



Wildland fire risk and social vulnerability in the Southeastern United States: An exploratory spatial data analysis approach

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ABSTRACT

The southeastern U.S. is one of the more wildland fire prone areas of the country and also contains some of the poorest or most socially vulnerable rural communities. Our project addresses wildland fire risk in this part of the U.S and its intersection with social vulnerability. We examine spatial association between high wildland fire prone areas which also rank high in social vulnerability (“hot spots”) for Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina. We also look at the proximity of hot spots to wildland fire mitigation programs. We hypothesize that hot spots are less likely than high wildland fire risk/low social vulnerability communities to engage with mitigation programs (e.g., Community Wildfire Protection Plans or Firewise Communities). To assess our hypothesis, we examined mean distances between: 1) hot spots and mitigation programs and 2) high wildland fire risk/low social vulnerability communities and mitigation programs. Overall, results show longer mean distances from hot spots to mitigation programs, compared to distances for high wildland fire risk/low social vulnerability communities. This finding provides support for our hypothesis and suggests that poorer communities in the southeast with high wildland fire risk may be at a greater disadvantage than more affluent, high fire risk communities in these states.

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1. Introduction

This investigation examines the association between wildland fire risk and social vulnerability in six states in the southeastern U.S.—Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina. Recent studies conducted outside the South suggest that poorer communities such as those prevalent in the southern Black Belt² and elsewhere across the rural South would face greater wildland fire risks than middle-class or affluent communities (Ojerio, 2008; Ojerio et al., 2008; McCaffrey, 2004; Lynn and Gerlitz, 2006; Center for Watershed and Community Health, 2001). Social vulnerability, in terms of low socio-economic status of residents, has the effect of exacerbating community risk to wildland fire occurrence and devastation because socially vulnerable populations are generally less able to either

mitigate wildland fire risk or recover from such events (Cutter et al., 2000; Lynn and Gerlitz, 2006; Evans et al., 2007; Blaikie et al., 1994, p.3). For instance, Mercer and Prestemon (2005) found a positive association between poverty and area of wildland burned and wildland fire intensity, suggesting that once wildland fires are ignited, poorer communities have fewer resources to extinguish fire.

We use Exploratory Spatial Data Analyses (ESDA) to look at possible links between wildland fire risk and social position. Our objective is to identify descriptive clusters of wildland fire risk and social vulnerability—“hot spots,” defined as areas with both above average fire risk and social vulnerability; or “cold spots,” geographies with low wildland fire risk and social vulnerability. Further, we examine the proximity of wildland fire mitigation programs to hot spots and other clusters to assess whether communities facing the greatest risks, in terms of both biophysical and socio-demographic characteristics, have the requisite community-based programs to lessen the effects of wildland fire devastation.

1.1. Wildland urban interface and non-wildland urban interface settlements in the South

A study of southern poverty commissioned by former U.S. Senator Zell Miller of Georgia found that in 2000, 13.6 million poor people

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² The Black Belt is comprised of 623 counties contained in eleven states of the former Confederacy—Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. The region holds 18% of the nation's population (Allen-Smith et al., 2000). These counties are mostly adjacent although they span several states (Wimberley and Morris, 1997).

lived in the South, representing 40% of total U.S. poverty (Carl Vinson Institute of Government, 2002). Along with high poverty concentrations, however, the South also contains areas of affluence in urban metropolises such as Atlanta, Georgia and wealth pockets in amenity-rich wildland areas. The South contained six of the fastest growing counties in the nation, in terms of percentage change in population from 1 April 2000 to 1 July 2009 (U.S. Census Bureau, 2009a).

Population growth increases demand for housing and other development, much of which contributes to the expanding Wildland Urban Interface or the WUI—"the area where structures and other human development meet or intermingle with undeveloped wildland" (http://silvis.forest.wisc.edu/projects/WUI_Main.asp). WUI growth in turn, increases the likelihood of wildland fire ignition caused by humans, given the closer proximity of human dwellings and activities to woodlands (Macie and Hermansen, 2002). Research indicates that WUI expansion is driven largely by affluent migration to peri-urban areas (Rodrigue, 1993; Collins, 2008a,b). In many instances then, WUI settlement implies higher income strata populating woodland and wildland areas.³

Federal mandates for wildland fire mitigation efforts prioritize WUI communities (Lynn and Gerlitz, 2006; Western Governor's Association, 2002). This is justifiable given the combination of physical and social factors (increasing population and housing density) contributing to higher wildland fire risk in the WUI. However, less densely populated rural areas outside the WUI containing abundant vegetation may be at a comparable risk of wildland fire.

Importantly, non-WUI settlements have been found to contain higher percentages of lower income populations, in contrast to the WUI. In Oregon and Washington, Lynn and Gerlitz (2006) found a higher percentage of poor people in a class of wildlands they term Inhabited Wildlands, as compared with the WUI. As well, analysis of county-level WUI data⁴ for the six states included in this study shows that non-WUI acreage in nonmetropolitan counties⁵ varies positively with percentage of population below the poverty threshold ($r=0.363$; $p<0.0001$; correlation between a county's WUI acreage and percentage of population below poverty is $r=-0.439$, $p<0.0001$) (Radeloff et al., 2005). Hence, those places where development is expanding into rural wildlands are less likely to be in high poverty counties in Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina.

Again, however, our interest in wildland fire across these southeastern states concentrates on those socially vulnerable populations that locate in nonmetropolitan areas outside the WUI. Thus, our analysis includes not just the WUI but also less densely settled, high vegetation places outside the WUI that contain long-established, socially vulnerable groups. These populations are prevalent in Black Belt counties such as Jefferson County, Mississippi and Perry County Alabama, where 37.5 and 31.7%, respectively, of the population is classified as impoverished (U.S. Census Bureau, 2009b).

2. Wildland fire risk in the South

Physiographic features contribute significantly to wildland fire risk in the South (Stanturf et al., 2002; Monroe, 2002). Critical factors are long growing seasons with frequent rainfall and wind, which contribute to abundant vegetation. This growth, along with a high frequency of lightning strikes and lack of a persistent snow layer, increase the likelihood of wildland fire.

³ Collins (2005) stresses that poor communities may coexist with affluent populations in the WUI.

⁴ Data source: Forest and Wildlife Ecology, University of Wisconsin at Madison. Wildland Interface Maps, Statistics, and GIS Download (http://silvis.forest.wisc.edu/projects/WUI_Main.asp).

⁵ As measured by the USDA's Rural–Urban Continuum Codes (<http://www.ers.usda.gov/briefing/Rurality/RuralUrbCon/>).

The greatest number of wildland fires, by region, occurs in the South (National Interagency Fire Center, Wildland Fire Statistics, n.d.). In 2007, one-half of all reported wildland fires in the nation occurred in the thirteen states comprising the U.S. Forest Service's Southern Region; in 2006, more than one-half of all reported wildland fires in the nation were in the South, and 42% of all large wildland fires reported were in this region (Andreu and Hermansen-Báez, 2008).

In pre-industrial times, Native Americans and early European settlers used fire to reduce fuel loads. The advent of agricultural and industrial development during the nineteenth century resulted in wide-spread loss of forest cover throughout the South. To aid forest regeneration in the early twentieth century, fire suppression programs were implemented across the region. However, decades of fire suppression have resulted in substantial fuel buildup in Southern woodlands, which contribute to an increased likelihood of wildland fire (Fowler and Konopik, 2007; Monroe, 2002).

In addition, severe drought conditions over the past several years have made some areas in the region especially susceptible to wildland fire. In Florida, for instance, state fire officials reported 1847 wildland fires on state and private lands from January to April 2009. This number represents an increase of 88% over 2008 figures for the same period (Florida Division of Forestry, 2009).

The Southern Group of State Foresters', 2005 report, *Fire in the South*, identifies a number of factors contributing to the problem of wildland fire in the region. These include the fact that there is relatively little federally owned land in the South, which makes states responsible for wildland fire protection on greater than 94% of the region's land area. Again, the wildland urban interface (WUI) exacerbates wildland fire threat in many areas; and local fire departments must contribute heavily to fire suppression. Also, changing demographics in heavily forested areas makes the task of prescribed burning harder to implement, resulting in increased fuel loadings in some communities.

3. Social vulnerability and wildland fire risk

Haque and Etkin (2007) write that an after-the-fact response to disaster emphasizing cleanup and recovery efforts has for the most part been replaced with a "vulnerability/resilience paradigm." This perspective places as much emphasis on the social dimensions of disaster, that is, on suspected societal conditions and inequities which may cause some groups to be less prepared for and less able to recover from hazard events, as physical causes.

In a review of the literature on poverty and disasters in the U.S., Fothergill and Peek (2004) describe disasters as a "social phenomenon" and cite a number of studies showing that poorer people are more likely than other income groups to perceive greater risks from natural disasters but are less likely to respond to disaster warnings. Poor people also suffer disproportionately from the physical and psychological impacts of disasters, experience higher mortality rates, and find it more difficult to recover after disasters. The authors conclude that these findings "...illustrate a systematic pattern of stratification within the United States" and that disasters often highlight a priori disparities in social well-being (Fothergill and Peek, 2004, p. 103).

Cannon (in Haque and Etkin, 1994) makes explicit social variables that contribute to social vulnerability—social, economic, and political factors. These factors can either enhance or detract from a community's ability to mitigate disaster. Along similar lines, Cutter et al. (2000) argue that socially vulnerable groups such as the elderly, lower income, racial minorities, and women are more likely to be exposed to a larger number of hazards and or be less able to recover from disasters (e.g., chemical spills, hurricanes, wildfire), than wealthier, more able-bodied individuals and communities. Morrow (1999) and Lynn and Gerlitz (2006) also posit that poor communities are less able to absorb the effects of natural disasters.

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