Mississippi's Resiliency and Changing Environmental Conditions

Cooperative Report: Funded by the U.S. Geological Survey and U.S. Fish and Wildlife Service

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Table of Contents

Foreword

Series Overview

The following report is part of a multi-state series synthesizing the potential hazards of changing environmental conditions on U.S. southeastern Ecoregions and wildlife vulnerabilities. The series was developed through an interagency collaboration among the U.S. Geological Survey (USGS) Southeast Climate Adaptation Science Center (CASC), the U.S. Fish and Wildlife Service Southeast Conservation Adaptation Strategy, and partners, with input from the South Central CASC and the Southeastern Association of Fish and Wildlife Agencies' Wildlife Diversity Technical Committee. The effort supports the integration of climate adaptation considerations into 2025 State Wildlife Action Plan (SWAP) revisions, following guidance from the Association of Fish and Wildlife Agencies and U.S. Fish and Wildlife Service encouragement in 2012 (AFWA, 2022). To ensure consistency and comparability across states and territories, certain components, such as the process description, methodological explanations, and summaries of region wide climate trends, are standardized across the series and may appear verbatim from one report to another; each report then applies this shared framework to the context of an individual state or territory. Therefore, only the first report of this series is cited in text to indicate these instances.

How to Use This Report

This report was organized to support Mississippi's SWAP revision team in applying climate adaptation information directly to planning needs. The standardized Series Overview and Process sections provide the foundational framework and methodological approach used throughout the broader series. All subsequent sections present analyses, figures, interpretations, and wildlife impact considerations developed specifically for Mississippi. Readers can use the Mississippi tailored results—such as hazard summaries, ecological context, and vulnerability insights—to inform updates to Species of Greatest Conservation Need (SGCN) assessments, habitat narratives, monitoring strategies, and adaptation actions within the state's SWAP. Instances where text aligns with other state reports reflect shared series wide methods, while all ecological interpretation and applied management considerations are customized to Mississippi.

Process

To effectively synthesize the potential hazards of changing environmental conditions on Ecoregions of the Southeast and vulnerability of their wildlife, the SE CASC developed a process comprised of the following steps: 1) summarize historical means and future projected changes of select environmental risks by Ecoregion; 2) summarize available vulnerability assessments and niche models (i.e., species distribution models) for each state's/territory's revised Species of Greatest Conservation Need (SGCN) list; 3) conduct a literature review of impacts from changing environmental conditions to a specific taxon or habitat of each agency's choosing. Ecoregions as characterized by the Environmental Protection Agency (EPA) were chosen to summarize historical means and projections for the continental states of the southeastern U.S., in accordance with how SWAPs are generally organized and to efficiently inform management. We used EPA Level III Ecoregions due to the popularity of use by Southeast state wildlife agencies. Existing data collections of both historical climatology and future projections were used to calculate means for each Ecoregion within each state's boundaries and maps of future projections were created using the Fifth National Climate Assessment (NCA5) Interactive Atlas in ArcGIS Pro (Alder, 2024; Pierce et al., 2021; Shanovich et al., 2026; NCA5 Atlas Data). Each state or territory wildlife agency cooperator chose which Global Warming Levels and projection scenarios for inclusion. Additionally, existing data collations were used to summarize vulnerability assessments and niche models conducted for each state's and territory's SGCN (Armsworth et al., 2025a, 2025b). For each habitat or taxonomic group identified by a state or territory wildlife agency, we reviewed and synthesized available scientific literature. We searched for relevant literature related to these habitats and species that either explicitly mentioned or indirectly discussed impacts of changing environmental conditions.

For coastal Southeast states and territories, information pertaining to sea-level rise was taken from the National Oceanic and Atmospheric Administration (NOAA) via their Sea-level Rise Technical Reports and Sea-level Rise Viewer Tool (Sweet et al., 2022). The NOAA 2022 sea-level rise projection dataset was obtained from the official technical report download portal (https://earth.gov/sealevel/us/resources/2022-sea-level-rise-technical-report/) and processed to generate spatially explicit projection layers for use within the Southeast region. The source file (SLR_TF U.S. Sea Level Projections.csv) was ingested, and records were limited to one-degree grid cells overlapping the Southeast geography. Following the instructions provided in the dataset header, 2000–2005 offset values were applied to all future projections, and all sea-level rise values were converted from meters to feet. Scenario identifiers were standardized to match the naming conventions used in the NOAA report, and the dataset was restructured to produce separate fields for each scenario and decadal timestep at each grid-cell centroid. Geographic boundaries for each one-degree cell were calculated in WGS84 and reprojected to EPSG:5070 to align with other spatial data layers; the resulting grid was then clipped to the Southeast boundary. For each state, all intersecting one-degree cells were identified within the state boundary, including cells that overlap the analysis boundary but are not directly associated with the physical coastline or immediate coastal areas. Intersection areas were calculated, and area-weighted averages of sea-level-rise projections were computed for each scenario and decade. The associated Python workflow is available through GitHub (https://github.com/astutespruce/secas-blueprint/blob/main/analysis/prep/prepare_slr.py#L369).

Executive Summary

Mississippi is experiencing shifts in environmental conditions, many of which are expected to intensify in the coming decades, and will have important implications for ecosystems, species, and natural resource management across the state. Historical climate analyses and downscaled projections summarized for the state's Environmental Protection Agency (EPA) level III Ecoregions show that Mississippi will likely face increases in extremely hot days, more intense heatwaves, greater evapotranspiration, and reductions in cold-season extremes.

Temperature trends indicate that while Mississippi has warmed relatively little over the last century, recent years have been among the warmest on record. Projections suggest substantial increases in the number of days with maximum temperatures at or above 95°F across all Ecoregions, particularly under higher warming scenarios. Correspondingly, the number of freezing nights is expected to decline, with statewide decreases of 7–21 days depending on the global warming level and timeframe. These combined patterns are likely to reshape habitat conditions, influence species' thermal stress, and alter ecological processes such as soil moisture retention and stream temperature regimes.

Mississippi's hydrological systems are also expected to be significantly affected. Extreme rainfall events, particularly the most intense 1% of precipitation days, are projected to increase across the state, raising risks of flooding, erosion, and altered stream flow. Coastal Mississippi faces additional stress from sea-level rise, which is already contributing to more frequent high-tide flooding; projections show continued increases in inundation risk throughout the century. These flooding patterns, combined with stronger hurricane rainfall rates and the potential for landfalling storms to stall, pose ongoing threats to coastal ecosystems and communities.

The state is also vulnerable to extreme weather hazards such as tornadoes. Recent research shows a geographic shift in tornado activity toward the Southeast, with Mississippi experiencing some of the nation's greatest increases in favorable tornado days and nighttime tornado frequency—hazards that have direct implications for wildlife, habitat stability, and human safety. Drought conditions may intensify as well: higher temperatures and increased evapotranspiration during dry spells could worsen water stress regardless of uncertainty in average annual precipitation.

These changing environmental conditions have important consequences for Mississippi's Species of Greatest Conservation Need (SGCN). Vulnerability assessments and ecological niche models indicate that several fish, mussel, crayfish, plant, amphibian, bird, and mammal species may face heightened stress due to warming temperatures, shifting hydrology, habitat loss, and increases in extreme events. For example, many cold-water and moisture-dependent species in the state's rivers and wetlands are already near their thermal limits, and further warming could reduce suitable habitat. Birds breeding in bottomland hardwood forests, such as the Prothonotary Warbler, are increasingly susceptible to nest loss from flooding. Similarly, species like the Louisiana Black Bear may encounter higher risks from habitat inundation and shifting food availability.

The "A Closer Look" section underscores the vulnerability of the Mississippi Alluvial Plain—one of the state's most ecologically rich yet heavily altered Ecoregions. Its bottomland hardwood forests, wetlands, and floodplain habitats support diverse wildlife but are increasingly threatened by rising temperatures, hydrological changes, development pressures, and compounded disturbances. These habitats provide

critical ecosystem services such as water filtration, flood attenuation, and biodiversity support, making their conservation particularly urgent under future conditions.

Collectively, these findings indicate that Mississippi's ongoing and projected environmental changes present both challenges and opportunities for natural resource management. Incorporating adaptation strategies into the State Wildlife Action Plan will be essential for sustaining habitats, mitigating risks, and supporting the long-term resilience of Mississippi's wildlife and ecosystems.

Mississippi and changing environmental conditions

In the Southeast, changing environmental conditions may have pervasive impacts on natural habitats, ecological processes, and ecosystem services and regional efforts to mitigate or adapt to these impacts could be extremely important (Hoffman et al., 2023). Recent analyses indicate that current trends in the Southeast are likely to continue, such as the rising frequency, strength, and duration of heatwaves, elevated wildfire risk, and ongoing sea-level rise (Hoffman et al., 2023). The most notable projected changes include greater extreme heat, more intense precipitation events, increased drought, rising seas, and tropical cyclones, accompanied by reduced intensity and occurrence of cold-season conditions (Hoffman et al., 2023). Despite the significant threat changing environmental conditions pose to the landscape, understanding the tools and resources available to address climate change and develop effective strategies is difficult. As part of the survey administered to SWAP coordinators in 2021, the majority of Southeastern Association of Fish and Wildlife Agencies (SEAFWA) states/territories reported integrating adaptation as one of the most challenging aspects of the upcoming SWAP revision (SECAS, 2021). Anecdotally, some SWAP coordinators noted that it is difficult to discern what tools are available, decide which tool is the right one to use, and choose the appropriate scale and timeframe when using tools (SECAS, 2021). Like the rest of the Southeast, Mississippi is predicted to experience a number of impacts from changing environmental conditions, though the magnitude of change often varies by Ecoregion, scenario, and future timeframe. Generally, these impacts include hotter summers, warmer winters, more frequent extreme precipitation events, and rising sea levels (Hoffman et al., 2023).

Hotter days and nights and cascading impacts

Mississippi has experienced only a slight temperature increase—about 0.1°F—since the early 1900s, making it one of the few regions worldwide with minimal overall warming (Runkle et al., 2022). Still, temperatures have been notably high in recent years, with 2016–2020 marking the warmest five-year span on record. (Runkle et al., 2022). Additionally, heatwaves in the Southeast have become hotter, more frequent, larger, and longer lasting in recent decades and are projected to continue, which has implications for drought in the region (Hoffman et al., 2023). Table 1 summarizes historical observed and future projections of extremely hot days (maximum temperatures ≥95°F) under different shared socioeconomic pathway (SSP) scenarios for Mississippi Ecoregions. Another way to look at future projections is through the lens of Global Warming Levels (GWLs): if the earth surpasses a GWL of 1.5°C (2.7°F) or 2°C (3.6°F) for a sustained period of time, the number of extremely hot days may increase across the state, compared to the past 30 years (1991-2020) (Figure 1). Estimates of when these GWL might be reached depend on the SSP. Overall, the number of extremely hot days (maximum temperatures ≥95°F) may increase across Mississippi, with the most pronounced increases projected to occur in the eastern portion of the state, though the magnitude of change often varies greatly by GWL or SSP and location within the state (Hoffman et al., 2023; Figure 1 & Table 1). If the warming trends continue, future heat waves are likely to be more intense. Higher temperatures throughout the year also could increase the rate of soil moisture loss (i.e., evapotranspiration) during dry spells, which may lead to more intense droughts (Runkle et al., 2022). In other words, more days of extreme heat can exacerbate drought conditions.

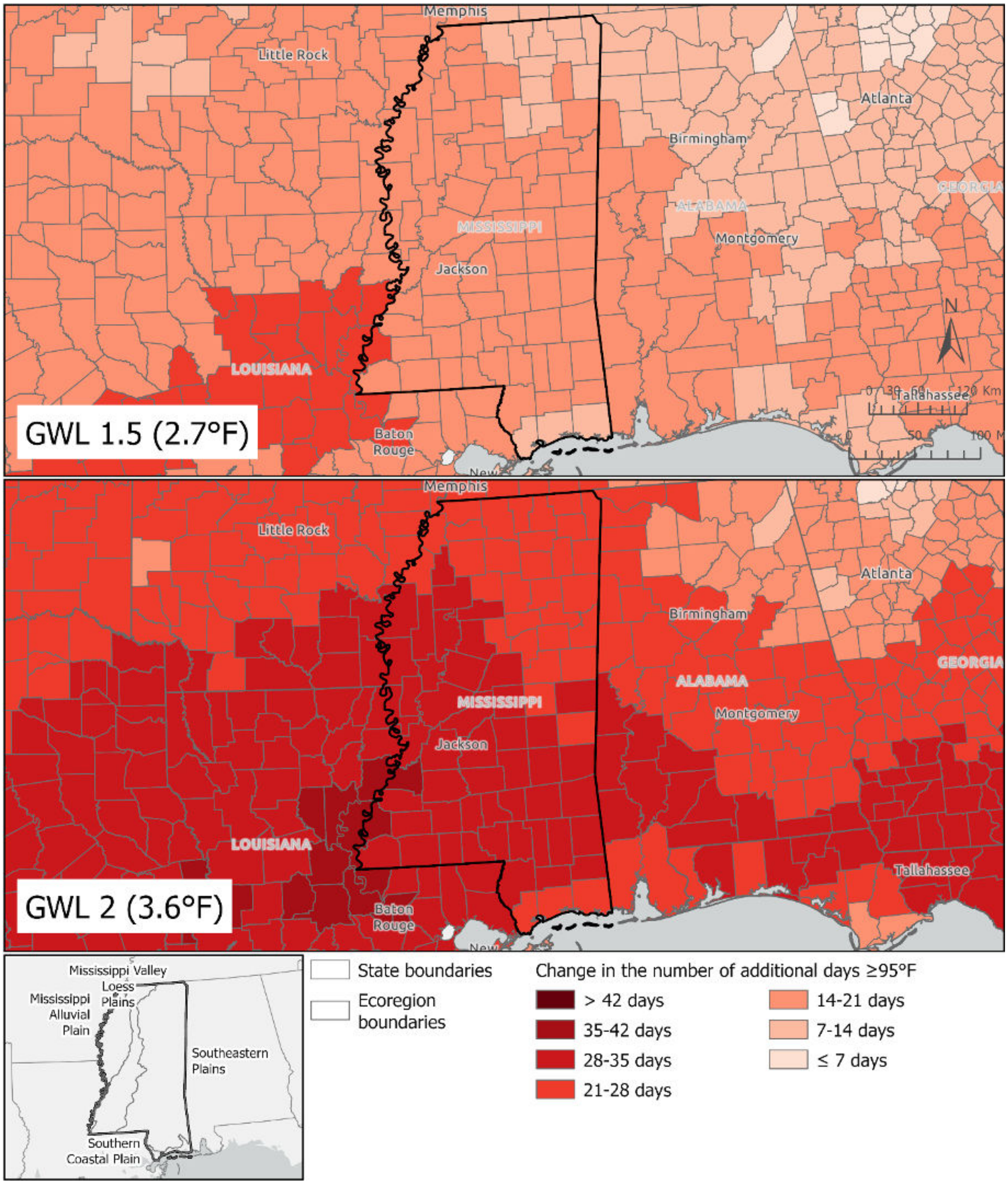

Figure 1. Projected future changes in the number of days of extreme maximum temperatures (threshold temperature of 95°F) per year compared to preindustrial levels (1851-1900) based on GWL 1.5°C (global temperature increase of 2.7°F) 2°C (global temperature increase of 3.6 F°). Figure created from data in the 'NCA5 Interactive Atlas" web tool (NCA5 Atlas Data | Interactive Atlas accessed on 1 February 2024) via ArcGIS Pro.

Table 1. Approximate observed historical and the future projected number of extremely hot days per year (i.e., days with high temperatures of at least 95 °F) by EPA Level III Ecoregions within Mississippi. The table summarizes projected future number of days for low, moderate, and high scenario, called Shared Socioeconomic Pathways (SSPs), using CMIP6-LOCA2 threshold and extreme event metric projections (Alder, 2024) summarized at the Ecoregion level (Shanovich et al., 2026). For each future time period, numbers in parentheses represent the

percent change between the models' future projections and the models' historical simulations. Observed historical summaries were generated with data from Pierce *et al.* (2021) (Shanovich et al., 2026).

Historical & Future Projections: Number of Days with Maximum Temperatures ≥ 95°F			
Shared Socioeconomic Pathway (SSP)	Observed Historical: **1950-2014**	**2025-2049** projections (percent change from historical simulation)	**2050-2074** projections (percent change from historical simulation)
Mississippi Alluvial Plain Ecoregion			
Low (SSP2-4.5)	18 days/year	57 days/year (164%↑)	73 days/year (238%↑)
Moderate (SSP3-7.0)		54 days/year (152%↑)	76 days/year (254%↑)
High (SSP5-8.5)		59 days/year (173%↑)	88 days/year (303%↑)
Mississippi Valley Loess Plains Ecoregion			
Low (SSP2-4.5)	18 days/year	48 days/year (222%↑)	66 days/year (344%↑)
Moderate (SSP3-7.0)		45 days/year (200%↑)	70 days/year (369%↑)
High (SSP5-8.5)		51 days/year (239%↑)	82 days/year (446%↑)
Southeastern Plains Ecoregion			
Low (SSP2-4.5)	18 days/year	46 days/year (200%↑)	63 days/year (310%↑)
Moderate (SSP3-7.0)		43 days/year (183%↑)	67 days/year (335%↑)
High (SSP5-8.5)		49 days/year (216%↑)	79 days/year (412%↑)
Southern Coastal Plain Ecoregion			
Low (SSP2-4.5)	19 days/year	28 days/year (275%↑)	45 days/year (494%↑)
Moderate (SSP3-7.0)		27 days/year (256%↑)	49 days/year (555%↑)
High (SSP5-8.5)		32 days/year (325%↑)	63 days/year (739%↑)

In addition to higher maximum temperatures, the number of days with minimum temperature below freezing (i.e., extremely cold days) are projected to decrease in the state (Figure 2; Table 2). Table 2 summarizes approximate values for historical observed and future projections of the number of cold days under different SSP scenarios for Mississippi's Ecoregions; while Figure 2 shows the projected future percent change in the number of extremely cold days per year (e.g., days with low temperatures of ≤ 32°F) in Mississippi at GWL 1.5 (2.7°F increase globally) and 2 (3.6°F increase globally) compared to the last 30 years. Overall, the number of cold days in Mississippi is projected to decrease between seven and ten days under GWL 1.5 and ten to 21 fewer under GWL 2 across the vast majority of the state, though the magnitude of change often varies by location within the state (Table 2; Figure 2).

While these shifts in air temperature are important on their own, they also have cascading effects on Mississippi's freshwater systems. Because air and water temperatures are tightly connected, the warming of the atmosphere inevitably influences the thermal regimes of streams and rivers. Mississippi harbors a large diversity of both warm-water and cold-water fishes. Freshwater ecosystems are projected to warm in response to rising air temperatures, though this relationship is not one-to-one; factors such as flow, shading, and groundwater inputs strongly shape how much stream temperatures ultimately shift (Graf, 2019; van Vliet et al., 2023). Because air and stream temperatures are closely linked, this means a reduction in the number of cold nights may cause warmer winter stream temperatures. In fact, a recent study found that in cold streams across the U.S., fish abundance declined by over 50% and species richness by 32% over 27 years; although warming temperatures were an important driver, the authors noted that other factors—such as altered flows, water quality degradation, sedimentation, and the influence of introduced or stocked species—also contributed to these declines (Rumschlag et al., 2025). Cold-water fish in Mississippi may be especially vulnerable because they are already near their thermal limits at the southern ends of their ranges – See ‘A closer look’ section of this report for species examples.

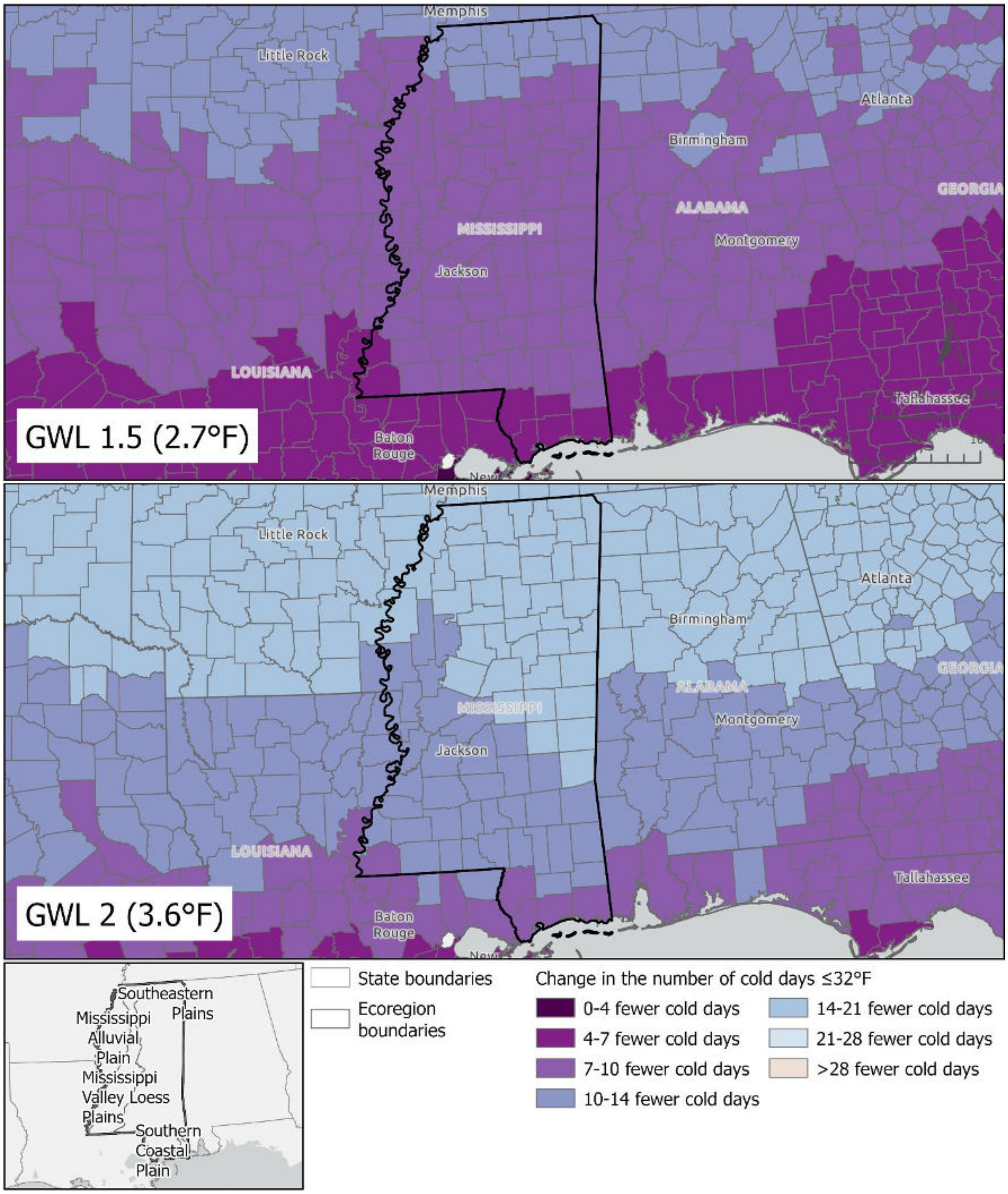

Figure 2. Change in days per year with minimum temperatures that reach or drop below freezing (32°F) in Mississippi compared to preindustrial levels (1851-1900) based on GWL 1.5°C (global temperature increase of 2.7°F) 2°C (global temperature increase of 3.6 F°). Note that this is not the total number of days, as presented in the table above, but the number of additional days where temperatures will reach 32°F or below. Figure created from data in the ‘NCA5 Interactive Atlas” web tool (NCA5 Atlas Data | Interactive Atlas accessed on 1 February 2024) via ArcGIS Pro.

Table 2. Approximate observed historical and the future projected number of extremely cold days per year (i.e., days with low temperatures of at least 32°F) by EPA level III Ecoregions within Mississippi. The table summarizes projected future number of days for low, moderate, and high Shared Socioeconomic Pathways (SSP) using CMIP6-LOCA2 threshold and extreme event metric projections (Alder, 2024) summarized at the Ecoregion level (Shanovich et al., 2026). For each future time period, numbers in parentheses represent the percent change between the models' future projections and the models' historical simulations. Observed historical summaries were generated with data from Pierce et al. (2021) (Shanovich et al., 2026).

Historical & Future Projections: Number of Days with Minimum Temperatures ≤ 32°F			
SSP	Observed Historical: **1950-2014**	**2025-2049** projections (percent change from historical simulation)	**2050-2074** projections (percent change from historical simulation)
Mississippi Alluvial Plain Ecoregion			
Low (SSP2-4.5)	45 days/year	31 days/year (32%↓)	27 days/year (43%↓)
Moderate (SSP3-7.0)		32 days/year (30%↓)	25 days/year (46%↓)
High (SSP5-8.5)		30 days/year (35%↓)	22 days/year (52%↓)
Mississippi Valley Loess Plains Ecoregion			
Low (SSP2-4.5)	47 days/year	33 days/year (31%↓)	28 days/year (41%↓)
Moderate (SSP3-7.0)		34 days/year (29%↓)	27 days/year (44%↓)
High (SSP5-8.5)		31 days/year (34%↓)	24 days/year (50%↓)
Southeastern Plains Ecoregion			
Low (SSP2-4.5)	52 days/year	37 days/year (29%↓)	32 days/year (38%↓)
Moderate (SSP3-7.0)		38 days/year (27%↓)	31 days/year (41%↓)
High (SSP5-8.5)		36 days/year (31%↓)	27 days/year (47%↓)
Southern Coastal Plain Ecoregion			
Low (SSP2-4.5)	19 days/year	12 days/year (41%↓)	10 days/year (50%↓)
Moderate (SSP3-7.0)		12 days/year (36%↓)	9 days/year (54%↓)
High (SSP5-8.5)		11 days/year (42%↓)	8 days/year (60%↓)

Extreme weather events

Precipitation

Future projections suggest that the Southeast region may become wetter overall, with increases of some seasonal precipitation averages and the annual precipitation average (Hoffman et al., 2023). Extreme precipitation amounts may increase across the Southeast, largely because very heavy precipitation events (such as receiving 3 or more inches in a single day) are expected to occur more frequently at higher global warming levels (Hoffman et al., 2023). There are no robust trends in total annual precipitation for Mississippi, meaning future changes in average precipitation are uncertain, but the frequency and intensity of extreme rainfall is projected to increase (Runkle et al., 2022; Hoffman et al., 2023). For Mississippi, extreme weather events usually take the form of severe storms, tornadoes and flooding events, with 23 of the 29 disaster declarations for the state between 2005 and 2020 being for these three types (Runkle et al., 2022). Flooding occurs frequently in the state, with the main flood season running from November through June, when the Mississippi River typically reaches its highest flows, but unprecedented rainfall upstream has been known to cause largescale historic floods (Runkle et al., 2022). Table 3 summarizes approximate values for future projected changes of extreme rainfall under different SSPs for Mississippi Ecoregions; while Figure 3 shows the projected future percent change in the number of days per year with extreme precipitation (e.g., days with the top 1% of rainfall events) in Mississippi at GWL 1.5 (2.7°F warming) and GWL 2 (3.6°F warming) compared to the last 30 years. While all Ecoregions within Mississippi may experience changes in days with extreme precipitation, the northern part of the state, in the Mississippi Alluvial Plain, Mississippi Valley Loess Plains and Southeastern Plains Ecoregions, is projected to experience the greatest percent change by GWL 2 (Figure 3; Table 3).

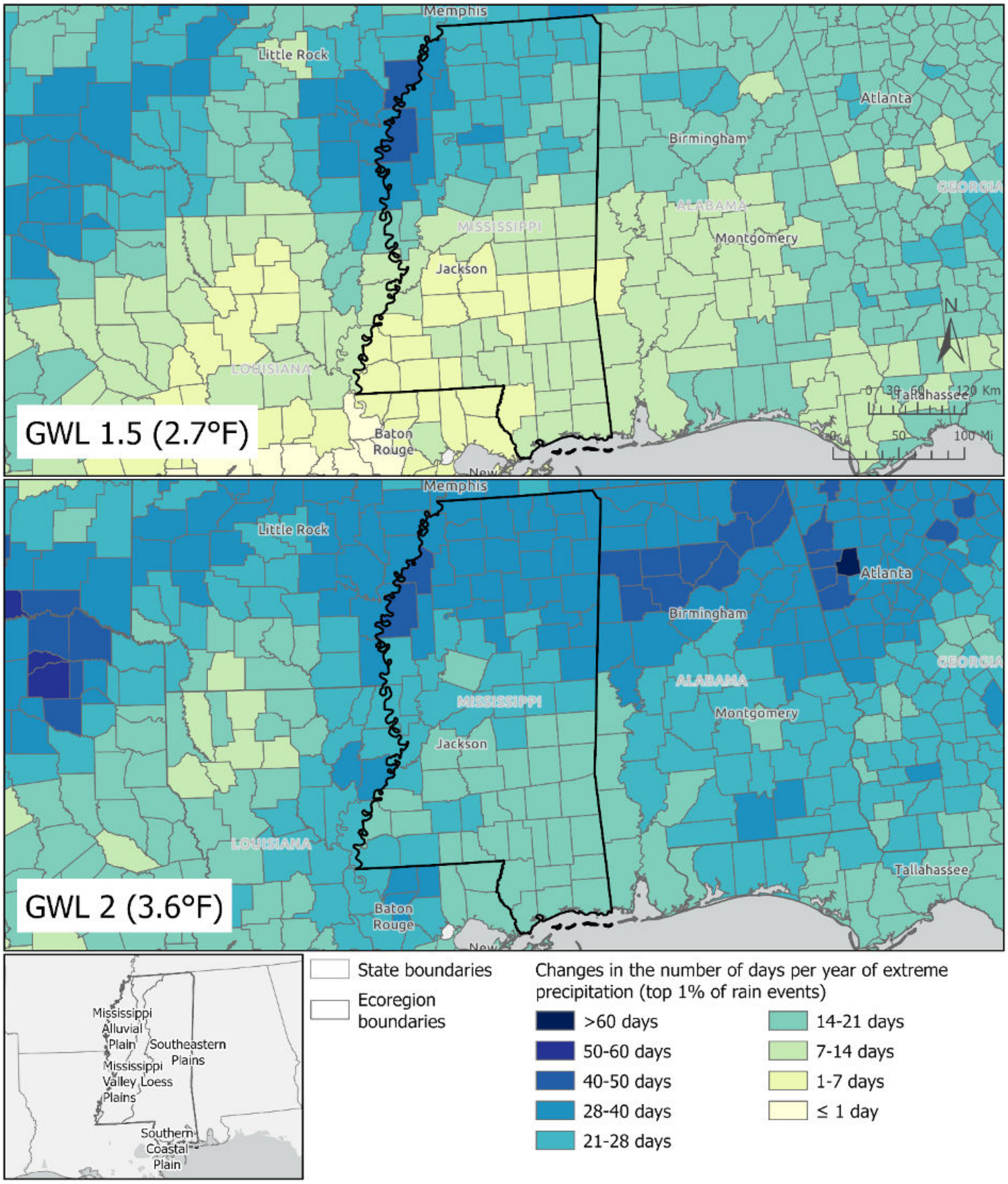

Figure 3. Future projected changes in the number of days per year of extreme precipitation (top 1% of rain events) in Mississippi counties compared to preindustrial levels (1851-1900) based on GWL 1.5°C (global temperature

increase of 2.7°F) 2°C (global temperature increase of 3.6 F°). Figure created from data in the 'NCA5 Interactive Atlas" web tool (NCA5 Atlas Data | Interactive Atlas accessed on 1 February 2024) via ArcGIS Pro.

Table 3. Approximate observed historical and future projected number of days per year with extreme precipitation events (in the top 1% of historical rainfall events) for EPA level III Ecoregions within Mississippi. The table summarizes projected future number of days for low, moderate, and high Shared Socioeconomic Pathways (SSP) using CMIP6-LOCA2 threshold and extreme event metric projections (Alder, 2024) summarized at the Ecoregion (Shanovich et al., 2026). For each future time period, numbers represent the percent change between the models' future projections and the models' historical simulations. Observed historical summaries were generated with data from Pierce et al. (2021), Shanovich et al., 2026).

Historical & Future Projections: Number of Days with Extreme Rainfall			
SSP	Observed Historical: **1950-2014**	**2025-2049** projections (percent change from historical simulation)	**2050-2074** projections (percent change from historical simulation)
Mississippi Alluvial Plain Ecoregion			
Low (SSP2-4.5)	3.5 days/year	28%↑	35%↑
Moderate (SSP3-7.0)		32%↑	39%↑
High (SSP5-8.5)		30%↑	50%↑
Mississippi Valley Loess Plains Ecoregion			
Low (SSP2-4.5)	3.6 days/year	23%↑	27%↑
Moderate (SSP3-7.0)		29%↑	32%↑
High (SSP5-8.5)		23%↑	40%↑
Southeastern Plains Ecoregion			
Low (SSP2-4.5)	3.5 days/year	25%↑	31%↑
Moderate (SSP3-7.0)		32%↑	36%↑
High (SSP5-8.5)		25%↑	40%↑
Southern Coastal Plain Ecoregion			
Low (SSP2-4.5)	4 days/year	15%↑	25%↑
Moderate (SSP3-7.0)		19%↑	22%↑
High (SSP5-8.5)		17%↑	26%↑

In the Southeast coastal region, extreme weather events are generally characterized by hurricanes and storms that may likely increase in frequency and magnitude (Hoffman et al., 2023). Tropical storms have produced many of the region's most destructive flooding events in recent years, and models project that hurricane strength and rainfall intensity will continue to increase (Hoffman et al., 2023). Hurricanes are also becoming more prone to slowing or stalling near the Gulf coast, a shift that magnifies rainfall-driven flood hazards (Hoffman et al., 2023). The Southeast has endured more billion-dollar disasters than any other region, and Mississippi has been hit by 97 such events between 1980 and 2022; the 2018 landfall of Tropical Storm Gordon underscores the state's ongoing vulnerability to destructive tropical systems (Hoffman et al., 2023). On average (1900–2020), Mississippi is directly impacted by a hurricane about once every 6 years that can cause both extensive damage along the coast and inland, such as the extensive damage from Hurricane Katrina in 2005 (Runkle et al., 2022). Hurricanes bring strong winds that can spawn tornadoes and cause widespread wind damage besides flooding (Coleman et al., 2024). In fact, tornadoes and hurricanes are two of the deadliest weather hazards in Mississippi: between 1895 and 2019, an estimated 43 tornadoes, typically occurring in the spring and fall, touched down in

Mississippi each year (Runkle et al., 2022). Hurricane-induced storm surges along the Mississippi Gulf Coast occur over a broad range of recurrence frequencies, and events producing water levels of at least 15 feet have an approximate mean return period of 25 years (Runkle et al., 2022). A storm surge reaching 15 feet can generate severe coastal inundation, overtopping natural and engineered barriers, mobilizing large volumes of debris, and exerting hydrodynamic forces sufficient to undermine building foundations, erode roadbeds, and damage critical infrastructure across low-lying areas.

Tornadoes

Tornadoes are short-lived, lasting from a few seconds to hours as opposed to days or weeks at time and span a much shorter area than hurricanes, which makes them very difficult to model. Instead, we can examine potential changes in individual weather "ingredients" that support the development of supercell thunderstorms that then produce tornadoes (e.g., warm, moist air, an unstable atmosphere, and wind shear). Mississippi regularly experiences tornados and between 1985-2019, the state averaged approximately 46 tornadoes per year (Runkle et al. 2022). In fact, Mississippi experienced its all-time highest annual number of tornadoes in 2019 at 113 tornadoes that year (Runkle et al. 2022). Recent tornado research has been showing evidence for two phenomena: 1) tornado events are becoming more clustered (i.e., there are fewer days with at least one tornado per year but more days with over 30) (Tippett et al. 2016), and 2) tornado patterns have shifted geographically (Gensini and Brooks 2018). Tornado occurrence has decreased in the states historically associated with the Great Plains 'Tornado Alley,' whereas tornado activity has risen across Mississippi and adjacent states in the region known to meteorologists as 'Dixie Alley,' an area characterized by high tornado frequency in the Southeast (Gensini and Brooks 2018). Within Mississippi, the areas most associated with Dixie Alley, and therefore functioning as Mississippi's tornado-alley region, include the North (e.g., counties of Benton, Marshall, Lafayette, Tippah, Union, Lee), Northeast, and Northwest Mississippi/the Delta (Figure 4). The number of favorable tornado days per decade since 1979 has increased throughout the region with northern Mississippi as a whole experiencing more tornadoes than the rest of the state (Figure 4A). Figure 4A shows many counties in northern Mississippi having three more days per decade and the counties of Benton, Lafayette and Marshall seeing the country's highest change at four additional days. There is also evidence that tornadoes are becoming more powerful in the U.S., with increased tornado activity now in the Southeast region than previously (Elsner and Schroder 2018; Gensini and Brooks 2018). Figure 4B shows that a substantial proportion of Mississippi tornadoes occur at night, with approximately 35–45% of all tornado events happening during nighttime hours. While tornadoes occur year-round in Mississippi there is a distinct tornado season with a high peak of events in April and a second, smaller peak in November (Runkle et al. 2022). Wildlife is impacted by tornadoes via wind damage to their habitats, for example, the removal of forest canopy.

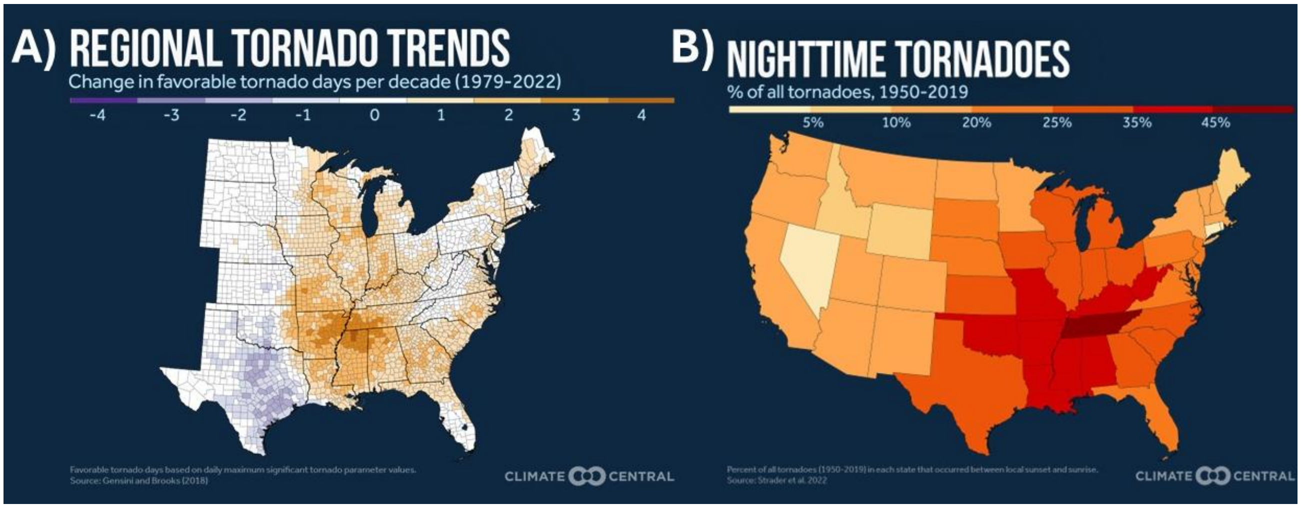

Figure 4. Calculations showing A) the change in the number of favorable tornado days per decade from 1979 to 2022 at the county-level for the eastern United States (U.S.), and B) percent of total nighttime occurring tornadoes from 1950 to 2019 for the U.S. Reprinted from Climate Central (in the public domain available for public download) using data from NOAA NCEI (Climate Central 2024; NOAA NCEI 2025).

Drought

The Southeast is the only region in the eastern half of the U.S. that is prone to extreme drought and longer-term droughts in the Southeast appear to be increasing in severity (Hoffman et al. 2023). Any increases in temperature could cause more rapid loss of soil moisture during consecutive dry days (i.e., consecutive days without rainfall), increasing the intensity of naturally occurring droughts in the future (Runkle et al., 2022). Although hydrological droughts have become less frequent in eastern regions of the country since the 19th century, higher increases in evapotranspiration (the processes by which water is transferred to the atmosphere from Earth's surface) have generally made the Southeast more drought-prone than the Northeast (Hoffman et al., 2023). A recent example of extreme drought for Mississippi was when excessive heat and drought parched the Mississippi River in the summer and early fall of 2023 resulting in extreme and exceptional drought and low water levels for the entire southern half of the state (Cassidy, 2023). However, future changes in the annual number of consecutive extreme dry days in Mississippi are not projected to increase substantially: 1% to 5% increase by 2025-2049, and 1% to 6% increase by 2050-2074 depending on Ecoregions and SSP (Alder, 2024; Shanovich et al. 2026). Therefore, in Mississippi, projected drought intensification is expected to be governed primarily by thermally driven increases in evapotranspiration and soil moisture depletion, with temperature-induced drying exerting a stronger influence than comparatively minor and seasonally variable changes in precipitation (Runkle et al., 2022).

Future projections indicate that streamflow across the southeastern US, including Mississippi, is expected to generally decrease by approximately 10% through the year 2099, with the largest reductions in runoff (a proxy for streamflow) occurring in the western and southern parts of the region (LaFontaine et al., 2019; Figure 5). However, localized increases in runoff may occur near expanding metropolitan areas due to urbanization and increased impervious surfaces, while most rural and agricultural areas—including much of Mississippi—are projected to experience reduced streamflow volumes, especially during winter and summer seasons (LaFontaine et al., 2019; Figure 5).The Southeast has the highest aquatic diversity of any temperate system; however, the ecological relationships and life histories of many of the endemic species are not yet well understood within the constraints of changing weather patterns and conditions (Ingram et al., 2013). Impacts of changing environmental conditions on riverine and wetland ecosystems are also predicted to include increased water temperatures, which dictate many species ranges and exacerbate low dissolved oxygen conditions (Ingram et al., 2013). Freshwater ecosystems (e.g., streams, rivers, lakes, and wetlands) in the Southeast may change if conditions continue to change and impacts on rare species of fish and mussels would be of particular concern.

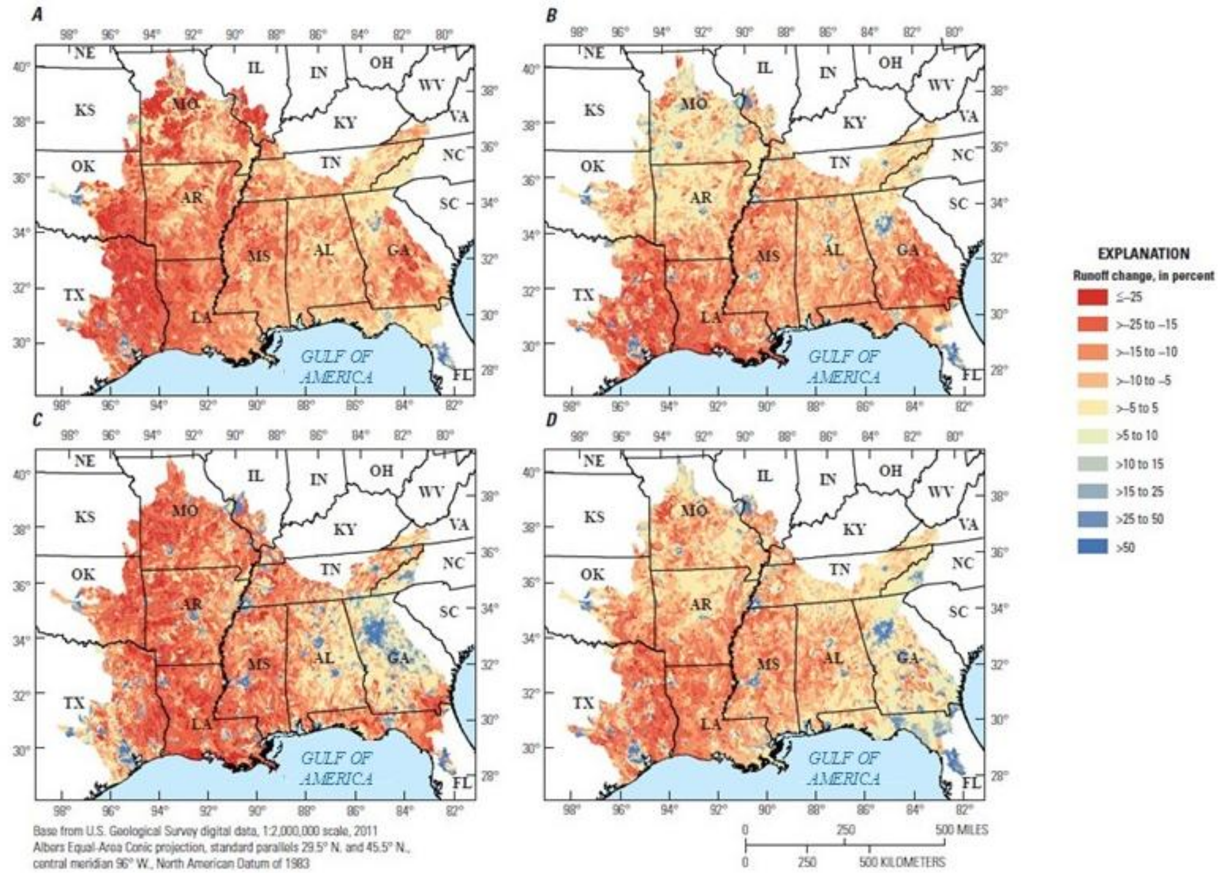

Figure 5. Maps showing the distribution of percent difference in future runoff (a proxy for streamflow) for the period 2045-2075 (the median of all 45 representative concentration pathway scenarios) compared to the historical runoff period of 1952-2005 response unit. The maps show seasonal periods (A) January to March, (B) April to June, (C) July to September, and (D) October to December. Modified form LaFontaine *et al.* (2019) in the public domain.

Sea-level rise

Beyond potential changes in temperature and precipitation, sea-level rise may also impact Mississippi. Sea-levels along the Mississippi coast have risen at the rate of 1.6 inches per decade, faster than the global average rate (Runkle et al., 2022). Due to the magnitude of sea-level rise (SLR) projected throughout the 21st century and beyond—coupled with subsidence—coastal systems and low-lying areas may increasingly experience adverse impacts such as submergence, flooding, and erosion (Wong et. al., 2014). Historically, coastal ecosystems in the region have adjusted to SLR by vertical (accretion) and horizontal movement across the landscape. As SLR continues, some coastal ecosystems may be submerged and converted to open water, and saltwater intrusion may allow salt-tolerant coastal ecosystems to move inland at the expense of upslope and upriver ecosystems (Wong et. al., 2014). The National Oceanic and Atmospheric Administration (NOAA) 2022 Sea Level Rise Technical Report, Global and Regional Sea Level Rise Scenarios for the United States, provides the most recent projections available to all U.S. coastal areas out to the year 2150 (Sweet et. al 2022). The following tables show the predicted extent of flooding for coastal Mississippi at the average highest daily tide due to sea-level rise (Table 4) and the projected amount of sea-level rise by decade under various emissions scenarios (Table 5). Figure 6 also provides a statewide map of areas likely to experience flooding at high tide based on each foot of sea-level rise above current levels.

Table 4. Extent of flooding by projected average highest daily tide due to sea level rise (SLR) within Mississippi. Acres represents number of acres of land projected to be under water for different SLR scenarios and 'Percent of Area' represents corresponding percentage of Mississippi land. Values come from the NOAA sea-level rise inundation data (Sweet et al., 2018).

Feet of sea-level rise	Acres	Percent of Area
0 feet	535,278	1.7%
1 foot	572,401	1.8%
2 feet	597,478	1.9%
3 feet	613,216	2.0%
4 feet	626,417	2.0%
5 feet	639,873	2.1%
6 feet	654,871	2.1%
7 feet	667,808	2.2%
8 feet	683,025	2.2%
9 feet	701,309	2.3%
10 feet	719,453	2.3%
Not projected to be inundated by up to 10 feet	*939,210*	*3.0%*
Sea-level rise unlikely to be a threat (inland counties)	*29,334,730*	*94.6%*
Sea-level rise data unavailable	*5,491*	*<0.1%*
Total area	**30,998,884**	**100%**

Table 5. Projected sea-level rise by decade in Mississippi. Values are based on area-weighted averages of decadal projections for 1-degree grid cells that overlap this area based on NOAA's 2022 Sea Level Rise Report.

SLR Scenario	2020 (ft)	2030 (ft)	2040 (ft)	2050 (ft)	2060 (ft)	2070 (ft)	2080 (ft)	2090 (ft)	2100 (ft)
Low	0.42	0.64	0.87	1.1	1.3	1.5	1.6	1.8	2
Intermediate-low	0.45	0.7	0.97	1.2	1.5	1.8	2	2.3	2.6
Intermediate	0.45	0.72	1	1.4	1.7	2.2	2.7	3.3	4
Intermediate-high	0.45	0.76	1.1	1.6	2.1	2.9	3.7	4.6	5.6
High	0.45	0.77	1.2	1.8	2.5	3.5	4.7	5.9	7.2

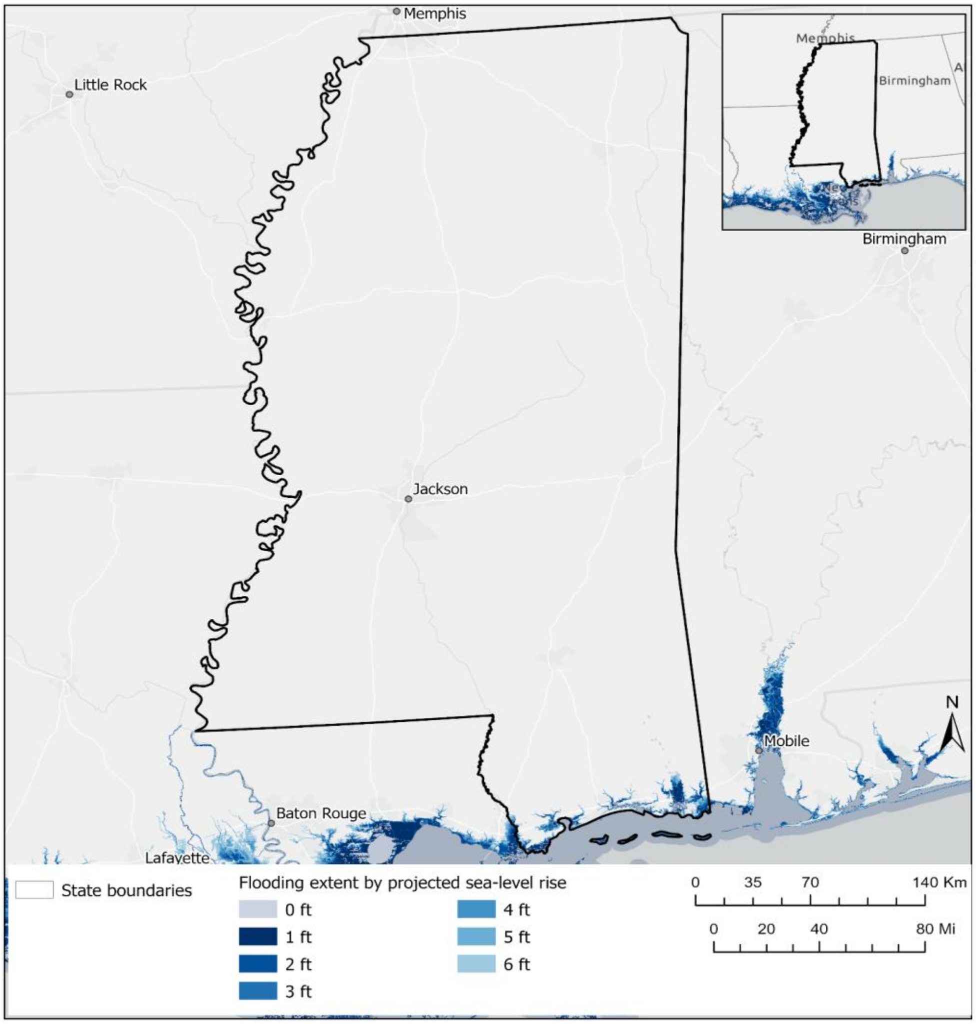

Figure 6. NOAA's sea-level rise (SLR) inundation models represent areas in Mississippi likely to experience flooding at high tide based on each foot of SLR above current levels. Darker blue areas will experience flooding first, and at greater depth, compared to lighter blue areas. These models are not linked to a future timeframe; see the projections in Tables 4 and 5. NOAA calculates the inundation footprint at "mean higher high water", or the average highest daily tide. The area covered in each SLR scenario includes areas projected to be inundated at lower levels. For example, the area inundated by 4 ft of SLR also includes areas inundated by 3 ft, 2 ft, 1 ft, and 0 ft of SLR (where 0 ft represents current levels).

Sea-level rise has already affected changes in flood frequency and extreme flood events in coastal areas of Mississippi. For example, Bay Waveland, MS, saw a 97.22% increase in high tide flooding days per year from the 2010-2019 decade to the current 2020 decade (Figure 7). By 2030, projected high tide flooding days for the location are projected to increase from approximately 14 days per year to between 20 days per year for the lowest scenario to 25 days per year for a high scenario, representing a 78.6% increase (Figure 7).

Average Historic Flooding Days

Decade	Flooding Days per Year
2020-2024	14.2
2010-2019	7.2
2000-2009	4.4
1990-1999	3.2
1980-1989	2.5
1970-1979	3.0

Projected High Tide Flooding Days

Scenario	2030	2040	2050	2060	2070
High	25	65	175	310	360
Int. High	25	60	135	260	345
Intermediate	25	50	105	190	280
Int. Low	20	45	85	145	215
Low	20	35	65	110	155

Figure 7. Average historical flooding days above National Ocean Service Minor Threshold MHHV and projected high tide flooding days for Bay Waveland, MS, on the Gulf coast (Sweet et al. 2018). Future projected flooding days are presented by decade to 2070 and are provided for each sea level rise scenario based on sea-level rise scenarios outlined in the 2022 Sea Level Rise Technical Report (Sweet et al. 2022). Both historical and projected days are provided for the National Ocean Service flood thresholds.

Species Reponses to Changing Environmental Conditions

Tools and models available

Identification of SGCN and regional SGCN (RSGCN) that are vulnerable to changing environmental conditions may be important to developing adaptive management strategies. A species may be considered vulnerable if it is both sensitive to changing environmental conditions and also exposed to the impacts of that change, and has low ability to adapt to climate change impacts (i.e., low adaptive capacity) (Williams et al., 2008; Thurman et al., 2020). Two common tools that have been used to determine a species' vulnerability to changing environmental conditions include 1) assessments like NatureServe's CCVI tool (Lyons et al. 2024), and 2) environmental niche modeling-based vulnerability estimates produced by the academic research community. The CCVI is a worksheet-based tool where users apply readily available information about a species' natural history, distribution, landscape circumstances, and expert opinions to predict whether it will likely suffer a range contraction and/or population reduction due to changing environmental conditions (e.g., temperature, precipitation) that then produces a vulnerability score. By design, this score is distinct from NatureServe's global and national conservation status ranking system that considers other threats. For example, a species could score as not particularly vulnerable in terms of its Global or State rank (G-or S-rank), which is based on other factors, but could still rate as vulnerable to climate change. To date, several SEAFWA states have used the CCVI tool to conduct assessments of their SGCN in order to inform previous SWAPs, management priorities, and research and conservation planning, and these previous assessments can serve as references for what has been done before and to shape planning and conservation efforts (Armsworth et al. 2025a). Ecological niche models (also called species distribution models) start by identifying shared environmental conditions (i.e., the species' niche) at sites where a species is known to have occurred and then predict where similar conditions may be found on the landscape in the future. Some models also consider the ability of a species to disperse to reach any new areas that may become suitable. The resulting predictions from these models allow researchers to create spatially explicit estimates of whether suitable environmental conditions for a species are likely to remain stable, become more widespread in the landscape (i.e. increase), or become more geographically rare in the future (i.e. decrease).

Niche model results may be used in tandem with CCVI estimates to enhance the understanding of a given species' vulnerability, because assessments and niche models have complementary strengths that may help land managers make informed conservation decisions. Niche models offer spatially explicit predictions (i.e., changes in suitable habitat) about the direct exposure of a species to changing environmental conditions but are only available for a limited set of species, in part because the models require extensive data on a species before they can be applied. Assessments use an expert judgment-based approach that allows integration of different types of information about species and what might make them vulnerable (e.g., their natural history). Therefore, outputs from both of these tools may be used to paint a full picture of a given species' vulnerability while keeping in mind the geographic (e.g., region or habitat that was evaluated) and biological contexts (e.g., estimated dispersal distance) used.

Summary of available vulnerability indices

Of Mississippi's 1,053 SGCN listed in their 2025 SWAP revision, 124 of them have been evaluated to date using NatureServe's CCVI tool across nine organizations (Armsworth et al., 2025a): drawing from CCVI assessments published in four SWAPs in the Southeast (West Virginia, Byers & Norris, 2011; Tennessee, Glick et al., 2015; Florida, DuBois et al., 2011; and Louisiana, Holcomb et al., 2015) as well as the Illinois SWAP (Walk et al., 2011), Natural Heritage Programs in the Northeast (Schlesinger et al., 2011, Furedi et al., 2011), the Appalachian and North Atlantic Landscape Conservation Cooperatives (Sneddon & Galbraith, 2015, Sneddon & Hammerson, 2014), and the National Park Service Cumberland Piedmont Network (Bruno et al., 2012), all of which were informed by state conservation practitioners. Mississippi bird SGCN have had the most CCVI assessments, at 33, completed as a taxon to date (Figure 8). Many of these CCVI assessments indicate that while some bird species may be vulnerable, a larger proportion may remain stable or increase under changing environmental conditions (Figure 8). Though more assessments could be done for other taxa, especially those that are not as well studied, these current

CCVI estimates show that fish, mussels and plants have the largest proportions of Mississippi's SGCN estimated to be vulnerable to date (Figure 8).

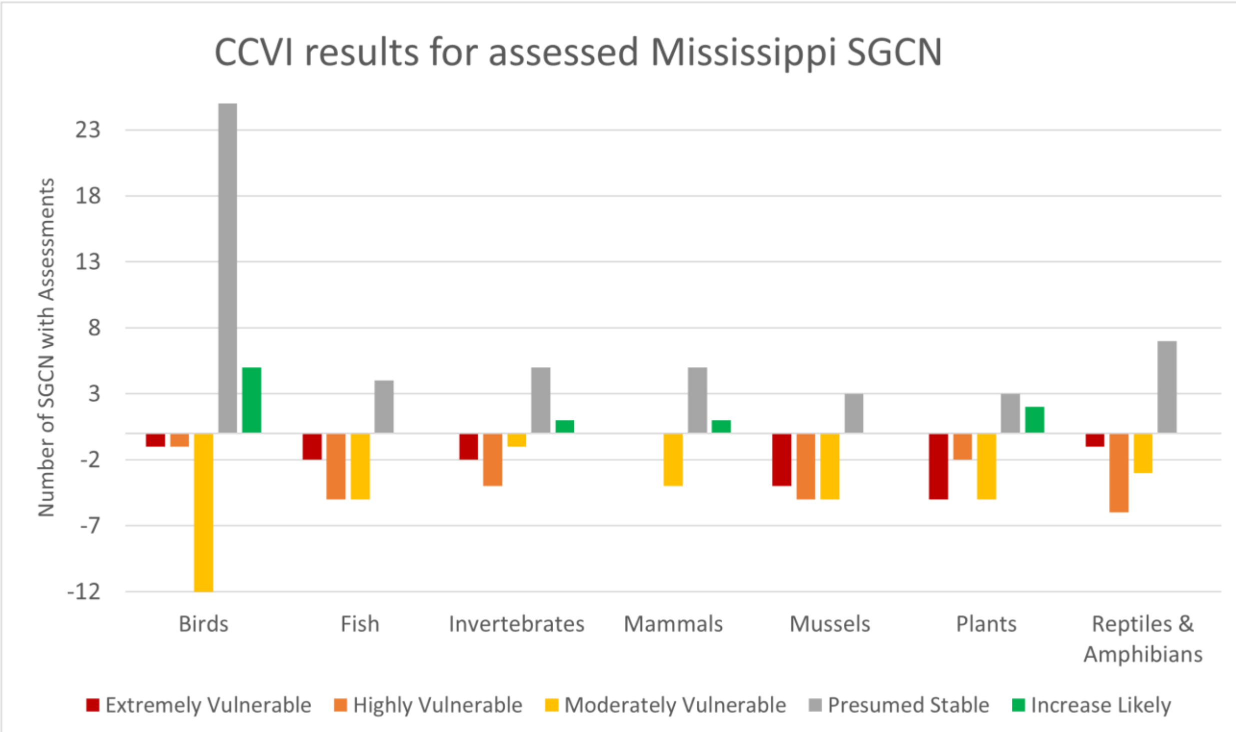

Figure 8. Mississippi species of greatest conservation need (SGCN) that are considered vulnerable, stable, or may increase in population based on available NatureServe CCVI estimates.

Summary of available correlative niche models

Of Mississippi's 1,053 SGCN listed in their 2025 SWAP revision, 159 of them have had their climatically suitable ranges evaluated to date via correlative niche models, which consists of vulnerability scores (note: some species have multiple scores for different future projected scenarios) across 13 studies (Mckenny et al., 2007; Iverson et al., 2008; Matthews et al., 2011; Sutton et al., 2014; Bucklin et al., 2015; Struecker & Milanovich, 2017; Pandey & Papeş, 2018; Bateman et al., 2020; Lawler et al., 2020; Zellmer et al., 2020; Zhu et al., 2021; Lyon & Papeş, 2022; Yoon et al., 2024). Figure 9 summarizes the combined results on each species climatically suitable range from these correlative niche models by SGCN taxa group (Armsworth et al., 2025b; Yoon et al., 2024). Similar to current CCVI assessments to date, the majority of climate projected niche models have been generated for Mississippi's bird SGCN compared to other taxa (Figures 8 & 9). Though more niche modeling needs to be performed, especially for those that are not as well studied, these current estimates generated from niche models show that for those modeled to date, Mississippi's amphibian SGCN have proportionately the highest number of species projected to experience a large decrease in their climatically suitable range (Figure 9).

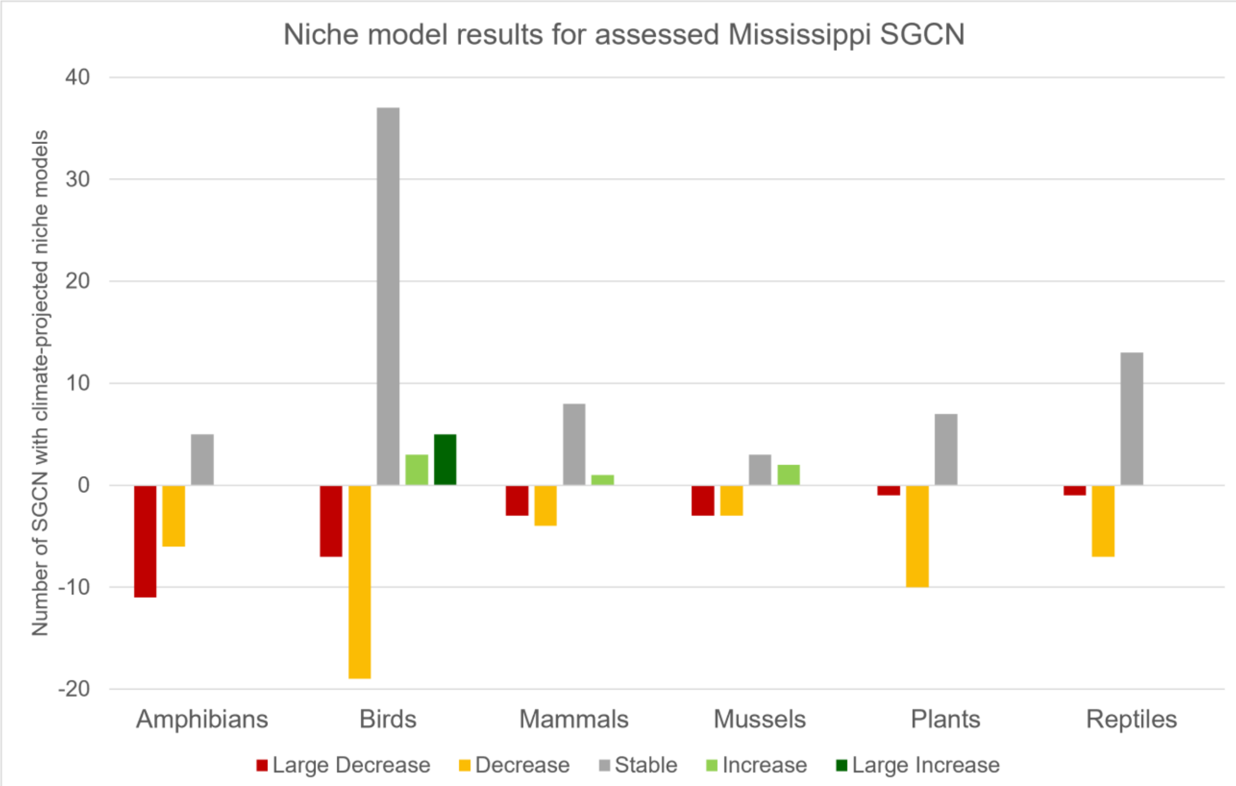

Figure 9. Mississippi Species of Greatest Conservation Need (SGCN) whose ranges may decrease, remain stable, or increase based on vulnerability scores from available ecological niche models across 13 studies.

Comparing CCVI and available ecological niche models results

Comparing the results of the ecological niche models to the CCVI estimates for SGCNs within Mississippi reveals similar trends for taxa that were evaluated using both methods. However, it is not uncommon for different approaches to assess risk to have varying results, as each of the two methods includes different types of information. For example, we can see that some SGCN from all Mississippi's evaluated taxa are estimated to experience some vulnerability (i.e., moderately, highly, extremely vulnerable) and some decreases (i.e., decrease or large decrease) in their range (Figures 8 & 9). Birds have the greatest number of SGCN with predicted stable or increasing populations across both approaches, partially due to how many more bird SGCN have been evaluated compared to other taxa (Figures 8 & 9). Currently, few species overlap between both the CCVI and ecological niche model datasets, which limits the scope of comparisons. But looking beyond birds, results from both CCVI and niche models suggest that plant SGCN in Mississippi are projected to have many vulnerable SGCN (Figures 8 & 9). In particular, niche model estimates are not yet available for many aquatic species such as fishes; which the scientific literature suggests may be some of the most vulnerable to changing environmental conditions in Mississippi and the Southeast region (Halpern and Kappel, 2012; Poff et al., 2012; Ingram et al., 2013). However, the available CCVI for these aquatic taxa suggest that there are more fish SGCN predicted to be extremely and highly vulnerable to changing environmental conditions than stable (Figure 8).

A closer look – Impacts to floodplain forests and species of the Mississippi Alluvial Plain

The Mississippi Alluvial Plain (MAP) Ecoregion (EPA Ecoregion level III –73) covers the western side of the state, following the Mississippi River and its floodplains and is one of the most heavily altered Ecoregions in the United States (Chapman et al., 2004; Saikku, 1996). This Ecoregion was once dominated by bottomland deciduous forests, but extensive clearing for agriculture, along with the construction of levees to control flooding and drainage systems to dry the soils, has transformed much of the original dense hardwood landscape into farmland (Chapman et al., 2004; Saikku, 1996). Influenced by seasonal flooding and saturated soils, the Ecoregion once supported one of the largest continuous wetland systems in North America and remains an important corridor for migrating birds (Chapman et al., 2004). The Yazoo River basin in this part of the state drains most of the northwestern Mississippi River (Chapman et al., 2004). Despite being heavily altered and affected by agricultural runoff, the Yazoo River still provides important habitat for fish and wildlife, and some sections continue to sustain dense populations of native freshwater mussels, including those in the Big Sunflower River (Chapman et al., 2004). In Mississippi, the Mississippi Alluvial Plain Ecoregion contains five distinct sub-Ecoregions (i.e., Ecoregion Level IV):

1. Northern Holocene Meander Belts (73a), which include both the active meander belt of the modern Mississippi River and the abandoned belts from its former paths
2. Northern Pleistocene Valley Trains (73b), which is made up of glacial outwash deposits and limited in area in the Yazoo Basin of the state
3. Northern Backswamps (73d), characterized by flat, poorly drained floodplain depressions where water often accumulates in shallow streams, lakes, swamps, and other low-lying areas
4. Southern Holocene Meander Belts (73k), experience a longer growing season, warmer conditions, and greater rainfall than the northern meander belts; and
5. Southern Backswamps (73m), which are generally warmer, receive more precipitation, and have a longer frost-free season than the Northern Backswamps.

Floodplain forests, specifically bottomland hardwoods in this Ecoregion, are considered among the most important habitats for wildlife (Liu et al., 1998). Forests, swamps, ponds, and winding waterways in these regions offer a wide range of habitats that support numerous fish and wildlife species, as well as migrating birds. Additionally, these environments host high levels of plant and animal diversity (Liu et al., 1998). They also contain essential resources these organisms need to survive (Liu et al., 1998). Bottomland hardwood forests are especially important because they help reduce soil erosion, protect water quality, replenish groundwater, and minimize flood impacts (Liu et al., 1998). Of the habitats within the Mississippi Alluvial Plain in the state, floodplain forests and bottomland hardwood forests are the most threatened (Saikku, 1996). Concerningly, bottomland hardwood forests are thought to be among the most vulnerable ecosystem types to changing environmental conditions (Brandt et al., 2014, 2020).

This is largely due to the fact that the bottomland hardwood areas were, and still are today, desirable locations for economic development: The combination of hardwood forests, productive soils, abundant water, and distinctive terrain has drawn many types of development, including agriculture, forestry, tourism, industrial activities, and water-related projects (Liu et al., 1998; Saikku, 1996). For example, most of the bottomland forest that covered the Northern Holocene Meander Belts, Northern Pleistocene Valley Trains, and Southern Holocene Meander Belts have been entirely cleared and have been extensively modified for human uses (Chapman et al., 2004; Saikku, 1996). The Northern Backswamps still support a few remaining pockets of bottomland hardwood forest, where cypress and tupelo dominate the wettest zones (Chapman et al., 2004). Bottomland hardwood forests are more common in the Southern Backswamps than in the neighboring Southern Holocene Meander Belts (Chapman et al., 2004). oth the Northern and Southern Backswamps undergo seasonal fluctuations in water levels, and their clay-rich soils expand and contract in response to alternating wet and dry periods (Chapman et al., 2004). As a result, these backswamp areas serve as valuable zones for absorbing excess water and storing it during intense rainfall events (Chapman et al., 2004).

The unique wildlife the Mississippi Alluvial Plain supports

Mississippi's floodplain forests and the bottomlands of the Mississippi Alluvial Plain contain scattered remnants of wetlands. Restoring bottomland hardwood ecosystems, especially those with strong wetland characteristics, offers vital habitat for many migratory bird species (Brandt et al., 2014). These wetlands serve as essential stopover and feeding sites for hundreds of thousands of shorebirds, marsh birds, ducks, and geese (Brandt et al., 2014). Many priority species for the state are associated with floodplain bottomland hardwood forests (Table 16). The Prothonotary Warbler (*Protonotaria citrea*) relies on bottomland hardwood forests in the Mississippi Alluvial Plain for breeding, nesting in tree cavities typically located near water (Figure 9A). The Swamp Rabbit (*Sylvilagus aquaticus*) inhabits the region's bottomland swamps and floodplains, staying close to water, with its primary range centered in Mississippi, Louisiana, and Arkansas (Figure 9B). The Louisiana Black Bear (*Ursus americanus luteolus*), that depends on bottomland hardwood forest habitat, was recently removed from the threatened species list under the Endangered Species Act after populations bounced back following conservation actions such as restoring corridors in these forests to increase connectivity via landowner partnerships (Figure 9C).

Figure 10. Photos of A) the Prothonotary Warbler (*Protonotaria citrea*) by Daniel Gomez; B) the Swamp Rabbit (*Sylvilagus aquaticus*) by Jeremy Hynes; and C) the Louisiana Black Bear (*Ursus americanus luteolus*) by the U.S. Fish and Wildlife Service. All photos used are in the public domain.

Impacts to the Ecoregion's Habitats and Species

Bottomland hardwood forests of the Southeast are among the most ecologically diverse wetland systems in North America and remnant forest patches remain important seasonal and year-round habitats for diverse communities of vertebrates and invertebrates (Adams and Jones, 2021; Brandt et al., 2014; Elliott et al., 2020; Foth et al., 2018; Ketzler et al., 2017; Le et al., 2018; Podoliak, 2023; Twedt and Wilson, 2017). Here we provide an overview of impacts from changing environmental conditions to Mississippi's habitats and species of the Mississippi Alluvial Plain and its rivers.

Increased Air and Water Temperatures

Air Temperatures

The Mississippi River's High, Low, and Depression Floodplain Forest (Ecoregions 73a, b, d, k and m) have all been assessed to be moderately vulnerable to temperature extremes by the Mississippi Department of Wildlife Fish and Parks (see Chapter 6 of Mississippi's 2025 State Wildlife Action Plan). Average yearly air temperatures across the entire U.S. Mississippi Alluvial Plain Ecoregion are expected to increase by about 2.2 to 5.2 °F by 2060 (Gardiner, 2015). For the state of Mississippi, most counties in the Ecoregion will experience large increases in the number of extremely hot days by GWL 2 (Figure 2). In Mississippi, the Ecoregion is projected to experience 36 to 41 additional extremely hot days per year (i.e., the number of days that have maximum temperatures ≥95°F) by 2050, and 55 to 70 additional extremely hot days per year by 2075, depending on the scenario (Table 1). These projected increases are substantial considering this Ecoregion typically experiences 18 days at or above 95°F in Mississippi, which therefore represent a 152 to 173% increase in extremely hot days by 2050, and a 238 to 303% increase by 2075, compared to historical simulations (Table 1). Additionally, the number of extremely cold days annually is decreasing (i.e., days with low temperatures of at least 32°F) across the Ecoregion. Historically (1950-2014) in the state the Mississippi Alluvial Plain Ecoregion experienced approximately 45 days with lows below freezing annually (Table 2). By 2049 the Ecoregion is projected to experience a 30% reduction in extremely cold days and a 46% reduction by 2074 (Table 2). As low temperatures rise, some species may also be impacted. Warmer nights can have a profound impact on animal and plant health because temperatures are generally lower at night, allowing the environment to cool down (Shanovich et al., 2026a).

Warmer annual temperatures can cause habitat alteration and species range shifts that would allow for warm-adapted species to dominate and shift distributions of species adapted to cooler temperatures. Swainson's Warbler is an example of a forest specialist to Mississippi's floodplain forests that is sensitive to changing environmental conditions. This secretive songbird breeds in dense understory of bottomland hardwood forests, often in areas with cane thickets or floodplain shrubs, making it highly dependent on moist, shaded microhabitats. Increased high and low temperatures can lead to drier understory conditions and reduce the availability of moist leaf litter where the Warbler forages for insects. As temperatures rise, suitable breeding habitat may shift northward or become fragmented, especially in areas where forest cover is already limited (Osland et al., 2021). Therefore, bottomland hardwood forest connectivity is a key method emphasized by researchers to escape thermal stress and find areas with suitable conditions for shelter and food (Brandt et al., 2014, 2020).

Water Temperatures

Water temperature is known to have important effects on various life history traits of aquatic species with species exhibiting specific thermal tolerances (Beitinger et al. 2000; Bennett et al. 2018). Consequently, forecasted changes in water temperature are likely to impact both native and invasive aquatic species distributions, as only slight changes in temperature could promote large shifts in the allocation of production across fish species (Ficke et al. 2007; Rahel and Olden 2008). For example, the Paddlefish (*Polyodon spathula)* may not be able to successfully cope well with any potential acute water temperature increases (e.g., heatwaves) in the future because in its early life stages, its physiological tolerance to rapid thermal shifts is very limited, making acute heat exposure potentially lethal or highly disruptive (Stell et al., 2025). Table 6 summarizes information on the thermal tolerances and other life history data for freshwater fish species in the rivers, streams and swamps of the Mississippi Alluvial Plain Ecoregion of Mississippi.

Table 6. Thermal tolerance information and life history notes of freshwater fish SGCN of the Mississippi Alluvial Plain Ecoregion of Mississippi.

Fish Species	Thermal Tolerances	Life History Notes
American Eel (*Anguilla rostrata*)	Early juveniles (glass eels) entering freshwater select temps of 68-77°F in still water, and lower temperatures in flowing water (Tongiorgi et al., 1986). Final preferred temp in freshwater is 63.3°F (Barila and Stauffer, 1980). Long-term thermal preference in silver migratory phase is 62.6-68°F (Haro, 1991).	Can tolerate a range of temperatures but prefer cool waters
Alligator Gar (*Atractosteus spatula*)	Typically inhabit warmer waters that reach at least 73.4°F (USFWS, 2023). Juveniles have critical thermal minimum of 69.8°F and maxima of 103-112°F (Bartnicki, 2021; Fernando et al., 2016)	Live in sluggish pools and the back waters of large rivers (preferably with overflow flood plains) and swamps (USFWS, 2023).
Southern Redbelly Dace (*Chrosomus erythrogaster*)	Prefers cooler streams, typically occurring in sites with permanent headwater spring (Farless and Brewer, 2017; Frenette et al., 2019). Critical thermal maxima is 98.9 °F (Hopper et al., 2020)	This species declines steeply under severe habitat drying, attributed to its low thermal tolerance (Hopper et al., 2020).
Blue Sucker (*Cycleptus elongatus*)	Spawning movements, including migrations, most likely to occur between 56-64°F (Acre, 2019).	Adapted to fast, moderately deep, and shaded stretches of chutes (Gammon et al., 1981).
Slender Madtom/Mud Darter (*Etheostoma asprigene*)	Tolerance likely similar to related species, exact limits not documented. Egg incubation occurs at 71.6–75.2°F (Cummings et al., 1984).	Prefer cool, clean waters and show stress at elevated temps
Western Starhead Topminnow (*Fundulus blairae*)	Exact thermal limits not well-documented, but as a general rule, species of *Fundulus* have higher critical thermal maxima than most other fishes. Egg incubation temperature for *Fundulus* species is 75.2°F (Cashner et al., 2019).	Many species of *Fundulus* reside in coastal marshes that are subject to episodic oscillations in DO and temperature; requires a low salinity habitat (Cashner et al., 2019).
Northern Starhead Topminnow (*Fundulus dispar*)	See above	See above
Black Buffalo (*Ictiobus niger*)	Data deficient	Spawning habitat reported in cypress swamps and brackish ponds
Chestnut Lamprey (*Ichthyomyzon castaneus*)	Likely around that of other lamprey species. Egg incubation and hatching occurs at 18C for lamprey (Potter et al., 2019)	Parasitic, freshwater species, generally, lamprey are found in cool, clean waters
Northern Lamprey (*Ichthyomyzon unicuspis*)	Spawning of freshwater lamprey is dependent on critical water temperature. Critical water temperature for spawning for this species of 71.6°F (Potter et al., 2019). Egg incubation and hatching occurs at 18C for lamprey (Potter et al., 2019)	Parasitic, freshwater species, generally, lamprey are found in cool, clean waters

Fish Species	Thermal Tolerances	Life History Notes
Paddlefish (*Polyodon spathula*)	The number of days during which the Mississippi River experiences temperatures exceeding 82.4°F greatly reduces larval fish abundance (Phelps et al., 2010). Juvenile Paddlefish may be operating near their aerobic maximum at warmer water temperatures, with few options to reduce metabolic costs (Stell et al., 2025).	Inhabit slow-moving, large, deep, freshwater rivers and reservoirs (USFWS, 2023b).

Riverine water temperatures and dissolved oxygen (DO) levels are essential indicators of water quality and ecosystem health. The predominant factor controlling daily levels of DO in rivers is temperature, with colder regions and rivers exhibiting higher DO and warmer regions and rivers exhibiting lower DO levels (Zhi et al., 2023). Decreases in DO levels in rivers, called riverine deoxygenation, and resulting hypoxia happens more often than typically expected based on recent data; with faster deoxygenation rates found to occur in the southern US (Zhi et al., 2023). Decreases in DO concentrations can lead to "stress days" for aquatic organisms (defined as when the daily DO drops to or below 5 mg l^{-1}, a criterion used by the US Environmental Protection Agency), or hypoxic conditions (when DO is less than 3 mg l^{-1}) that could induce acute death and sublethal negative health effects for fishes and threaten biodiversity in rivers (Hypoxia 101 | US EPA; EPA, 2021). Rising water temperatures and deoxygenation trends in US rivers align with consistent rises in air temperatures across the country and warmer regions may experience more stress and hypoxia conditions than colder ones (Zhi et al., 2023). For example, abundance of the Vernal Crayfish, *Procambarus viaeviridis*, has been found to be associated with DO levels, having a positive relationship with the species (Barnett et al., 2017). All riverine sites monitored by the US Geological Survey along the Mississippi River in Mississippi are projected to experience increases in the annual sum of stress days under both low and high emission scenarios, with most of these days occurring in summer (Zhi et al., 2023).

Warming water temperature has also increased the prevalence of disease, as warmer temperatures and lower oxygen levels stress fish and allow disease organisms to complete their life cycle more rapidly and thus attain higher population densities (Paukert et al. 2021). Additionally, changing environmental conditions can create unique pH-related disease vulnerabilities in freshwater: leading to water acidification, bacterial proliferation, and shell formation impacts - as lower pH levels interfere with calcium deposition during invertebrate molting, creating opportunities for bacterial invasion through compromised exoskeletons (Beaune et al., 2018). Diseases affecting freshwater fish can be related to periods of oxygen depletion and stress and outbreaks are often observed through the spring and early summer. While specific disease outbreaks (like *Columnaris*, *Aeromonas hydrophila*, *Flavobacterium columna*, or *Ichthyophthirius multifiliis*) are not always well-documented in public-facing reports, microbial threats are common in warm, nutrient-rich waters and may be exacerbated by the region's environmental conditions (e.g., agricultural run-off). Microbial threats may affect fish SGCN, such as gar, especially in hatchery or high-density environments, though specific outbreaks are not well-documented. The lack of detailed disease surveillance in the Lower Mississippi Alluvial Valley suggests a need for more targeted fish health monitoring.

Increased evaporation, drought and wildfire risk

<u>Evapotranspiration and water stress</u>

Past modifications and degradation of the Mississippi River, its tributaries, and the surrounding floodplain have permanently altered the hydrology and reduced the ecosystem service capacity of the lower Mississippi Alluvial Valley. Despite these changes, water resources in the region fortunately have not faced significant stress (Gardiner, 2015). However, projected shifts in environmental conditions and ongoing land-use changes highlight the need for continued research to understand how these factors may affect the long-term sustainability of local water resources (Lockaby et al., 2013). Projections suggest that changes in precipitation and drought could have the greatest impacts with “accelerated evapotranspiration causing a 10-100% increase in water supply stress” under most scenarios for the Mississippi portion of the Ecoregion (Figure 10; Gardiner, 2015).

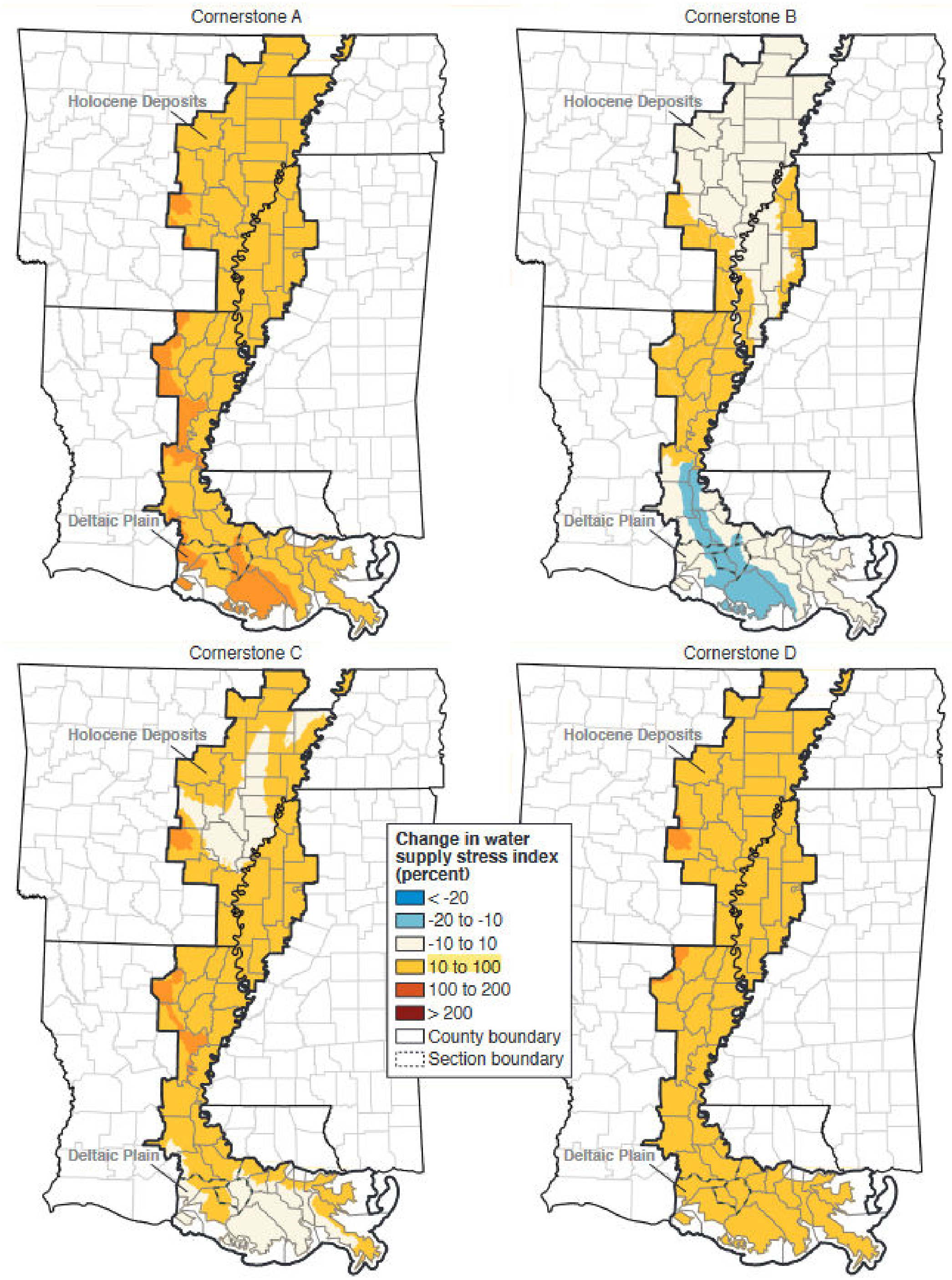

Figure 10. Projected change in water supply stress (water demand divided by water supply) in the Mississippi Alluvial Plain Ecoregion by 2050 under four Cornerstone Future scenarios. The geologic units of the Holocene Deposits and Deltaic Plain are labeled to highlight their groundwater storage capacity and recharge dynamics, and vulnerability to future hydrologic stress. Each Cornerstone Future Scenario represents a general circulation models paired with one of two scenarios—A1B representing high-population/high-economic growth, high energy use, and B2 representing low growth and use: Cornerstone A is MIROC3.2+A1B, Cornerstone B is CSIROMK3.5+A1B, Cornerstone C is CSIROMK2+B2, and Cornerstone D is HadCM3+B2. (Reprinted from Gardiner, 2015; Lockaby et al., 2013 technical reports in the public domain).

Drought

Drought is an environmental disturbance that affects freshwater aquatic invertebrates and can exacerbate other abiotic/biotic stressors to an ecosystem like invasion by nonnative species (Hodges and Magoulick 2011, Wolff et al. 2016, Yarra and Magoulick 2018). Drought affects stream structure and depth, flow, and at the population level drought can decrease aquatic invertebrate survival and body size, and thereby fecundity (Taylor 1988; Larson et al. 2009, Rolls et al. 2012; Banha & Anastácio 2014, Magoulick 2014, Timoner et al. 2014; Osman et al. 2015). Natural seasonal droughts are not uncommon in the Southeast, where streams become very low or dry for several months each year, leaving pools to serve as refuges for crayfish and other aquatic animals (Dekar and Magoulick 2007; Hodges and Magoulick 2011). However, studies have indicated that increased variability in stream flow from changing environmental conditions may alter risk factors for crayfish in streams. While stream crayfish have some abilities that may make them resilient to natural droughts, their vulnerability during prolonged or severe droughts is unclear: they are able to burrow into the hyporheic zone (a region of sediment and porous space beneath the stream channel that is the interface between the surface water and groundwater) or go through a state of summer dormancy in either damp sediment or under substrate to escape dry conditions (Jones and Bergey 2007, DiStefano et al. 2009, Kouba et al. 2016). For example, predation on crayfish by terrestrial predators was found to increase during drought conditions (Wolff et al., 2016). Further understanding of how predation risk of aquatic prey may change between drought and nondrought conditions is needed to understand potential effects of changing environmental conditions on aquatic systems.

Droughts are expected to increase in frequency, severity, and duration in the southeastern U.S. in response to future changing environmental conditions (Hoffman et al. 2023). Naturally occurring droughts in Mississippi are projected to be more intense because higher temperatures and longer growing season lengths will increase the rate of soil moisture loss, called evapotranspiration, during dry periods (Gaertner et al. 2019; Marvel et al. 2019; Frankson et al. 2022). The Mississippi River's High, Low, and Depression Floodplain Forest, Riparian Forest, and Sandbars of the state (Ecoregions 73a, b, d, k and m) have all been assessed to be moderately vulnerable to droughts. Additionally, drought was evaluated to pose a high threat to the Inland Freshwater Marsh and Mississippi River and Associated Drainages in the state (e.g., Yazoo River).

Extreme precipitation events, flooding and altered flows

Changing environmental conditions are increasing the severity and frequency of extreme precipitation events (i.e., rainfall events) that increase the frequency of flooding. Under a moderate scenario, the Mississippi Alluvial Plain Ecoregion of the state is projected to see a 32% increase in the number of days with extreme rainfall events by 2049 and a 39% increase by 2074 (Table 3). Storms and flooding were evaluated by the Mississippi Department of Wildlife, Fisheries and Parks to pose moderate to high threats to all the Floodplain forests in the Mississippi Alluvial Plain and the MS River and its drainages (Chapter 6).

Increasingly frequent floods will negatively affect birds during certain times a year in the Mississippi Alluvial Plain. Mississippi hosts substantial portions of breeding populations for regional bird SGCN :14% of the breeding population of the Prothonotary Warbler and 11% of the Kentucky Warbler, for example (Hahn and Wilkinson, 2025). During the spring/summer breeding season in Mississippi's bottomland hardwood forests and swamps, the Prothonotary Warbler is at risk to extreme flooding (Smith et al., 2022; Figure 11A). These warblers are cavity nesters that build their nests in tree cavities or nest boxes typically located three to ten feet above water in floodplain forests and swamps. During extreme flooding, rising water levels can submerge or destabilize nests leading to nest loss, egg or chick drowning and increased predation if nests are displaced or exposed (Delta Wind Birds, 2022; Figure 11A). Flooding can also affect insect populations, which are the primary food source for adult and nestling Prothonotary Warblers (Johnson et al., 2025).

Figure 11. Both the A) Prothonotary Warbler and B) the Louisiana Black Bear deal with the consequences of increased flooding. Photos in the public domain by David Gomez and the U.S. Fish and Wildlife Service, respectively.

The Louisiana Black Bear is another one of Mississippi's SGCN experiencing habitat shifts from increased flood and extreme events (Figure 11B). This subspecies of the American black bear relies on bottomland hardwood forests for denning, foraging and raising young. However, increased flooding, especially during spring and early summer, can submerge key denning and foraging areas. During extreme flood events, young cubs are especially at risk – if dens are flooded, cubs may drown or be abandoned as recently depicted on NBC Universal's new documentary "The Americas" (The Americas: The Gulf Coast, 2025; Ward, 2025). Altered precipitation patterns are also changing the timing and availability of food sources like berries and acorns for bears (Metthé et al., 2025). Bears have been observed moving to higher ground or closer to urban areas and agricultural fields during food shortages, increasing the risk of human-wildlife conflict (Laufenberg et al., 2018; Figure 11B). Because human–bear interactions are strongly shaped by social context, even limited ecological displacement can have outsized management implications. Communities near bottomland hardwood regions may face increased exposure to bears, and landowner tolerance, perceptions of risk, and trust in agencies influence acceptance of bear presence more than bear density alone (Siemer et al., 2023).

Backwater habitats of the Mississippi Alluvial Plain's floodplain forests and swamps are essential for fish nurseries and overwintering and can be an important area for capturing excess water and storing water during extreme precipitation events (Chapman et al., 2004). The combined effects of warming and changes in precipitation will likely alter overall hydrology and stream flow for the backwaters, including increased evapotranspiration and reduced stream base flow (Miranda, 2023). Currently, many aquatic species declines are associated with widespread alteration of flow regimes and are expected to be exacerbated by changing environmental conditions (Cushway et al., 2024; Dutta et al., 2024). Several aquatic species in the Mississippi River drainages of the state could be at risk from stream flow alterations caused by changing environmental conditions, particularly due to increased discharge, sedimentation, and temperature shifts. Many of Mississippi's SGCN could be severely impacted by stream flow alteration including the Paddlefish, Alligator Gar, and freshwater mussels. Altered flow regimes and sedimentation from increased discharge can reduce habitat availability and disrupt spawning cues, thereby potentially reducing successful spawning events of Paddlefish and Alligator Gar (Bunn and Arthington, 2002; Dutta et al., 2024; Miranda, 2023). Streambed instability and sedimentation from altered flows can smother mussels and disrupt their crucial host fish relationships needed to complete their life cycles (Cushway et al., 2024; Miranda, 2023).

Risk Assessments

Species-specific traits of wildlife and their varying adaptive capacity mean that not all species respond the same to these changes in climatic conditions. Table 7 lists Mississippi's most of the revised species of greatest conservation concern associated with the Mississippi Alluvial Plain and results from available approaches to evaluate species vulnerability to future changing environmental conditions: vulnerability assessments (Armsworth et al. 2025a), ecological niche models (Armsworth et al 2025b; Yoon et al. 2024). The first of these assessment approaches for vulnerability are NatureServe CCVI assessments (Lyons et al. 2024). CCVI assessments combine a worksheet-based exercise informed by expert judgment about species traits and environmental factors with physical weather data. The second set of vulnerability assessments comes from ecological niche models, which project whether climatically suitable conditions will become more widespread or more restricted in the future. The niche model results shown in the table are based on the predicted range changes for each SGCN. A number of Mississippi's SGCNs are also regional species of greatest conservation need (RSGCNs), meaning that other states in the Southeast also consider these species to be a priority, and are indicated as such in Table 6. Finally, Table 7 also indicates whether the species is listed under the US Endangered Species Act or listed at a state level, reflecting the species overall conservation status.

Table 7. Broad risk measures (e.g., state or federal listing status, NatureServe conservation status ranks for Mississippi) and vulnerability measures (e.g., ecological niche model outputs) for Mississippi Species of Greatest Conservation Need (SGCN) that primarily occupy mountain habits. Species common and scientific names are included for each taxonomic group. RSGCN stands for Regional Species of Greatest Conservation Need as determined by the Southeast Association of Fish and Wildlife Agencies' (SEAFWA) Wildlife Diversity Committee and the Southeast and whether a species is on these lists is indicated by a Y for yes and a N for no in the column (SEAFWA-WDC 2019; SPCA 2023). State Status and Federal Endangered Species Act Status (ESA) codes reflect the current protected status of species in Mississippi and nationally, respectively, and codes include: E = Endangered, PE= Proposed Endangered; PT= Proposed Threatened; SC = Species of Concern; T = Threatened. NatureServe Conservation Status Ranks are coded as S1 = Critically Imperiled, S2 = Imperiled, S3 = Vulnerable, S4 = Apparently Secure, S5 = Secure, respectively. vulnerability measures for each species are included as follows: the most recent results NatureServe CCVI assessments conducted by southeastern states represent whether an SGCN was scored as extremely, highly or moderately vulnerable to changing environmental conditions , presumed stable or increase likely (Armsworth et al. 2025a); outputs for ecological niche models (i.e., species distribution models) from the

literature are included for SGCN summarized by Armsworth et al. (2025b) and indicate whether the climatic suitability for a species will experience a large decrease, decrease, remain stable or increase in the region.

Species		Broad Risk Measures				Vulnerability Measures	
Common name	Scientific name	RSGCN	MS Concern Level	ESA Status	NatureServe State Rank	CCVIs	Niche Models Output
Amphibians							
Smallmouth Salamander	***Ambystoma texanum***	N	Moderate		S3	Highly Vulnerable	Stable
Common Mudpuppy	***Necturus maculosus***	N	DD		S4	Presumed Stable	Stable
Birds							
American Bittern	***Botaurus lentiginosus***	N	High		S1	Presumed Stable	NA
Little Blue Heron	***Egretta caerulea***	M	High		S2	Presumed Stable	Increase
Swallow-tailed Kite	***Elanoides forficatus***	VH	Highest		S2	Presumed Stable	Stable
Rusty Blackbird	***Euphagus carolinus***	H	High		S2	Presumed Stable	Decrease
Kentucky Warbler	***Geothlypis formosa***	M	High		S4	NA	Decrease
Worm-eating Warbler	***Helmitheros vermivorum***	M	High		S2	Presumed Stable	Large Decrease
Wood Thrush	***Hylocichla mustelina***	M	High		S5	Presumed Stable	Decrease
Loggerhead Shrike	***Lanius ludovicianus ludovicianus***	H	High		S2	Presumed Stable (sp level)	Stable (sp. level)
Swainson's Warbler	***Limnothlypis swainsonii***	H	High		S3	Presumed Stable	Increase
Wood Stork	***Mycteria americana***	H	Highest	T	S2	NA	Stable
Louisiana Water-Thrush	***Parkesia motacilla***	M	High		S2	Presumed Stable	Decrease
Prothonotary Warbler	***Protonotaria citrea***	M	High		S5	Presumed Stable	Increase
King Rail	***Rallus elegans***	H	High		S2	Moderately Vulnerable	Stable
Golden-winged Warbler	***Vermivora chrysoptera***	H	Highest	UR	S2	Presumed Stable	Large Decrease
Crayfish							
Ets Crayfish	***Faxonius etnieri***	N	DD		NA	NA	NA

Species		Broad Risk Measures				Vulnerability Measures	
Common name	Scientific name	RSGCN	MS Concern Level	ESA Status	NatureServe State Rank	CCVIs	Niche Models Output
Vernal Crayfish	*Procambarus viaeviridis*	H	Moderate		S3	NA	NA
Freshwater Fish							
American Eel	*Anguilla rostrata*	VH	DD		NA	Presumed Stable	NA
Alligator Gar	*Atractosteus spatula*	M	High		S2	Highly Vulnerable	NA
Southern Redbelly Dace	*Chrosomus erythrogaster*	N	High		S2	NA	NA
Blue Sucker	*Cycleptus elongatus*	H	Moderate		S3	Moderately Vulnerable	NA
Mud Darter	*Etheostoma asprigene*	N	Moderate		S3	NA	NA
Western Starhead Topminnow	*Fundulus blairae*	N	Moderate		S3	NA	NA
Northern Starhead Topminnow	*Fundulus dispar*	M	Moderate		S3	Moderately Vulnerable	NA
Black Buffalo	*Ictiobus niger*	N	Moderate		S3	NA	NA
Chestnut Lamprey	*Ichthyomyzon castaneus*	N	Moderate		S3	NA	NA
Silver Lamprey	*Ichthyomyzon unicuspis*	N	High		S1	NA	NA
Paddlefish	*Polyodon spathula*	N	Moderate		S3	Highly Vulnerable	NA
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	H	Moderate		S3	NA	NA
Mammals							
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	H	High		*S3*	*Presumed Stable*	*Stable*
Southeastern Myotis	*Myotis austroriparius*	M	Moderate		S3	Moderately Vulnerable	Stable
Northern Long-eared Bat	*Myotis septentrionalis*	VH	Highest	E	S1	Presumed Stable	Stable
Tricolored Bat	*Perimyotis subflavus*	H	High	PE	S3	NA	Stable
Southeastern Shrew	*Sorex longirostris*		High		S4	Moderately Vulnerable	Large Decrease

Species		Broad Risk Measures				Vulnerability Measures	
Common name	Scientific name	RSGCN	MS Concern Level	ESA Status	NatureServe State Rank	CCVIs	Niche Models Output
Eastern Spotted Skunk	*Spilogale putorius*	H	Highest		S1	Increase Likely	Large Decrease
Louisiana Black Bear	*Ursus americanus luteolus*	M	Highest	DL	S1	Presumed Stable	Stable (sp. level)
Mussels							
Mucket	*Actinonaias ligamentina*		High		S1	NA	Stable
Rock Pocketbook	*Arcidens confragosus*		High		S3	Extremely Vulnerable	NA
Butterfly	*Ellipsaria lineolata*		High		S2	NA	Very Large Increase
Spike	*Eurynia dilatata*		High		S1	NAN	Decrease
Louisiana Fatmucket	*Lampsilis hydiana*		High		S2	NA	NA
White Heelsplitter	*Lasmigona complanata*		Moderate		S3	Presumed Stable	Increase
Sheepnose	*Plethobasus cyphyus*	VH	Highest	E	S1	Highly Vulnerable	NA
Round Pigtoe	*Pleurobema riddellii*	H	Highest		S2	NA	NA
Fat Pocketbook	*Potamilus capax*	VH	Highest	E	S1	Highly Vulnerable	NA
Rayed Creekshell	*Strophitus radiatus*	H	Highest		S2	NA	Increase
Creeper	*Strophitus undulatus*		High		S1	Presumed Stable	Decrease
Rabbitsfoot	*Theliderma cylindrica cylindrica*	H	Highest	T	NA	Moderately Vulnerable	Stable (sp level)
Tapered Pondhorn	*Uniomerus declivis*		Moderate		S3	NA	NA
Trees and plants							
Broad-leaved Water-plantain	*Alisma subcordatum*	L	Highest		S1	NA	NA
Purple Milkweed	*Asclepias purpurascens*	L	DD		SX	NA	NA
Big Shellbark Hickory	*Carya laciniosa*	L	High		S2	NA	Decrease

Species		Broad Risk Measures				Vulnerability Measures	
Common name	Scientific name	RSGCN	MS Concern Level	ESA Status	NatureServe State Rank	CCVIs	Niche Models Output
Southern Woodfern	*Dryopteris australis*	L	High		S1	NA	NA
Field Horsetail	*Equisetum arvense*	L	Highest		S1	NA	NA
Hooker's Coyote-thistle	*Eryngium hookeri*	L	Highest		S1	NA	NA
Grassleaf Mud-plaintain	*Heteranthera dubia*	L	High		S1	NA	NA
Featherfoil	*Hottonia inflata*	M	High		S1	Presumed Stable	NA
Woodland Spider-lily	*Hymenocallis occidentalis* var. *eulae*	N	High		S1	NA	NA
Inland Rush	*Juncus interior*	L	High		S1	NA	NA
Pondberry	*Lindera melissifolia*	H	Highest	E	S2	NA	NA
Prairie Rhynchosia	*Rhynchosia latifolia*	L	High		S2	NA	NA
Lake-cress	*Rorippa aquatica*	M	High		S1	NA	NA
Powdery Thalia	*Thalia dealbata*	M	Highest		S1	NA	NA
Reptiles							
Western Chicken Turlte	*Deirochelys reticularia miaria*		Highest	UR	S3	NA	NA
Red Milk Snake	*Lampropeltis triangulum*		High		S3	NA	Stable
Alligator Snapping Turtle	*Macrochelys temminckii*		Highest	PT	S3	Presumed Stable	NA

Eight Mississippi SGCN in this Ecoregion are listed as Endangered, Threatened or Proposed Endangered or Threatened under the Endangered Species Act, with an additional two under review (Table 7). Eighty-six percent of species in Table 7 have conservation status ranks of Critically Imperiled, Imperiled, or Vulnerable for the state (NatureServe Explorer). Risk designations concur for some species such as the Sheepnose mussel (*Plethobasus cyphyus*) being listed as Endangered for the ESA, of highest state-level concern, and having a conservation rank of Critically Imperiled for Mississippi (Table 7).

Impacts may exacerbate existing stressors for many of the state's SGCN in floodplain forests of the Mississippi Alluvial Plain. This is particularly worrying for species like the Fat Pocketbook (*Potamilus capax*) that has already been evaluated by NatureServe and their ESA listing as being in critical condition and are projected also to be highly vulnerable to future changing environmental conditions (Table 7). In contrast, for other species like the Wood Stork (*Mycteria americana*), niche models suggest the impacts of changing environmental conditions may not be as substantial with a predicted increase in climatically suitable area (Table 7). However, there are some discrepancies in the estimates of vulnerability of species between the niche model outputs and the NatureServe CCVI method, such as with some SGCN like Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) (Table 7). There can be different reasons for this, not least that the two methods include different kinds of information: It may also be due to the niche models representing the projected trend for the whole region due to local weather and impoundment effects, whereas CCVI assessments were conducted at a state level; by Louisiana, for example for the abovementioned bat species (Table 7). Additionally, to date, many species have either not been assessed using the NatureServe CCVI tool by states or been the subject of regional ecological niche modeling efforts as is indicated by the gray “Not Assessed” boxes in Table 7.

Species Status Assessment reports (SSAs), produced by the USFWS, provide another source of valuable information for enhancing the conservation of floodplain forest SGCN in Mississippi. SSAs generally integrate population and demographic data, current and projected weather data, and data quantifying a variety of potential risks (e.g., pollutant concentrations, land use change) to both assess the current status of individual species populations and predict how this will change under future changing environmental conditions. For example, in 2022 a SSA for the Northern Long-eared Bat (*Myotis septentrionalis*) used both winter and summer data to model its decline in abundance, range and occupancy found that the bat’s range wide summer occupancy declined by 80% from 2010–2019 and by 2030 its range wide abundance and spatial extent could decline by 95% and 75%, respectively (U.S. Fish and Wildlife Service, 2022). They conclude that variables, such as changes in temperature and precipitation, may influence the bat’s resource needs, such as suitable roosting habitat for all seasons, foraging habitat, and prey availability (U.S. Fish and Wildlife Service, 2022).

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