to address the federally threatened Suwannee moccasinshell in its Biological Opinion that was issued to the USACOE in 2020, to allow Chemours/DuPont to expand mining in tributary wetlands of the upper Santa Fe River. In fact, that was the BO that the FDEP used to justify issuing its "State 404" permit for that expanded mining of Trail Ridge in 2022, two years after that BO had been completed. Yet that BO only addressed "harm" to one federally listed species that occurred within the actual surface footprint of that mining operation, rather than all of the adverse indirect and cumulative impacts to the Santa Fe River and lower Suwannee River. Equally concerning are the additional statements that were included in the Johnson et al. (2016) publication and clearly ignored in the BO for the expanded mining of Trail Ridge that will result in significant habitat modification and degradation that will kill and injure the Suwannee moccasinshell downstream from that mining. Considering the findings of Bernardes et al. (2019), about the sudden massive releases of mining wastewater to the upper Santa Fe River, the fact that not even the USFWS is acting on behalf of this federally threatened aquatic species, and the following additional excerpts from Johnson et al. (2016), it is highly improbable that the last excerpt, suggesting the potential restoration of the federally threatened Suwannee moccasinshell to the upper Santa Fe subbasin, is realistic (emphasis added):

> "Recent surveys detected M. walkeri only in the middle Suwannee subbasin (n = 86, 22 locations) and lower Santa Fe subbasin (n = 2, 2 locations), and **it appears the species may be extirpated from 67% of historically occupied 10-digit hydrologic unit code (HUC 10) watersheds**."
>
> "**This species is endemic to the Suwannee River basin (SRB)** and has been considered threatened (Williams et al. 1993), endangered (Williams & Butler 1994), and extremely rare and critically imperiled (Williams et al. 2014) in previous assessments and is considered Critically Endangered by the International Union for the Conservation of Nature...and, after a 16-yr hiatus, 3 live M. walkeri were found in 2012."
>
> "**The SRB is located in north Florida and south Georgia** in southeastern North America (see Fig. 1) and **represents a unique hydrogeological setting where low nutrient, acidic, tannic water originating from lakes and swamps (e.g. Okefenokee Swamp, Lake Santa Fe) mixes with alkaline, enriched, clear waters discharging from over 250 springs located throughout the watershed below the Cody Scarp** (**FDEP** 2011)."
>
> "Major land use changes in the SRB **combined with karst geology have resulted in altered hydrologic flow regimes and increased sediment and nutrient loads** (Katz et al. 1999)."

> "**Prior to the 1950s when most M. walkeri collections occurred, the upper Santa Fe subbasin was largely perennial** (Scott et al. 2004), but **USGS stream gauge data shows it has been dry multiple times since 2000 at one historical locality** (Santa Fe River near Worthington Springs). This shift in hydrologic flow regime might explain detection failure by recent surveys as **abnormally low flow conditions can result in high mussel mortality** (Johnson 2001, Golladay et al. 2004)."
> "**Transplanting adults or releasing cultured juveniles might be the only option to restore M. walkeri to the upper Santa Fe subbasin**."

Current Range and Critical Habitat—On November 27, 2019, the USFWS published a proposed rule in Volume 84, Number 229 of the Federal Register to designate critical habitat for the Suwannee moccasinshell (USFWS, 2019e). The comment period for that proposed rule ended January 27, 2020. The summary of that proposed USFWS rule states (emphasis added):

> "We, the U.S. Fish and Wildlife Service (Service), propose to designate critical habitat for the Suwannee moccasinshell (*Medionidus walkeri*) under the Endangered Species Act (Act). **The Suwannee moccasinshell is a freshwater mussel species from the Suwannee River Basin in Florida and Georgia.** In total, **approximately 306 kilometers (190 miles) of stream channels in Alachua, Bradford, Columbia, Dixie, Gilchrist, Hamilton, Lafayette, Madison, Suwannee, and Union Counties, Florida, and Brooks and Lowndes Counties, Georgia, fall within the boundaries of the proposed critical habitat designation. If we finalize this rule as proposed, it would extend the Act's protections to this species' critical habitat. The effect of this regulation is to designate critical habitat for the Suwannee moccasinshell under the Act.** We also announce the availability of a draft economic analysis of the proposed designation."

The current range for the federally threatened Suwannee moccasinshell is confined to the lower Santa Fe River, and the lower and middle Suwannee River in Madison, Suwannee, Lafayette, Gilchrist, Dixie, Columbia, Alachua, Union, and Bradford Counties, Florida (Suwannee River Water Management District, 2022). **Figure 9** shows the current range extent and critical habitat of the threatened Suwannee moccasinshell within the lower portion of the Greater Okefenokee Swamp Basin. **Figure 9** also shows the proximity of that range extent and critical habitat to White Sulpher Springs (also known as White Spring), and previously mapped fractures.

Both the historic (pre-2000) and recent (2000-2020) documented occurrences of the federally threatened Suwannee moccasinshell are shown in **Figure 10**, created by (SRWMD, 2022). **Figure 10** shows that all of the historic locations for the threatened Suwannee moccasinshell that were located in the New River, headwaters tributary to the Santa Fe River (between Bradford and Union Counties) and the upper reaches of the Santa Fe River, as the boundary between Alachua

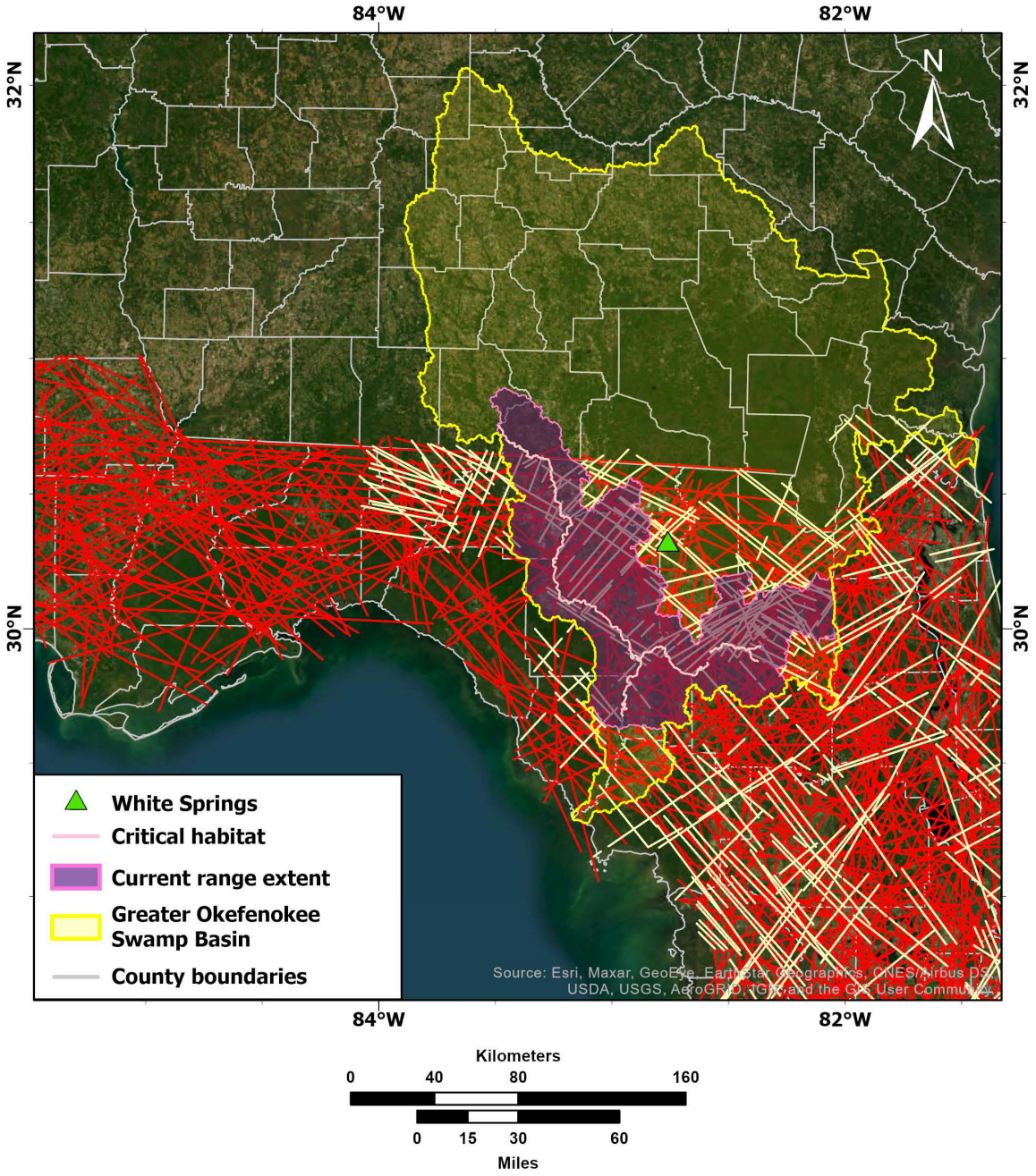

Figure 9. Critical habitat and current range extent of the threatened Suwannee Moccasinshell in proximity to the Greater Okefenokee Swamp Basin in Florida and Georgia, White Springs, and fractures previously mapped in Florida by FDOT 1973 (red diagonal lines) and in northeastern Florida by Vernon 1951 (yellow diagonal lines).

County and Bradford, Columbia, and Union Counties have been destroyed since 2000.

The body of knowledge compiled in the Part 1 and Part 2 companion studies, including but not limited to published literature, historical knowledge of long-time residents, and the author's extensive site investigations, beginning in the 1990s and continuing to the present day, in the areas of the mining of Trail Ridge. Based on the body of that knowledge, the adverse direct, indirect and cumulative

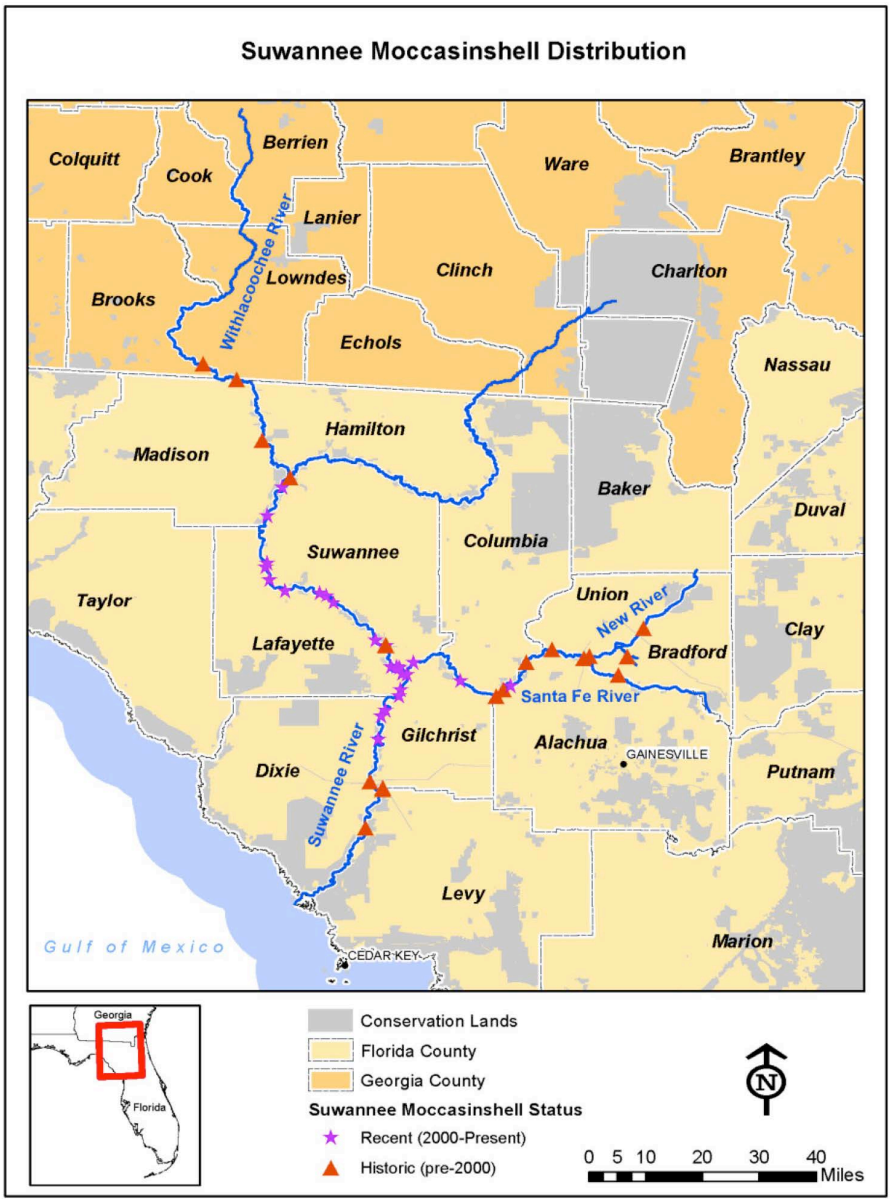

Figure 10. Suwannee Moccasinshell's recent distribution (2000-present) and historic distribution (pre-2000) in the New River, Santa Fe River, Suwannee River, and Withlacoochee River, in the Greater Okefenokee Swamp Basin in Florida and Georgia (from SRWMD, 2022).

effects of the continuing mining of Trail Ridge by DuPont/Chemours/Twin Pines in the northeast Florida portion of the Greater Okefenokee Swamp Basin (primarily Baker, Bradford, and Clay Counties) is the primary factor in the elimination of all of the historic occurrences of the Suwannee moccasinshell in the New River, headwaters tributary to the Santa Fe River and the upper reaches of the Santa Fe River. The elimination of those occurrences was due to a combination of the following direct, indirect, and cumulative actions: a) unsustainable pumping of groundwater from the regional Floridan aquifer system; b) permitted (NPDES) discharges of large volumes of contaminated mining wastewater;

and c) unpermitted (violations of the NPDES permit) discharges of even larger volumes of contaminated mining wastewater. Those direct, indirect and cumulative effects represent the following actions that the USFWS (2016) specifically identified as constituting "harm," pursuant to the ESA, to the Suwannee moccasinshell when it was listed as a federally threatened species: a) pollutants discharged or accidentally released from...mining operations; b) decreased flows due to groundwater extraction and...stream channel instability, and excessive sedimentation; and c) State and Federal water quality standards that are inadequate to protect sensitive aquatic organisms like mussels.

Despite these facts, the USFWS released a Biological Opinion to the USACOE on July 29, 2020 for "Trail Ridge Mine" [sic], approximately four years after that agency published the final rule specifically identifying those "harms" to the federally threatened Suwannee moccasinshell without even referencing that federally threatened aquatic species (USFWS, 2020b). Additionally, on June 6, 2022, approximately six years after the USFWS issued the final rule for the federally threatened Suwannee moccasinshell, the FDEP issued "Section 404" permit to Chemours for expanded mining, operations, and discharges in Bradford and Clay Counties, without any consultation for any of the federally listed species that expanded mining would harm. On July 25, 2022, after public objections to that permit, the FDEP modified that "State 404" permit issued to Chemours/Dupont on June 6, 2022, without public notice, to reference the grossly deficient USFWS Biological Opinion from two years before (USFWS, 2020b).

The harm from that Trail Ridge mining by DuPont/Chemours/Twin Pines in northeast Florida, almost certainly has extended for many kilometers (miles) from the foot print of the mining operations, via known fractures, bedding planes, and other karst conduits, to the designated critical habitat of the federally threatened Suwannee moccasinshell. Those indirect and cumulative effects also have extended to the southern portion of the Okefenokee Swamp/ONWR, harming habitat of federally listed species there. Additionally, those adverse indirect and cumulative effects would combine with those of the proposed Twin Pines mining of Trail Ridge in southeast Georgia, dewatering the entire St. Marys River and all headwater wetlands in that vicinity, similar to the dewatering of the upper Peace River and Kissengen Spring from the phosphate mining in the Peace River Basin.

The USFWS (undated) provides an online interactive map for the range extent of the federally threatened Suwannee moccasinshell that is helpful in visualizing the proximity to the existing and proposed Trail Ridge mining in northeast Florida and southeast Georgia, respectively. The dark green area on that map is the range extent for the Suwannee moccasinshell and the light green is the basemap, in this case representing the northern half of the ONWR, Osceola National Forest, and wildlife management area, all north of the Santa Fe River portion of the range extent (Keith Shannon, USFWS Acting Chief of Public Affairs, pers. com. October 18, 2020). The horizontal line extending through the southern tip of that reported wildlife management area in southeast Georgia, due

north of Macclenny, Florida, represents Highway 94. According to the Georgia Conservancy map included in the Rhone (2020) article, Highway 94 would be the southern boundary of the proposed Twin Pines heavy mineral sands (e.g., titanium) mining, that is proposed midway between the western and eastern channels of the St. Marys River, near Moniac and St. George, Georgia respectively.

The final rule for the federally threatened Suwannee moccasinshell (USFWS, 2016) also addressed areas of shared habitat between the federally threatened Suwannee moccasinshell and the federally threatened Gulf sturgeon. The following specific example emphasizes the fact that all of the adverse direct, indirect, and cumulative effects of the Trail Ridge and other mining, including unsustainable groundwater withdrawals, in the headwaters of the Santa Fe and Suwannee Rivers also will "harm" the federally threatened Gulf sturgeon and the habitat essential for its survival and recovery (emphasis added):

> **"The majority of the stream channels currently occupied by the Suwannee moccasinshell, including the Suwannee River mainstem and the lower Withlacoochee River, are also occupied by, or designated as critical habitat for, the federally threatened Gulf sturgeon. The lower Santa Fe River is the only area occupied by Suwannee moccasinshell, but not by Gulf sturgeon**. Therefore, because **activities that affect the Suwannee moccasinshell would also affect the Gulf sturgeon or its habitat (for example, dredging, filling, modification of stream channels or banks, and discharge of pollutants), in the majority of the Suwannee moccasinshell's current range**...".

Summary—The entire surviving population, entire critical habitat and range extent for the federally threatened Suwannee moccasinshell occur only within the Greater Okefenokee Swamp Basin (**Figure 9**). Much, if not most, of that proposed critical habitat for the Suwannee moccasinshell already has been subjected to "significant habitat modification or degradation where it actually kills or injures wildlife" from indirect, as well as cumulative adverse impacts from the heavy mineral sands (e.g., titanium) mining activities by Chemours/DuPont/Twin Pines, primarily in Baker, Bradford, and Clay Counties, Florida headwaters of the Santa Fe River, in addition to other mining activities in the lower Santa Fe River in Alachua County, Florida, including within the Santa Fe River floodplains (Bernardes et al., 2019). Adverse indirect and cumulative effects from the decades of phosphate mining and processing activities in White Springs, Hamilton County, Florida contribute to those cumulative effects, particularly for the population of the federally threatened Suwannee moccasinshell critical habitat in the Suwannee River. Additional "significant habitat modification or degradation where it actually kills or injures wildlife" from individual indirect, as well as cumulative adverse impacts within that proposed critical habitat for the Suwannee moccasinshell will occur from the newly permitted expansion of heavy mineral sands (e.g., titanium) mining activities by Chemours/DuPont/Twin Pines in

Bradford County, Florida, as would the proposed phosphate mining by HPSII in Bradford and Union Counties, Florida and the additional Trail Ridge mining proposed by Twin Pines between the channels of the St. Marys River, on the north side of Highway 94 in southeast Georgia. The Biological Opinion (USFWS, 2020b) incorporated by FDEP to justify issuance of the recent "State 404" mining expansion of Trail Ridge by Chemours/DuPont in Bradford County failed to address all of this "harm" to the critical habitat and range extent for federally threatened Suwannee moccasinshell.

4. Conclusion

The evidence provided in this study and in the related study by Bacchus et al. (2023) supports the conclusion that irreversible adverse impacts to ground water from mining alter the physical, chemical, and biological integrity of the nation's waters, violating the CWA of 1972. Photographs included in this study illustrate the most severe violations of the CWA antidegradation requirements for the physical, chemical, and biological integrity of the nation's waters, as the entire flow of those surface waters was captured for phosphate mining. Those photographs also illustrate the total destruction of the "fishable, swimmable" standard for surface waters described in the CWA. Those alterations also jeopardize the survival and recovery of federally endangered and threatened marine and aquatic species and the essential and critical habitat for those species. This study evaluated examples of federally listed marine and aquatic species that rely on essential or critical habitat within various parts of the Greater Okefenokee Swamp Basin, for survival and recovery. Those federally listed marine and aquatic species already have been jeopardized by indirect and cumulative adverse impacts of anthropogenic groundwater alterations. Those examples included the federally endangered Distinct Population Segments of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), and oval pigtoe mussel (*Pleurobema pyriforme*), as well as the federally threatened Gulf subspecies of the Atlantic sturgeon (*Acipenser oxyrinchus desotoi*) and Suwannee moccasinshell (*Medionidus walkeri*). The jeopardized survival and recovery of those species and their critical and essential habitats have occurred and will continue because the USFWS and NOAA NMFS have failed to consider adverse cumulative impacts of proposed actions on ground water within the Greater Okefenokee Swamp Basin and other areas of the Southeastern Coastal Plain Ecoregion. No evidence was found that the USACOE or the USEPA routinely considers those adverse impacts in reviews of mining applications in the Greater Okefenokee Swamp Basin or the Southeastern Coastal Plain Ecoregion. Finally, both the USACOE and the USEPA have failed to require a comprehensive AEIS, similar to the AEIS that was required by those agencies for mining within the Peace River Basin, for any of the numerous mining projects that continue to expand within the Greater Okefenokee Swamp Basin in both northeast Florida and southeast Georgia.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendices

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Appendix A. EarthJustice 2019 Center for Biodiversity et al. v USEPA et al. Florida 404 Assumption Federal Lawsuit (77-main 4/19/22).

Appendix B. Background of the CWA, concerns about protection of aquatic ecosystems, and connectivity during Congressional creation of the CWA* (from Conservation Law Foundation et al. v. USEPA and USACOE, 2020).