CURRENT AND EMERGING RISKS TO SOUTHEASTERN U.S. FORESTS

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EXTENDED ABSTRACT

The Southeastern United States contains a variety of ecosystems that are categorized into 22 level-three ecoregions. Ecoregions are divisions of land area grouped by similar features, including geology, vegetation, soils, land use, and wildlife (Omernik 1987). Forest vegetation across ecoregions includes the following major forest types: oak-hickory, oak-pine, loblolly-shortleaf pine, longleaf-slash pine, and other mixed hardwood and conifer forests. Each forest type is subject to unique stresses, including hurricanes and catastrophic wind, sea-level rise, drought, insects and pathogens, invasive species, and wildfire. These threats are expected to increase in severity and frequency under a changing climate. Here we summarize current impacts and projected changes in forest threats in the Southeastern United States.

Each year, hurricanes cause billions of dollars of damage. Intense winds from hurricanes, tornadoes, and storms are known to impact forest land by causing damage like defoliation, stem bending, breakage, and uprooting (Barlow and others 2021, Vogt and others 2020). Although coastal ecoregions have a much higher risk of hurricane damage, non-coastal (inland) ecoregions are also vulnerable to hurricane damage. Hurricane intensity and frequency have increased since 1960 (Bruyère and others 2012, Holland and Bruyère 2014) and are expected to continue increasing into the future (Knutson and others 2010, 2020; Sugi and others 2017). There is also evidence that hurricanes are moving slower (Kossin 2018), and this reduced speed may result in higher local rainfall totals and subsequent flooding relative to past hurricanes.

Drought is a unique forest threat that directly and indirectly impacts trees. Many areas of the Southeast have moderate to extreme cumulative drought severity indices based on 1987-2013 data (Clark and others 2016). Precipitation variability, frequency, and severity of summer droughts are projected to increase in the future (McNulty and others 2019, Zhao and Dai 2015,). Generally, temperatures are expected to increase and summer precipitation is expected to decrease (Kunkel and others 2013). Drought can directly induce tree mortality, or indirectly reduce tree vigor with subsequent increases in susceptibility to other threats like wildfire, insects, and pathogens. Vose and others (2016) reported that 30 days of drought dried all fuel-class sizes, increasing wildfire risk in southern forests. Productivity is also slowed by drought and trees can experience reduced growth rates for years following drought (Berdanier and Clark 2016).

Many native and non-native insects, including but not limited to southern pine beetle (SPB), hemlock woolly adelgid (HWA), emerald ash borer (EAB), gypsy moth, and spotted

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lanternfly, threaten southeastern forests. Bark beetles (i.e., SPB) and sapsuckers (i.e., HWA and spotted lantern fly) reduce vascular function and wood borers (i.e., EAB) additionally degrade wood. Other insects consume leaves (i.e., gypsy moth) which reduces the tree's vigor as it must expend energy to refoliate. This loss of tree vigor can lead directly to mortality, especially when insect populations are high, and trees are subject to repeated defoliation. Insects can also serve as vectors for pathogens, and this complex of factors increases tree stress and may lead to mortality. The native SPB is a particularly impactful insect and was reported to cause economic damage of $43 million per year between 1973 and 2004 (Pye and others 2011). The range of many species is predicted to move northward (Olatinwo and others 2014) due to increasing winter temperatures, leading to reduced winter insect mortality. Some States north of the natural SPB range in the Northeastern United States have already experienced pine mortality and subsequent impacts from northward SPB infestations (Dodds and others 2018, Heuss and others 2019) and this range expansion is projected to continue (Lesk and others 2017). Insect pests are generally expected to continue to have even greater economic impacts as well as significant impacts on forest composition and structure in the future (Dukes and others 2009).

In 2020, over 33 percent of all wildland fires in the United States occurred in the Southeast region (National Interagency Coordination Center 2020). Many forest types in the South benefit from fire. For example, longleaf pine (*Pinus palustris*) forests rely on fire to maintain community composition and structure. However, some forest types are more susceptible to damage from wildfire due to long-term fire exclusion (Carpenter and others 2020). Wildfires are forecast to increase in the future due to projected increased temperature and drought conditions which may lead to longer fire seasons (Liu and others 2013). The risk of large wildfires (>12,355 acres) is forecast to increase in the Southeastern United States, especially in the Coastal Plain and Appalachian Mountain ecoregions (Barbero and others 2015). Fire may also be promoted or suppressed by certain invasive species, for instance C4 grasses like cogongrass (*Imperata cylindrica*) may increase fire intensity (Fusco and others 2019).

Sea-level rise and soil salinization are threats to coastal ecoregions. Globally, sea-level has risen approximately 3 inches since 1990, and some areas of the Southeast are particularly vulnerable (Carter and others 2018). The encroachment of saline water into coastal soils leads to the conversion of coastal forests to more saline wetland habitats where current forest types are no longer viable.

These threats are some of the significant disturbances to southeastern forests. As these threats change, so too should forest management practices that reduce risk. Strategies for adaptation and mitigation must be incorporated into forest management plans to increase resistance and resiliency to threats as the climate changes. The U.S. Department of Agriculture Southeast Climate Hub works to develop guides (Barlow and others 2021, Gibson and others 2021) and adaptive management tools to ensure the productivity and health of forests in the Southeast.

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