



# Forest Health *Notes*



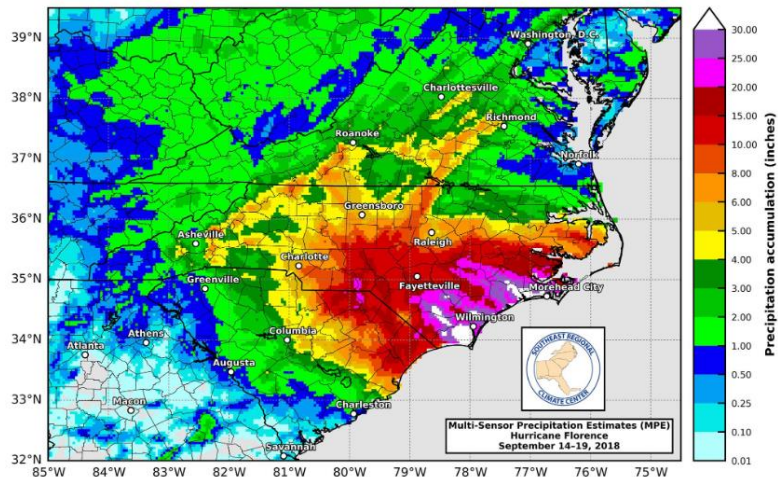
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## Hurricane Florence Aftermath: Water Stress, Drought, and Mortality in Forest Trees in Eastern North Carolina

Numerous factors can cause stress in trees, sometimes leading to their death. The last year has been particularly interesting in the eastern portion of North Carolina with multiple stress factors leading to problems with both landscape and forest tree species. On September 14, 2018, Hurricane Florence made landfall at Wrightsville Beach, NC. This was the 6<sup>th</sup> named storm, 3<sup>rd</sup> hurricane, and first major hurricane of the 2018 hurricane season.

**Immediate wind and flood damage.** Winds were measured at up to 106 mph and 105 mph at Wilmington, NC and Wrightsville Beach, respectively. Although some wind damage to trees was observed, much of the damage was in young stands where the trees were not close enough to support one another and in recently thinned stands. An aerial survey conducted soon after the storm by the N.C. Forest Service showed most forested areas to have sustained less than 10% damage. The major effects throughout the coastal plain were from flooding. Counties on a line roughly from Goldsboro east to Pamlico County and southward received over 15 inches of rainfall from this system. Elizabethtown, NC reported more than 35 inches of rain and private sources indicated similar amounts in other parts of the area. These floodwaters took some time to recede.

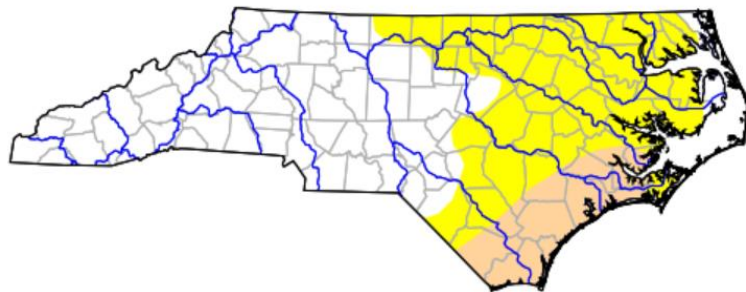


Precipitation estimates resulting from Hurricane Florence (September 14-19, 2018). Map: Southeast Regional Climate Center.

**Supplemental rainfall.** In the months following Hurricane Florence, the same area received average to above average rainfall. Rainfall events were evenly spaced throughout the late fall, winter, and early spring of 2018 and 2019. The frequency of these events was important.

Measurable rainfall events occurred at least every 5-7 days throughout most of this time (October – early April). This cycle kept the soil profile saturated for extended periods during this time. This likely led to loss of fine roots on some trees and may have increased the incidence of certain disease-causing organisms, particularly Phytophthora root rot. Observations and site visits by N.C. Forest Service, Forest Health Branch indicated trees (particularly susceptible species) exhibiting the symptoms of Phytophthora and other fungal root, stem, and foliage diseases.

**Dry period.** By the middle of April, the weather pattern had changed and there was little measurable rainfall between this time and the end of May. Weather station readings at Goldsboro, NC showed around 0.2” of rainfall for the entire month of May. In addition, the temperature rose into the 80°F - 90°F range topping out at 101°F on May 30<sup>th</sup>, 2019. Evidence of the impact on soil moisture can be shown by the fact that much of the southeastern portion of the state was experiencing a bad wildfire situation during the same period. Numerous ongoing, smoldering wildfires kept crews busy during this time and resources from outside the area were brought in to help. Many of these fires were burning in organic soils or in deep organic turf which had become dry enough to combust. During this period, trees were actively growing; requiring adequate moisture to support these functions. By June 1<sup>st</sup>, N.C. Forest Service personnel were observing tree mortality and receiving calls from homeowners and forestland owners about the same.



Drought map for June 4, 2019. Tan indicates areas with “moderate drought” and yellow indicates areas “abnormally dry” Map: US Drought Monitor of North Carolina.

**Observed mortality.** Much of the observed mortality was, and continues to be, on oak species inhabiting drier sites. These include southern red oak (*Quercus falcata*), white oak (*Q. alba*), turkey oak (*Q. laevis*), and sand post oak (*Q. margarettiae*). Generally, these species are somewhat resistant to drought. However, they are not accustomed to saturated soil conditions. It is believed that these trees lost root mass during the period of saturation and were not able to handle the droughty conditions early in the growing season. In addition, secondary insect and disease pests such as ambrosia beetles, horntails, hypoxylon (biscogniauxia) canker, and other organisms utilized the weakened trees, contributing to the problems seen. Additional landscape and forest tree species have shown problems as well. Reports were received regarding dogwoods (*Cornus florida*) exhibiting symptoms of drought stress and NCFs Forest Health staff has observed multiple southern yellow pine stands with *Ips* engraver beetle activity (an insect known for attacking stressed trees). Additional tree death has occurred across the same area into July and it would not be unusual for some trees to continue to die into next year as weakened trees succumb to secondary insect and disease pests or simply are not able to maintain life functions.

It should also be noted that many stands planted across the eastern part of the state failed this year. Many of the same causes are responsible for this phenomenon. Seedlings observed showed evidence of little to no lateral root growth. This lack of growth is due to either anaerobic conditions in the seedling bed due to soil saturation or a combination of this in concert with the “flash drought” experienced in late April and May (often following planting in March).

**Management and conclusions.** It is not unusual to see events of this type following extreme weather conditions. Similar situations have been observed within the last decade following the excessively dry weather experienced from 2008-2011 in this same area. Forest and landscape trees should be monitored as a routine practice and management recommendations made to maintain tree health. While not much can be done in a forested situation for individual trees experiencing the conditions described, landscape trees can be given adequate water and nutrition to aid in their recovery from these conditions. NC Forest Service personnel can aid in these recommendations and can be reached at your local county NC Forest Service Office ([https://www.ncforestservation.gov/contacts/contacts\\_main.htm](https://www.ncforestservation.gov/contacts/contacts_main.htm)).



Sand post oak (*Q. margaretta*; left) and Southern red oak (*Q. falcata*; right), both succumbed water stress caused by excessive rainfall followed by a “flash drought”. Images: Jim Slye, NCFS.



Although oaks are the primary group of trees affected by the described water stress, other trees such as Leyland cypress (*x Cupressocyparis leylandii*; top left) may also be impacted. The water stress event may also predispose trees to pests which are known to attack stressed/weakened trees, such as *Ips* engraver beetle on pine (top right; below). Images: Jim Slye, NCFS.



The N.C. Forest Service is a division of the N.C. Department of Agriculture and Consumer Services;  
Steve Troxler, Commissioner.