These two photos taken in June 2007 show the effect of the drought on the Upper Neuse River in North Carolina.
Photos by Tom Pender

RESEARCH AND OBSERVATIONS

Drought in the Southeast

by Stacy Clark, Martin Spetich, Zander Evans

"When coupled with an insect outbreak, mortality for northern red oak escalated to 10 - 15 percent, far above normal mortality levels of 1 - 2 percent."

A historic drought gripped the Southeast region in 2007. It was the second driest year on record for the region, and rainfall in some areas including Alabama and North Carolina was the lowest on record for the last century. By the end of 2007, over a third of the region was classified in "exceptional" drought (the worst drought designation used by the U.S. Drought Monitor. See the drought map on the back cover for a more detailed distribution of national drought conditions in 2007. Water levels all over the South fell. The city of Atlanta declared a water emergency because Lake Lanier, which supplies Atlanta's drinking water, was 10 feet below average. Lake Okeechobee in southern Florida was dramatically lower as well. Also during the 2007 drought, Georgia experienced its largest wildfire on record when the Georgia Bay Complex burned 441,705 acres. When added to the other 9,500 fires that year, the total burned was more than 504,000 acres.

Drought threatens many aspects of urban and rural life from municipal water supplies to agriculture to recreation, and forests are not exempt. Recently Georgia Forestry Commission staff forester, James Johnson was interviewed about the impact of drought on trees by *The Weekly*, a Macon, Georgia newspaper. According to Johnson, "The lack of rainfall is impacting shade trees, especially the red oak group in urban areas, and has also caused a decrease in timber production for the past growing season." Drought, a common disturbance in Southeastern forests, weakens trees and increases their susceptibility to secondary pest and pathogen outbreaks, causes tree mortality, and exacerbates fires. Following are selected observations and studies on various impacts of drought in the Southeast.

A long-term study conducted by the U.S. Forest Service (USFS), Southern Research Station (SRS), in a 200 – 300 year-old stand on the Cumberland Plateau in Tennessee found that a drought in the early 1980s may have been the primary factor leading to death of decadent northern red oak (*Quercus rubra*) and hickory (*Carya sp.*). SRS research forester Stacy Clark found evidence from tree-rings suggesting that drought weakened the trees. When coupled with an insect outbreak, mortality for northern red oak escalated to 10 –15 percent, far above normal mortality levels of 1 – 2 percent. Clark is continuing to study the stand dynamics following the exceptional 100-year drought of 2007.

The 2007 drought has had detrimental effects not only on old trees, but on newly established trees that Clark planted in the winter of that year. Drought hits seedlings even harder than established trees because their limited root networks cannot access moisture deeper in the soil, and they do not have the reserves to sustain themselves in dry times. For example, nearly half of the American chestnut (*Castanea dentata*) seedlings Clark planted as part of a restoration effort in the Bankhead National Forest died due to the drought. The trees were planted in former loblolly pine (*Pinus taeda*) plantations that the USFS is trying to restore to native hardwoods. The chestnuts did survive better when planted under thinned stands with a residual basal area of 50 percent, compared to stands with no basal area. While forest openings may have provided more sunlight for the

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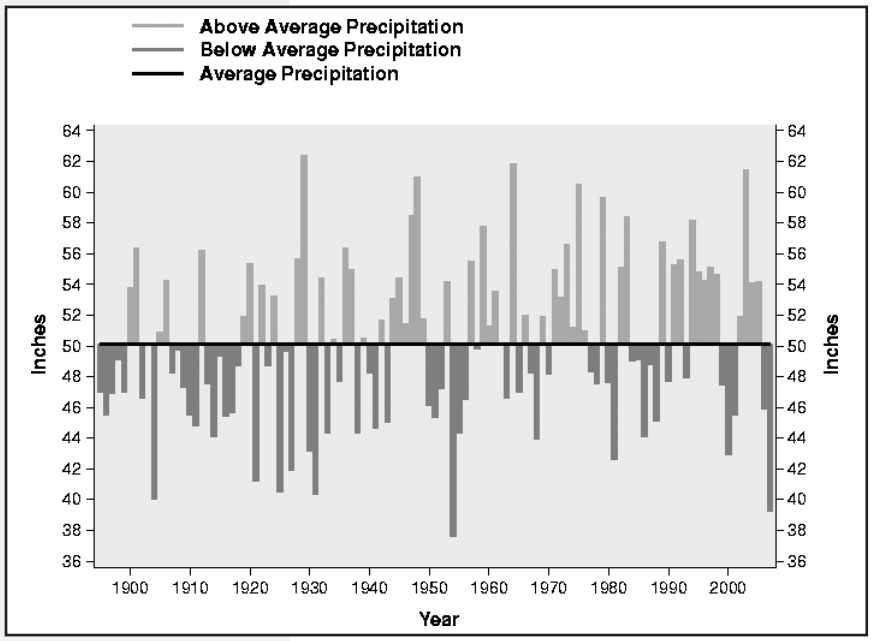

This graph shows the patterns of above-average and below-average precipitation in the Southeast from 1895 to 2007.

chestnuts, the openings were more water-limiting than the thinned stands. Other questions Clark is asking related to American chestnut regeneration include: Does chestnut need to be established before disturbance? Can it be introduced after? How does it respond to competition? Through her research, Clark is learning more about how to use silviculture to help restore the American chestnut to the forests of the Southeast.

According to Tennessee-based forester and Forest Guild member Nate Wilson, the 2007 drought was compounded by an early leafout followed by a late frost in the spring. In some locations in the South, there was complete defoliation of several species. Particularly hard hit on the plateau were hickory (*Carya sp.*) and yellow or tulip poplar (*Liriodendron tulipifera*). They lost their first flush of leaves completely and then were immediately sent into the worst drought in 100 years. Wilson also observed an increase in mature tree mortality, "It seemed that the red oaks (*Quercus rubra*) suffered most severely, and would in many cases 'brown out' from a complete foliation in a matter of days. I assume that this was cavitation in the xylem (essentially a collapse of the tree's hydraulic system), but have no way to verify it."

Forest pests and pathogens take advantage of drought conditions. For example, the southern pine beetle (*Dendroctonus frontalis*) reproduces more rapidly in prolonged hot and dry weather. Moreover, beetles are better able to attack and kill trees during a drought because the trees produce less resin, a cornerstone of their defense against the pest. Small, light yellow to white pitch tubes about the color and shape of popcorn usually form where the beetles enter the tree along the entire trunk length. Trees that are especially weak may only show reddish boring dust in bark crevices or cobwebs at the tree base.

Martin Spetich, SRS research forester, has been evaluating impacts of a major 1998-2000, Ozark-region drought on upland hardwood forests over the succeeding years. Drought-induced stress appears to trigger or contribute to oak decline syndrome. Spetich found that the density of standing dead trees increased from 21 to 28 trees per acre, and he attributed the mortality to drought-induced oak decline. Potential timber quality of surviving trees was also impacted by oak decline, as the number of northern red oak trees exhibiting epicormic branching increased from four trees per acre in 2000 to 22 trees per acre in 2001.

Fire in mature sand pine forest in Florida.
Photo by George Custer.

Spetich has also found that drought may lead to increased occurrence of fire, a phenomenon often associated with forests in the western United States during the past century. A tree-ring study by Spetich and University of Missouri professor Richard Guyette examined the relationship between drought and historic fire in the Boston Mountains of Arkansas. They examined fire history back to the early 1600s,

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and identified trends in historic fire frequencies associated with long-term climate variability and human population fluctuations. They postulate that the last century of fire suppression and resultant lack of fires in the region may partially explain the decline of oak in the Ozarks and other areas of Arkansas.

Drought can also alter species composition and reduce diversity particularly in wet areas such as marshes. Research from the Coweeta Long Term Ecological Research site, North Carolina suggests that the normally wet climate in the southern Appalachians helps foster high levels of species diversity. According to Steve McNulty, leader of the USFS Southern Global Change Team, an El Niño pattern of higher sea-surface temperatures in the Pacific Ocean is predicted for 2009 and 2010, which normally means more precipitation but also higher temperatures and faster evaporation. Increased precipitation and warmer temperatures encourage plant growth early in the spring. Later in the summer, higher temperatures can dry out plants quickly, creating fuel for wildfires. Their research suggests that drought in the Southeast and its related adverse impacts on the region's forests may become even more common in the twenty-first century.

Stacy L. Clark, PhD, is a research forester, U.S. Department of Agriculture, Forest Service, Southern Research Station, stacyclark@fs.fed.us.
Martin Spetich, PhD, is a research forester, U.S. Department of Agriculture, Forest Service, Southern Research Station, mspetich@fs.fed.us.
Zander Evans, PhD, is the Forest Guild's research director.

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Agriculture has noted a record pace of foreign purchase of land, including the rapid expansion of holdings belonging to the ironically named John Hancock Company of Canada.

As responsible land managers, we might ask what motivations these foreign investors have in advancing goals of sustainability, energy independence, or the rescuing of legacy values through restorative management of longleaf pine or bottomland hardwood. Will this new class of owners sense the same responsibility toward excellent forestry that might be felt by owners and investors who value social and cultural consequences beyond profits? Perhaps not, yet our responsibility and commitment to practice excellent forestry continues.

So what can we, as forestry professionals, do to ensure responsible resource management, indeed excellent forestry, in these new and difficult circumstances? After all, the sources of the change emanate from global market pressures that are beyond our reach and control.

The answer to this difficult conundrum may lie in the current public sympathy toward all things "environmental". Investors in TIMOs and REITs are, after all, people–with all the sensitivities and concerns for future generations that are currently so evident in public discourse. Could these same investors be motivated to rein in the exuberant purchasing of current TIMOs and REITs and focus some of that energy on assurances toward sustainable management and (dare I say it) excellent forestry?

Unloading logs at a Georgia mill in the 1990s. Photo by David J. Moorhead, University of Georgia, Bugwood.org

TIMOs and REITs have done an excellent job of diversifying to more effectively carve out niche markets and cater to various facets of the investor community. Many have explored or completed deals that monetize conservation easement values and ecosystem services. The next logical step may be to guarantee practices of excellent forestry in order to satisfy increasingly sophisticated investors. We may be able to influence this by continuing to expand the ranks of responsible professionals and by helping to make excellent forestry a mainstream expectation by landowners, investors, and the public.

"Will this new class of owners sense the same responsibility toward excellent forestry that might be felt by owners and investors who value social and cultural consequences beyond profits?"