

ECOSYSTEMS

Published: November 18, 2020

Authors

- Carolyn Keogh (*Emory University*)
- Rachel Usher (*Emory University*)
- Daniel Rochberg (*Emory University*)
- Jill Gambill (*University of Georgia*)
- Patricia Yager (*University of Georgia*)
- Amy Rosemond (*University of Georgia*)
- Seth Wegner (*University of Georgia*)
- Jacqueline Mohan (*University of Georgia*)

Key Messages

Georgia's ecosystems are home to incredible biological diversity including species found nowhere else in the country [1]. They also provide clean water, protect us from storms, store carbon, and provide recreational opportunities.

Climate change will disrupt Georgia's ecological communities at all scales, from individual species to the functioning of entire systems. For example, shrimp populations will be more vulnerable to disease [2], freshwater fish like trout and darters will lose habitat as a result of warming waters and variable water levels [3], and wetland habitats will be threatened by drought and other stressors.

Even those species that can shift their ranges in response to these changes will do so at different rates, making future ecosystems hard to predict.

Climate change is amplifying other stressors that challenge Georgia's ecosystems, including urban expansion, pollutant runoff, invasive species, and altered fire frequency [4].

Many climate resilience efforts, like connecting and protecting patches of high-quality habitat, will also protect ecosystems from these existing stressors. Resource managers, conservationists, scientists, elected officials, and private citizens are all crucial to protecting Georgia's habitats and species in the face of climate change.

Overview

Georgia's ecosystems are diverse and special

From the Blue Ridge Mountains to the coastal salt marsh, Georgia's ecosystems are extraordinary in their diversity and ecological value. Georgia is the 6th most biodiverse state in the country [1], and is home to species that are found nowhere else in the world. Georgia's ecosystems also provide numerous benefits to people: forested areas collect and filter rainwater and ensure a consistent supply of clean water to our rivers and reservoirs; coastal saltmarshes and dunes offer protection from storm surges and coastal flooding; estuaries, rivers, and forests provide opportunities for fishing, floating, hiking, and hunting. These ecosystems also offer valuable climate benefits—Georgia's forests, soils, and saltmarshes have the potential to store significant amounts of excess carbon and help slow climate change [5].

Climate change will squeeze habitats and shift species

Rising temperatures and variable rainfall are two key factors that will impact ecosystems across the state. Georgia has already experienced longer and more frequent heatwaves and greater variability in the timing and quantity of precipitation [6]. In streams, wetlands, and swamps, warming temperatures reduce oxygen availability for aquatic organisms, and drought worsens this challenge. In Georgia's forests, stress from prolonged drought can kill or stress trees, making them vulnerable to insect outbreaks and fires [7].

In response to warming temperatures, some species will shift their distributions to track favorable conditions. The different land types and climate across Georgia's five distinct "ecoregions" may set boundaries on how far north or how much higher in elevation ecological communities can move in response to climate change. Successful range shifts will require favorable soils, water and nutrient availability, and ecological interactions to promote species establishment and persistence. Because species differ in their ability to disperse and thrive in new areas, the future composition of Georgia's ecosystems is difficult to predict. Georgia's State Wildlife Action Plan identifies several species that may become extinct in Georgia, or which will require active relocation to refuge sites [4].

The challenges posed by warming and drought interact with other stressors

Warming and drought interact with other stressors such as invasive species, urban expansion, pollutant runoff, and reduced fire frequency that already pose significant risks to the health of Georgia's ecosystems [4].

- In aquatic habitats, pollutants that drain off the land during rain events can fuel algae growth that decreases oxygen levels in the entire system. Warming temperatures will worsen this stress because aquatic animals require more oxygen in warmer water [3].
- Many of Georgia's terrestrial habitats experience significant challenges from invasive plants and insects, some of which are best controlled by prescribed fires. At the same time, prescribed fire will be limited by fewer days with favorable conditions to safely manage prescribed burns [8].
- Pollinator populations are plummeting as a result of land-use changes and pesticide use in agriculture, with unknown consequences for plants that rely on them for successful pollination. Altered spring or autumn flowering times may cause mismatches between plants and the seasonal abundance of their pollinators, or between other migratory species and the availability of their food sources [9].

Coastal habitats face additional challenges

With roughly 100 miles of coastline, Georgia boasts approximately 2/3 of the remaining intact saltmarsh ecosystems in the eastern US. Sea level rise will continue to inundate marshes, wetlands, and beaches that serve as nurseries for Georgia's marine life and support the migration of thousands of shorebirds from across the globe. Preserving marshes will require their "migration" into adjacent upland habitats [10], requiring careful planning for future coastal development to accommodate this expansion. Ocean acidification, a byproduct of the ocean's absorption of CO₂, will make it harder for shellfish such as oysters to survive and grow [11].

Synergistic solutions – enhancing habitat connectivity and protecting high-quality habitats

Land and water management efforts that foster habitat connectivity will help preserve the critical functions of Georgia's unique ecosystems. Strategies that both restore ecological health and lessen climate impacts will amplify benefits for Georgia's unique ecosystems.

- In streams and rivers, efforts to remove outdated dams and culverts will restore habitat connectivity and allow aquatic species to migrate as conditions change. These efforts are already underway by groups like the Georgia Aquatic Connectivity Team (ga-act.org).
- Undeveloped areas on Georgia's coast have been identified as key locations to allow the salt marsh ecosystem to migrate into upland environments, helping marshes continue to fulfill these critical roles in a process called "marsh migration". These healthy dunes and marshes will continue to buffer coastal communities and upland habitats against intensified storms.
- Georgia has 22 million acres of working forests and coastal wetlands. These ecosystems forests are an important climate solution, responsible for offsetting 27% of emissions from the state [5].

Partnerships and participation are key to protecting Georgia's natural resources

Many individuals, agencies, and organizations are working to gather information and facilitate management decisions that help ensure the resilience of Georgia's ecosystems. Because Georgia shares many species and habitats with other states in the southeast, much of the ecosystem-level conservation planning takes place at a regional level to connect and preserve habitats. However, conservation actions at even the smallest scale – like planting a pollinator garden with the [State Botanical Garden of Georgia's "Connect to Protect" program](#) – can scale up to promote ecological resilience.

Participation in citizen science projects – including collecting data about observations of plants and birds through tools like iNaturalist or eBird – generates critical data about how the distribution, abundances, and phenology (seasonal timing of events like flowering, nesting, or migration) are changing. You can contribute to these efforts by using these free data-collection apps:

- [iNaturalist](#) (from National Geographic and the California Academy of Sciences)
- [eBird \(from the Cornell Lab of Ornithology\)](#)

The Georgia Native Plant Society, your local riverkeeper organization, and many other conservation organizations throughout the state can provide additional resources and opportunities to contribute to data collection and conservation efforts across the state.

Resources

Reports and tools focused on Georgia's ecosystems and climate

[Georgia DNR State Wildlife Action Plan](#)

(SWAP) synthesizes knowledge about the status of and threats to Georgia's wildlife populations.

The SWAP [Climate Change Adaptation Technical Team Report \(Appendix O\)](#)

Incorporates climate change data into wildlife monitoring and conservation planning, and identifies several additional partnerships that are advancing the goals of climate-adaptive conservation planning.

[Southeast Forest Futures Project Technical Report](#)

Examines how future climatic scenarios could impact the forests of the Southeastern United States and the ecosystem services they provide.

[Drawdown Georgia](#)

An effort to identify the most promising climate solutions in the state to accelerate progress toward net zero greenhouse gas emission.

[USGS – SE Global Change Monitoring Portal](#)

Aggregates data from observational networks collecting information about aquatic and terrestrial ecosystems in the southeastern United States in one online portal.

[USDA Southeast Climate Hub](#)

Delivers science-based knowledge and practical information on climate variability and change to farmers, ranchers, and forest land managers.

Partnerships focused on conservation planning in the Southeast

[Southeast Conservation Adaptation Strategy](#)

A regional southeastern conservation initiative bringing together government, non-profit, university, business and tribal partners to achieve a connected network of lands and waters to benefit ecosystems, species, and people.

[South Atlantic Landscape Conservation Cooperative](#)

A partnership that brings together federal, state and local organizations across six states to sustain lands, waters and cultural treasures today and for future generations.

[Southeast Aquatic Resources Partnership](#)

A regional collaboration of natural resource and science agencies, conservation organizations and private interests developed to strengthen the management and conservation of aquatic resources in the southeastern United States.

[NC State University's Southeast Climate Adaptation Science Center](#)

A consortium of academic institutions in the southeast identifying global change-related information needed by natural and cultural resource managers.



References

1. Stein, B.A., *States of the union: ranking America's biodiversity*, NatureServe, Editor. 2002, NatureServe: Arlington, VA.
2. <https://www.skio.uga.edu/2019/11/22/climate-change-affecting-black-gill-georgia-shrimp/>
3. Jones, K.L., et al., *Quantifying expected ecological response to natural resource legislation: a case study of riparian buffers, aquatic habitat, and trout populations*. Ecology and Society, 2006. **11**(2): p. 26.
4. Resources, G.D.o.N., *Georgia State Wildlife Action Plan*. 2015, Georgia Department of Natural Resources: Social Circle, GA.
5. Mohan, J.E., Dwivedi, P., *Land Sinks Solution Sector*. 2020, Drawdown Georgia: <https://info.drawdownga.org/>
6. Melillo, J.M., T.C. Richmond, and G.W. Yohe, *Climate Change Impacts in the United States: The Third National Climate Assessment*. 2014, U.S. Global Change Research Program. p. 841 pp.
7. Allen, C.D., D.D. Breshears, and N.G. McDowell, *On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene*. Ecosphere, 2015. **6**(8).
8. Wear, D.N. and J.G. Greis, *The Southern Forest Futures Project: technical report*. 2013. p. 1-542.
9. Pearson, K.D., *Spring- and fall-flowering species show diverging phenological responses to climate in the Southeast USA*. International Journal of Biometeorology, 2019. **63**(4): p. 481-492.
10. Schuerch, M., et al., *Future response of global coastal wetlands to sea-level rise*. Nature, 2018. **561**(7722): p. 231-+.
11. Beniash, E., et al., *Elevated level of carbon dioxide affects metabolism and shell formation in oysters *Crassostrea virginica**. Marine Ecology Progress Series, 2010. **419**: p. 95-108.