

# Southeast

## Species Summaries

**LISTING STATUS:** red (ESA listed as Threatened or Endangered), yellow (not ESA listed but federal sensitive species or state species of concern (majority of states), green (not listed in majority of states)

**CURRENT RANGE:** red (10 percent or less), yellow (11 -25 percent), green (>25 percent)

**HISTORICAL RANGE:** red (<1,000 miles), yellow (1,000-10,000 miles), green (>10,000 miles)



## Brook Trout (Southeast)

Category	Status	Explanation
Listing status	Yellow	Sensitive Species (USFS) Species of Special Concern (SC, TN)
Current range	Green	55 percent of historical stream habitat currently occupied
Historical range	Green	Over 10 million acres of historical distribution in the region
Climate change	Red	Stream warming is major issue
Energy development	Yellow	No local energy development, but downwind of coal-fired power plants which contribute to acid rain and acidify streams at high elevations
Non-native species	Red	Introduced brown and rainbow trout, northern strains of brook trout
Water demand	Yellow	Population growth in the region may increase water demand
Data issues	Yellow	Stream temperature data lacking; genetics information for many populations needs clarification

### Brook Trout (*Salvelinus fontinalis*)

The Southern Appalachian strain of brook trout is the only trout native to the Southeast. These colorful fish are fondly referred to as “specks,” “speckled trout,” “mountain trout,” or “brookies.” Historically, they thrived in streams draining the rich, temperate forests on the slopes of the Appalachian Mountains. Following agricultural development of the mountain valleys and especially as the region experienced widespread logging in the latter half of the 19th Century, Southern Appalachian brook trout habitats were degraded by sediments that ran off of denuded slopes or scoured when splash dams were used to float logs downstream.

As Southern Appalachian brook trout declined due to habitat loss, rainbow



trout and [brown trout](#) were planted in streams to “replace” the resource. Through competition or predation, these species displaced native brookies in many streams, especially in relatively warm streams at lower elevations. In other cases, brook trout from northern hatcheries were planted to supplement the local stocks, effectively swamping the unique genes and associated

adaptations to local conditions that Southern Appalachian brook trout had acquired over millennia. Genetic analysis has confirmed the unique nature of the historical brook trout strain of this region and there has been an increasing appreciation for those pure Southern Appalachian populations that remain for just how rare they are: in South Carolina, for example, just four populations of genetically unaltered [Southern Appalachian brook trout](#) persist. Through displacement or extirpation, brook trout of some form have been lost from 45 percent of their historical habitats across the Southeast. The presence of non-native species, habitat fragmentation caused by dams and impassable road culverts, and private lands development threaten those remaining populations.

## Regional Trends

The southern extent of the Appalachian Mountains provides a cool, moist, high-elevation refuge for Eastern brook trout. Yet hanging on at the southernmost margins of the species' range, Southern Appalachian brook trout will experience the [brunt of warming effects](#) anticipated with changing climate. Range constriction of the already highly fragmented populations will be most pronounced at lowest elevations, while populations relegated to headwater streams will have no ability to shift their distribution upstream. Long term stream temperature data reveal an average annual warming trend of approximately 0.36°F per decade since 1960 (1). According to projections, warming of annual temperatures by just 2.7°F from current conditions is expected to result in a 20 percent loss in trout habitat in Virginia, North Carolina, South Carolina, [Tennessee](#), and Georgia, while a warming of 6.3°F is expected to result in a nearly 80 percent loss (2). Additional climate change threats include prolonged drought and an increase in the frequency of large floods (see Northeast section for more details on flooding).

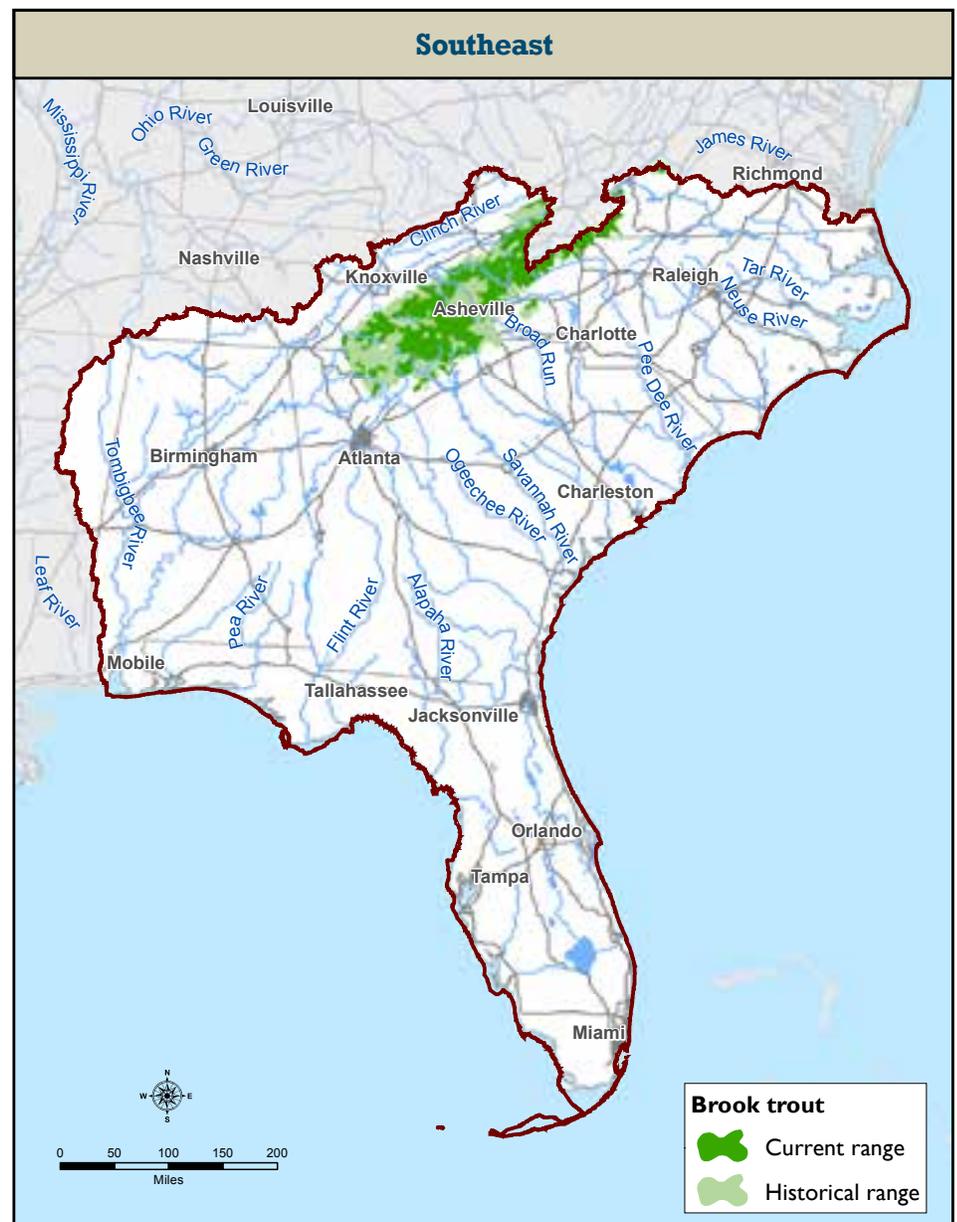
While non-native rainbow and brown trout and strains of brook trout from outside the region have displaced Southern Appalachian brook trout, the non-native species threats aren't all aquatic. In the last decade, a small Asian bug called the hemlock wholly adelgid has caused a widespread die-off of hemlocks, the quintessential riparian tree of the southern mountains. Hemlocks along streams provide a dense canopy year-round and help to buffer stream temperatures from extremes of hot or cold. Studies have shown that brook trout are three times more abundant in streams draining hemlock-dominated watersheds than in streams flowing from hardwood stands (3). The deciduous trees or evergreen shrubs that replace hemlock along streams will determine how stream shading, water chemistry and forest water yields will be affected.

The Southern Appalachians have not experienced the same recent development of shale gas and wind resources as has the mid-Atlantic region and threats associated with new energy development are, for the time being, limited. Higher elevations are, however, affected by [acid rain associated](#)

[with nitrates and sulfates](#) from automobile and coal-fired power plant emissions in the region. Acid rain not only alters the pH of streams but also causes toxic metals such as aluminum to leach from the uplands into streams. High elevations are associated with higher amounts of precipitation, subjecting them to more acid deposition – high elevation streams in Great Smoky Mountains National Park have chronically low pH (pH < 5) and even lower elevation streams can have pH spikes (decreases in pH of >0.7) episodically with rainfall, pushing the physiological limits of Southern Appalachian brook trout (4). Six populations have been lost in Great Smoky in the last 30 years. [Conditions have](#)

[improved](#) over the last decade in response to new emissions scrubbing technology and more stringent clean air regulations, however improvements in some streams may take decades due to excessive nitrate stored in forest soils.

High elevations of the Southern Appalachians can receive over 6 feet of annual rainfall, enough to be considered a temperate rain forest. Yet the region is not immune to periods of drought, and climate change forecasts predict decreases in water availability (5). Population growth in urban areas of the region since 2000 has been among the highest in the country -- Charlotte has grown nearly 33 percent, Atlanta nearly 28 percent, and the drinking

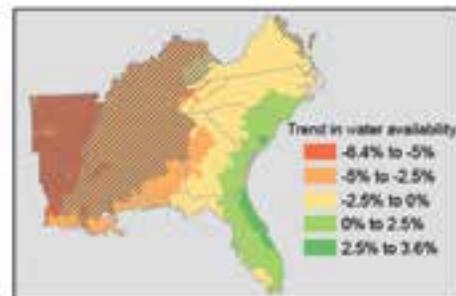
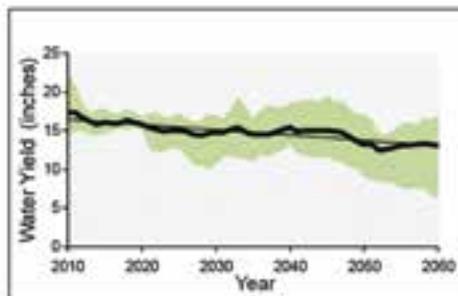


Historical and current distributions of native brook trout in the Southeast Region.

water for both cities originates in Southern Appalachian brook trout habitat. Water demand will only increase and with it the potential for conflict, as illustrated by Atlanta's water withdrawals from Lake Lanier and the Chattahoochee River during the drought of 2007.

An additional consequence of [increasing population growth](#) is the rate of land conversion. With only 50 percent of Southern Appalachian brook trout occurring on public lands in North Carolina, for example, an important conservation strategy for the Southern Appalachians is permanent conservation of unconverted private lands using conservation easements and other similar measures with willing landowners.

## Trends in Water Availability



Left: Projected trend in Southeast-wide annual water yield (equivalent to water availability) due to climate change. The green area represents the range in predicted water yield from four climate model projections based on the A1B and B2 emissions scenarios. Right: Spatial pattern of change in water yield for 2010-2060 (decadal trend relative to 2010). The hatched areas are those where the predicted negative trend in water availability associated with the range of climate scenarios is statistically significant (with 95% confidence). As shown on the map, the western part of the Southeast region is expected to see the largest reductions in water availability. (Figure source: adapted from Sun et al. 20131).

### SUCCESS STORY:

## Southern Appalachian Brook Trout Recovery in Great Smoky Mountains National Park

Some of the coldest and clearest streams in the Southeast are found in Great Smoky Mountains National Park, the largest protected area with an explicit mandate for conservation within the range of Eastern brook trout. However, as a result of acid rain (described above) and historical land uses including logging -- which buried habitats for brook trout and other aquatic species in sediments -- and the stocking of rainbow, brown and northern strains of brook trout, Southern Appalachian brook trout aren't nearly as widespread in the park as they once were.

Beginning in the 1990s, the park and its partners, including local chapters of Trout Unlimited, set out to bring back the Southern Appalachian brook trout to some of those streams where it had been lost. Forty miles of habitat across 19 streams were identified as potential reintroduction sites based on a history of brook trout populations and presence above a natural barrier. To date, 27.6 miles of habitat across 11 streams have been treated to remove non-native trout and reintroduce Southern Appalachian brook trout and four other Threatened and Endangered fish species. These reintroduction efforts take time and countless hours of hard work -- Lynn Camp Prong restoration took seven years -- but as a testament to the strength of the recovery of brook trout in the park, in March 2015 all streams in the park were opened for angling for the first time since the park was established in 1934.

"The opening of all streams in the park to recreational fishing marks an incredible milestone for the park and speaks to the commitment and dedication of our biologists and partners in restoring fish populations in the Smokies." Cassius Cash, Superintendent, Great Smoky Mountains National Park.



Willow Rutter with a Southern Appalachian Brook Trout on Lynn Camp Prong. Willow had helped collect this very fish several seasons earlier from a nearby stream for its reintroduction into Lynn Camp Prong. Photo: Ian and Charity Rutter