ENHANCING THE NED DECISION SUPPORT SYSTEM WITH WILDFIRE RISK ASSESSMENTS IN THE WUI

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1. INTRODUCTION

The Northeast Decision Model (NED) is a project level Decision Support System (DSS) that was developed by the Forest Service to assist land managers and owners in identifying and planning site-specific actions that will achieve their goals and objectives. A major focus of NED in the past has been on natural resource planning for primary goals such as timber, wildlife and watershed management, aesthetics and visual quality (Rauscher et al. 2000). The decision-making process within NED is based on user-defined goals, which are addressed through an evaluation of the effects of a variety of management alternatives on desired future conditions. Funding through a Joint Fire Sciences project has supported expansion of the NED system to include project planning and decisions for fire management in southern natural ecosystems as well as the wildland-urban interface (WUI). Including WUI applications in the NED system requires the development of fire risk ratings for different ecosystems and landscape designs within those ecosystems, and a set of rules that would relate hazard mitigation options to attainment of risk reduction goals.

Wildfire risk assessment and prevention planning are most often conducted at state, regional and community levels, although guidelines at all levels suggest hazards and protection measures for individual properties. Important components of risk and hazard include:

1. types, patterns and conditions of vegetation and fuels;
2. likelihood of an ignition by lightning, humans or equipment;
3. design and construction materials of individual homes;
4. infrastructure such as roads, signs, water sources and utilities;
5. topography and related environmental factors;
6. resource or asset values that would be impacted by a fire; and
7. frequency of adverse weather or climatic conditions.

Computerized mapping and geographic information systems (GIS) have greatly facilitated these evaluations in recent years. California began such assessments in the early 1970s, and their most recent version is a statewide Fire Hazard Mapping based on methodologies developed in conjunction with the 1996 California Fire Plan. Similar statewide assessments have been completed in New Mexico and Florida. Although the statewide protocols can be used by individual communities or landowners to determine if they are in a high hazard/risk zone, they do not necessarily reflect the actual risk for individual landowners in that zone.

The most common hazard assessment procedures have focused on local municipalities and communities. They vary in detail, but most include some evaluation of vegetation around homes or other structures, often classifying vegetation according to one of the 21 National Fire Danger Rating System (NFDRS) fuel models or 13 Fire Behavior fuel models (Anderson 1982). Other important factors in most of these community assessments include road characteristics, signage, building construction (especially roofs, siding and decks), utility placement, water sources, and fire history. Most assessment procedures are modeled after the hazard rating systems outlined in “NFPA 1144: Standard for the Protection of Life and Property”

(NFPA 2002), or described in the booklet "Wildland/Urban Interface Fire Hazard Assessment Methodology" (National Wildland/Urban Interface Fire Protection Program 1998). These assessment procedures usually result in a mathematical summary of rating scores for each of the factors included in the evaluation and a qualitative description of hazard and risk (low, medium, high) depending on the total rating score. The actual numerical rating is significant only for the system from which it was derived.

An excellent example of such a community-level assessment is the Hazard Assessment Booklet for Florida Homeowners, which includes rating factors for access, vegetation, building construction, utilities, fire protection resources and subdivision design; the scoring system follows the NFPA 1144 standard closely, but includes added details at the community level related to the percentages of homes that have different features. These additional details in the Florida assessment strengthen the utility of the assessment process for communities, but they also illustrate an important shortfall of community-level assessment procedures. The tabulated total scores and quantitative or qualitative fire risk descriptions are for a much larger area than individual landowner properties. Although homeowners can utilize most of the evaluative procedure and factors for their property, their total scores may not be comparable to the risk categories for an entire community, which generally require more assessment information than is available, or applicable, to individual landowners. Assessment procedures for individual lots or properties are critical and necessary for homeowners to determine their particular risk.

One of the most important educational messages for landowners in the WUI is that they must assume responsibility for protecting themselves. Under extreme fire situations, fire control resources are often insufficient to protect all threatened structures. Where landowners assess their particular risk and reduce that risk through landscape, fuel and structural modifications, homes are much more likely to survive WUI fires. If landowners are to assume this responsibility, educational materials and decision-support systems must present them with clearly defined and easily understood methods to assess risk and evaluate their mitigation options relative to other homeowner objectives and values (such as water conservation, wildlife habitat, and natural ambience).

We developed a risk assessment system for landowners based on the vegetation community surrounding their homes, landscape modifications of that vegetation to provide defensible space and structural features that would influence fire risk. Assessment scores became the condition analysis in NED for evaluating hazard mitigation treatment effects via a set of decision rules. Development of the scoring system and decision rules is described in this paper.

2. RISK ASSESSMENT IN THE SOUTHERN U.S. WUI

Attributes of our assessment system for the Southeast include both fuel hazard and home risk components (items 1 and 3 in previous list of risk components). The fuel hazard component evaluates vegetation on, or surrounding, individual properties, in terms of the major forested and grassland ecosystems in the Southeast. Five fire hazard ratings from very low to very high were assigned to each ecosystem based primarily on understory vegetation characteristics and fire behavior descriptions for fuel models described by Anderson (1982).

Ecosystem	Hazard rating
Agricultural fields	0 (very low)
Hardwood forest	1 (low)
Mature pine plantations	
Seasonally flooded swamps	
Pine savannas (with grass)	3 (moderate)
Grasslands	
Seasonal marshes	
Pine forests with shrubs < 6’	4 (high)
Young hardwoods/dense shrubs	
Recently logged forests	
Dense shrubs > 6’	5 (very high)

Four categories of defensible space were then rated according to the following scale:

Width of defensible space	Hazard rating
> 100 feet	1
60-100 feet	1.5
30-60 feet	2
< 30 feet	4

Fire hazard scores for each of the 20 combinations of ecosystem and defensible space were determined as the multiplicative value of the two separate hazard ratings. Our intent was to provide a reasonable representation of the diverse vegetation patterns which actually exist in WUI residential areas across the South. Overall hazard ratings for individual lots ranged from scores of zero to 20, with the highest score representing homes surrounded by dense high shrubs with little or no defensible space clearing.

The validity of these hazard ratings were determined by using the BehavePlus 2.0.0 fire modeling system (Andrews and Bevins 2001) for each of the applicable fuel models. Successive runs in BehavePlus for each fuel model adjusted 1-hr, 10-hr and 100-hr fuel loads to represent reductions in fuels due to landscaping measures that would reduce risk (0.5x or 0.25x normal, for 30-60 ft or 60-100 ft defensible space, respectively), or not change risk (normal fuel load in model for < 30 ft defensible space). We further defined critical fire weather conditions to use as inputs for each of the fuel models in BehavePlus as mid-flame wind speeds at 20 mph and 1-hr and 10-hr fuel moisture contents at 5% and 8%, respectively, although slower winds and higher moisture contents were also run for comparison. Outputs included fireline intensity, rate of spread and flame length. Fire line intensity displayed a strong linear relationship with the overall rating scores for the ecosystem-defensible space combinations suggesting that they were a reasonable representation of the heat load hazard for different WUI situations.

The structural (home) risk component was subdivided into three categories to account for ignition source (direct/embers, indirect – as through an adjacent wood pile, or heat related). Rating scores for several factors under each ignition source reflect the likelihood that the factor may be problematic for ignitions, but they also provide a means by which landowners can prioritize mitigation measures. Scores in the various categories ranged from zero to ten, and they were added to the vegetation hazard rating for an overall home risk score with a maximum of 30 points. All risk rating systems that look at home construction score wood substantially higher than non-flammable exteriors, as did ours. The risk component focused on exterior home construction materials.

The risk assessment guide was reviewed by 40 fire management specialists across the south, with some minor adjustments in the final scoring protocol before it was released (Long and Randall 2004).

3. DECISION MODEL FOR MITIGATION ACTIONS

This approach to defining WUI home fire risk allowed us to provide prescriptive recommendations for mitigating risk, depending on whether the risk is from fire intensity, rate of spread or a combination of the two. The risk assessment procedure and mitigation options were incorporated into the NED system through a set of goals and rules that defined how risk could be reduced by different management practices, defensible space clearings and structural modifications. The process of combining the fire information with NED is described in another EastFire paper (Hemel et al. 2005).

4. ACKNOWLEDGEMENTS

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6. BIOGRAPHY OF SPEAKER

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