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**Wildfire Risk Assessment and Community Wildfire Protection in
the Chilhowee Mountain Area of Blount County, East Tennessee**

A Dissertation
Presented for the
Doctor of Philosophy Degree
The University of Tennessee, Knoxville

Piyarat Chimchome
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DEDICATION

I dedicate this dissertation to my parents Boonruam and Pranee Wongarin for implanting in me the importance and value of education; and to my husband, Vijak Chimchome for his patience and support.

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ABSTRACT

The growing Wildland Urban Interface community in the Chilhowee Mountain area of Blount County, Tennessee, like many other forested areas in the mountains and hills of East Tennessee, was identified by officials of the Tennessee Division of Forestry as being a high risk area for wildfire. The purpose of this research was to help wildfire managers better understand how to facilitate wildfire protection and mitigation in the Chilhowee Mountain area. A mail survey was sent to the 474 property owners in the communities of Campers Paradise, Happy Valley, and Top of the World. The survey contained 33 questions related to wildfire risk, property characteristics, residential status, experience with wildfire, fire risk perception, and preferences for wildfire reduction strategies. A total of 159 property owners participated in the survey with an overall response rate of 35%. The data were weighted to represent the residential status of the property owners (resident, absentee, and lot owners).

Homeowners were more likely to perceive higher risk severity and feel more vulnerable than lot owners and they do not see a wildfire affecting them personally as much as their property or possessions. Perceived risk severity and risk vulnerability was positively correlated with fire risk reduction behaviors for all property owners. The reasons given for not implementing protective measures were (in rank order) vacation home/not living there, cost, age/physical ability, lack of fire fighting equipment/water, time, only so much one can do, and neighbors/others pose risks. Two-thirds of the property owners believe there should be no restriction on construction in areas highly susceptible to wildfire,

however, almost three out of four indicated it should be required that home buyers be informed when a house they are considering for purchase is in a fire risk zone.

There is a considerable need for agencies to work collaboratively in order to develop effective wildfire protection programs in communities. With a multi-agency team, a strong, coordinated message can be delivered to WUI communities. For wildfire risk mitigation to be effective over the long run, a community must be able to sustain involvement in wildfire risk reduction strategies into the future.

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1. INTRODUCTION

1.1 Background

Many people have the desire to live in rural areas rich in natural amenities, particularly around forests, lakes and streams. It is predicted that urbanization in the South will continue to grow at a rate of 1.1 million acres per year until 2020, with the possibility of losing over 12 million forest acres to urbanization (Tennessee Forestry Commission 2004). Consequently, large areas of forest land in the South are increasingly influenced by humans and surrounded by urban development. Areas of increased human influence and land use in forested and natural areas combine to create the Wildland Urban Interface (WUI) (Macie and Hermansen 2002).

An increase in the number of people settling in wildland areas has placed more homes at risk from wildfires. In the United States (U.S.), current population growth and expanding development into natural areas have substantially increased the likelihood of anthropogenic wildfires, with the potential for the loss of property and lives. Wildfires in the Western and Southern United States have caused millions of dollars of property damage to homes, forests, and rangeland, and loss of life. The 2000 wildfire season burned 3.5 million ha and cost nearly \$1.3 billion in Federal suppression funds (Prestemon et al. 2002). In 2001, wildfires cost over \$600 million in reduced tourism, fire suppression efforts, damaged timber, businesses, and homes across the South. In Tennessee, 2,739 wildfires burned 68,141 acres and 67 residences (Macie and Hermansen

2002). Wildfire is a very serious hazard that may result in significant damage to the ecological, economic and social fabric of a community. Wildfire hazards are especially pronounced when meteorological conditions are extremely dry with hot or strong winds. For example, in late October 2007, the strong Santa Ana wind caused a large fire in San Diego, California, that forced nearly one million people to evacuate, burned 497,963 acres, destroyed 2,406 homes, and killed 16 people. In 2003, the worst wildfire in state history burned nearly 750,000 acres, destroyed 3,600 homes and other buildings, and killed 24 people across Southern California (Archibold 2007).

Wildland fire in the WUI is a significant issue to resource managers and local communities in terms of protecting people and property, including the lives of professional fire fighters. Increased funding and policy support have dramatically expanded programs, such as “Firewise,” which are designed to improve community wildfire preparedness. Due to the wildfire risk in WUI communities, the Tennessee Department of Agriculture, Division of Forestry (TDF) is promoting and administering the Firewise Communities program. Firewise was developed with the primary goal of protecting homes and homeowners from property damage and bodily harm associated with wildfires. The purpose of this national program is to provide citizens with the knowledge necessary to maintain an acceptable level of fire readiness, while ensuring that firefighters can use equipment more efficiently during a wildfire. Identifying areas of the WUI that are prone to severe wildfire is an important step in prioritizing fire prevention and preparedness projects (T. Dailey, pers. comm., 2006).

Understanding the human dimensions of wildfire management is very important as well. Knowledge of and experience with wildfire and fuels management vary across WUI communities in different regions of the United States. In addition, such knowledge and experience can affect perceptions of risk and preferences for, and acceptance of, management practices (Vogt 2003). Any solutions to the problems associated with the danger of wildfires are best thought of in terms of long-term system improvements in wildfire management and protection rather than short-term mending (Carroll et al. 2007). As a result, there is a continuing need for research on wildfire risk and human response to wildfire risk.

1.2 Statement of the Problem

Population growth in the South is increasing relative to other regions of the U.S. Between 1990 and 2000, the South's population grew 14% to 91 million residents and now accounts for 33% of the national total. The population is projected to increase another 24% to 114 million people by 2020 (Cordell and Macie 2002).

With a population increase of 22% from 1970 to 1990, and 23% since 1990, Blount County, Tennessee is one of the fastest growing counties in the state with a population of 105,823 in 2000 (Tennessee Historical Society 2002). The county is located in the southeastern portion of Tennessee and one-third of the Great Smoky Mountains National Park (GSMNP) is located in the southeastern corner of the county. The weather is typically a mild variation of all four seasons. Moderate climate and the natural beauty of

the Great Smoky Mountains National Park and surrounding foothills are significant motivations for in-migration into Blount County, including the Chilhowee Mountain area adjacent to the Park. Chilhowee Mountain is 6 miles southeast of Maryville, 15 miles southeast of Knoxville, and 5 miles west of Pigeon Forge at its closest point. The Mountain covers the ranges between the Little Tennessee River in Blount County and Bluff Mountain in Sevier County. It adjoins the Great Smoky Mountains National Park at Look Rock toward the southern end of Chilhowee Mountain (Thomas 1989) (Figure 1.1).

Development on Chilhowee Mountain has increased in recent years, also increasing the number of homeowners exposed to wildfire risk (T. Dailey, pers. comm., 2006). For example, the Blount County Planning Commission recently approved a developer's plan to build a subdivision with 80 lots on the east side of Chilhowee Mountain facing the Great Smoky Mountains National Park (Figure 1.2). The development will be located on a steep mountainside in the Abrams Creek Watershed. These 140 acres of previously forested land are quite rugged, with elevations ranging from 1,600 to 2,400 ft. With existing homes and new developments, TDF is particularly concerned about the wildfire risk in the Chilhowee Mountain area.

There were three fires in the Chilhowee Mountain area of Blount County in 2007. The first fire was caused by residential debris burning on April 20 in the steep and rocky

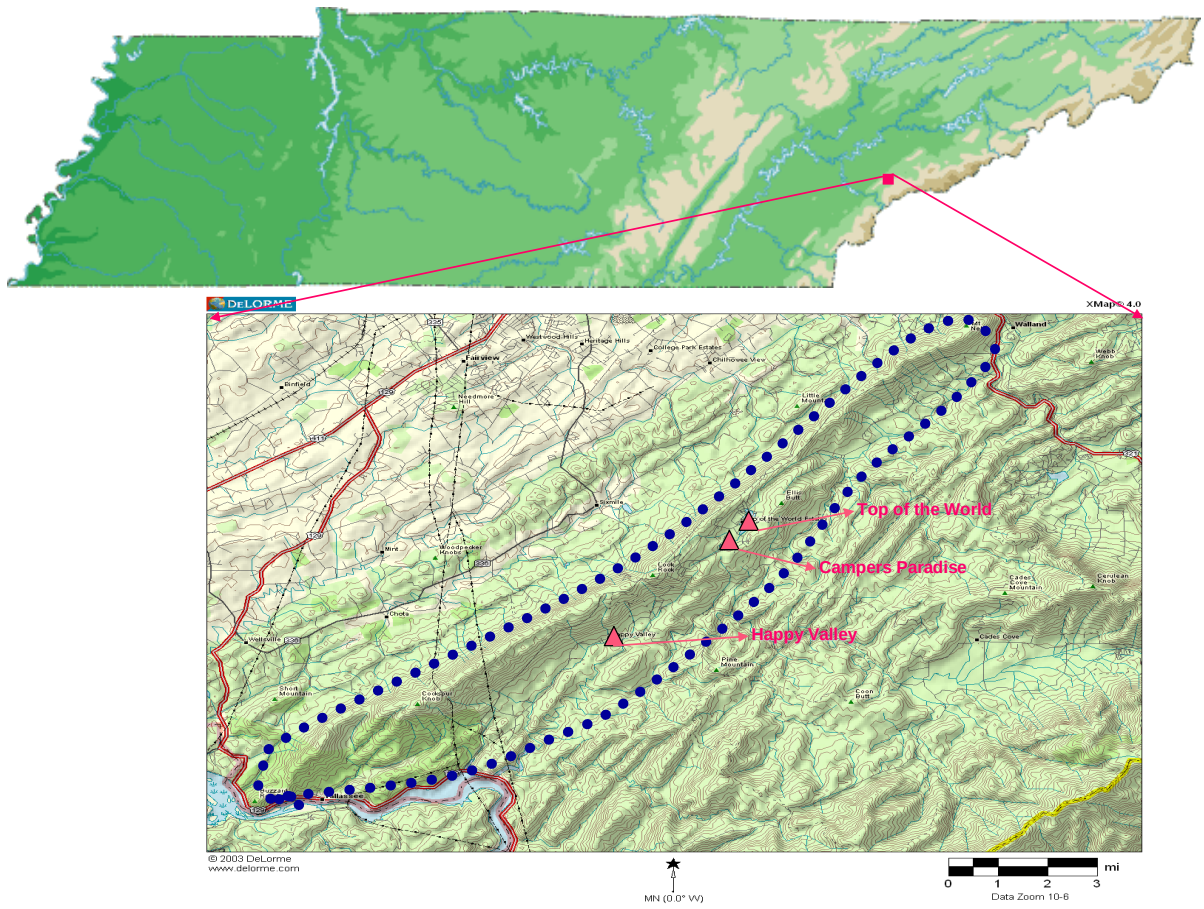


Figure 1.1 Map of Chilhowee Mountain.

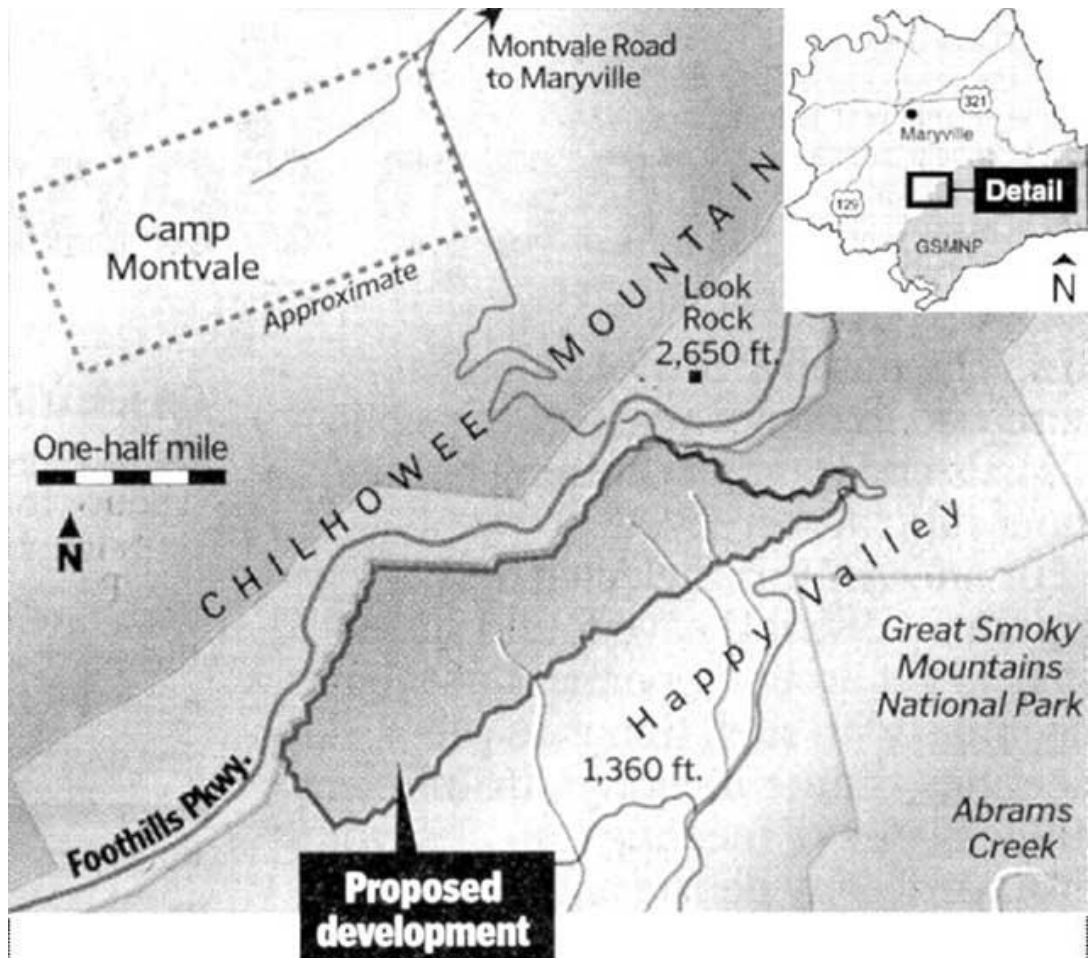


Figure 1.2 Location of the Proposed Development on the East Side of the Great Smoky Mountains National Park. (Save Chilhowee Mountain, <http://savechilhoweemountain.org>)

terrain. It was started by an older woman with no burning permit. This Happy Valley fire burned almost 150 acres over 8 hours. On the afternoon of Tuesday, May 1, 2007, five acres of land burned in the Top of the World community. One home was destroyed and another slightly damaged by the wildfire (Wilson 2007a). Luckily, there were no injuries, but the residents within a quarter-mile of the fire were evacuated. According to the TDF fire report, the May fire was ignited by arson. The fire danger rating system was rated high on that day based on the U.S. Forest Service – Wildland Fire Assessment System (Figure I-1, Appendix 1 and Figure II-1, Appendix 2). In August 2007, a brush fire at Top of the World burned more than 200 acres and threatened as many as 12 structures (Wilson 2007b).

With these wildfire risks, it is critically important to consider the knowledge, attitudes, and behavior of homeowners in areas like Chilhowee Mountain when managing for fire protection and mitigation. Decision makers concerned with policies to reduce wildfire damage and risks to area residents and fire fighters understand their success depends on the support of WUI homeowners. Therefore, the results of this study are intended to help fire managers and decision makers better understand how to facilitate fire protection and mitigation in the area.

1.3 Research Approach

This study is a collaborative research effort of the Department of Forestry, Wildlife and Fisheries at The University of Tennessee and the Tennessee Division of Forestry at the District Office in Knoxville, Tennessee with assistance from Leon Konz, formerly the fire management officer at the Great Smoky Mountains National Park, and Tennessee Wildlife Resources Agency (TWRA) staff. The staff of the TDF and other team members provided extensive input into the development of the research objectives and the survey questions. The FARSITE fire simulator model (Finney 1998) was used to make a preliminary assessment of the risk of wildfire in the Chilhowee Mountain area and to assess its potential for future use. A mail survey of property owners in the area was used to address the wildfire related research objectives listed below.

1.4 Research Purpose and Objectives

The purpose of this research is to help wildfire managers and other decision makers to better understand how to facilitate wildfire protection and mitigation in the Chilhowee Mountain area of Blount County.

The objectives are to: (1) assess wildfire risk in the Chilhowee Mountain area of Blount County including the communities of Campers Paradise, Happy Valley, and Top of the World, (2) identify the characteristics of the homes and property owners in the area, (3)

identify the property owners' perceptions of wildfire risk and reduction strategies, and (4) determine their preferences for education programs and regulations.

Research Questions

This study addresses the following research questions concerning the wildland urban interface in the Chilhowee Mountain area of Blount County:

1. What is the actual risk of wildfire?
2. What are the characteristics of the property owners in the wildfire risk zone?
3. What is the property owners' past experience with wildfire and fire reduction activities?
4. What is the property owners' perception of wildfire risk?
5. What is the property owners' perception of wildfire risk reduction strategies?
6. What are the property owners' preferences for education programs and regulations concerning wildfire reduction strategies?

1.5 Organization of the Dissertation

Chapter 2 reviews literature on previous research approaches to fire risk assessment and property owners' motivations on wildfire protection. The research methodology is described in Chapter 3, including a description of the survey methods and the procedure for applying the FARSITE fire simulator to assess fire risk. The research results and

findings are illustrated in Chapter 4. Finally, conclusions and recommendations for future work are discussed in Chapter 5.

2. REVIEW OF LITERATURE

2.1 Introduction

Wildfire is a natural process that interacts with other land disturbances and management activities. Changes in climate, land use, and management practices have led to widespread changes in fire regimes across the United States. The Wildland Urban Interface (WUI) issue is a social problem predominantly centered on people as well as forest ecology and wildfire behavior (U.S. Department of Agriculture (USDA) Forest Service 2006). The main cause of wildfires is people. Fire prevention, especially in the Eastern United States through education, awareness-raising, and participation in communities of interest, is the preferred management strategy. Most communities also have laws to prevent the setting of fires or to control the period during which fire may be used to burn brush, etc. Many communities have also implemented fire prevention programs, such as Firewise.

2.2 Fire Threat and Hazard Management in the WUI

Fire “threat,” defined as the chance of a wildfire occurring on the landscape, is related to two very different processes, the chance of a fire ignition, or fire “risk,” and the fuels available to maintain and spread a fire, or fire “hazards” (Sampson et al. 2000). Unfortunately, ignition can never be totally prevented. Lightning, arson, carelessness, and accidents always insure fire will occur in forested settings. Once ignited, the

resulting fire behavior is determined by three primary elements: topography, weather, and fuels. These elements form the fire behavior triangle with all three legs of the triangle having significant effects on fire behavior (Agee 1996).

Fire managers in the wildland urban interface are concerned with protecting people, structures, timber, and ecosystems. Identifying the level of risk from wildfire for a given community is a complex task that requires knowledge of fire behavior potential, the values at risk, and the infrastructure that could potentially affect firefighting. Furthermore, fire risk is seasonal. Wildfire risk decreases significantly during winter months when conditions are wet and cold in most parts of the country. While wildfire behavior has been extensively studied, little research has been conducted on the way fire spreads from wildland fuels into homes and other structures (Davis 1986). A common misconception among managers and the public is that fuel treatments, such as changes in fuel composition, structure, and loading, can stop fires (Stratton 2004). The primary purpose of a fuel treatment is to reduce fire intensity and growth of fire. Recent research suggests landscape scale fuel modifications, such as prescribed fire, are the most effective way to modify fire hazards and the behavior and growth of large fires (Finney 2001). The effectiveness of fuel treatments on fire intensity and growth depends on weather conditions at the time an actual wildfire occurs (Stratton 2004).

Fire resistant trees well-placed between a house and the surrounding forest can provide some heat protection by blocking the radiating heat of wildfire (Cohen 2000). There is a serious threat of a house igniting from direct contact with flames from nearby shrubs, firewood, or dried grass. A large proportion of the houses that burn during forest fires do

not ignite from intense crown fires, but from relatively low-intensity surface fires (Cohen 2000). Therefore, home site protection includes eliminating continuous ground fuels that lead from the forest to the house. Installing rock landscaping, cement sidewalks, and green grass, as well as raking away needles and dried vegetation, can also protect homes from wildfires.

In general, reducing the flammability of the house itself is absolutely necessary regardless of the vegetation treatment in the surrounding forest and the distance between the house and the adjacent forest (Nowicki 2002). Firebrands, the heat rising off a forest fire that can carry burning ash, leaves and branches, are extremely dangerous sources of ignition on and adjacent to houses. Therefore, the only effective ways to protect communities from fires started by firebrands are to treat the houses using fire resistant materials and manage vegetation adjacent to homes so they are protected from such fire starts (Nowicki 2001).

As described on their website:

The national Firewise Communities program is a multi-agency effort designed to reach beyond the fire service by involving homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of wildland fire - before a fire starts. The Firewise Communities approach emphasizes community responsibility for planning in the design of a safe community as well as effective

emergency response, and individual responsibility for safer home construction and design, landscaping, and maintenance.
(www.firewise.org)

Firewise encourages sound building codes and planning laws that take wildfire into consideration in community development (Lavin 1997). Firewise communities can help minimize a fire threat to their home and family by creating defensible space by changing the characteristics of the surrounding vegetation as well as having fire resistant exteriors and roof construction.

2.3 Human Dimensions of Fire

Wildfire protection agencies consider the wildland urban interface one of their most complex problems due to the human dimensions factor. The problem consists of an array of competing social values, multiple stakeholder interests, and uncertain management outcomes (Monroe 2002). Numerous and diverse stakeholders such as agency managers, local officials, and interface residents understand and define wildfire and wildfire risks differently. Social researchers, as stakeholders, view the wildfire problem through a social science or human dimensions framework and can aid in understanding these differences, especially the knowledge, attitudes, and behavior of homeowners.

Decision makers evaluating policies to reduce wildfire damage understand their success depends on the support of WUI homeowners. Little is known, however, about how homeowners in fire-prone areas perceive wildfire, or what policies they are likely to

prefer and why (Winter and Fried 2000). Therefore, understanding homeowners' knowledge, attitudes and behaviors may provide decision makers with a basis for choosing WUI risk management strategies that will succeed over the long run (Kundell et al. 2002).

Management solutions to the growing fire problem in the WUI require restoring fire to some extent through prescribed burning and developing programs that gain public support for prescribed fire. Chase (1993) suggests the main problem in the WUI is not one of lack of information but rather how to motivate people to use information available to them.

Limited research exists regarding public knowledge of and preferences for fire management alternatives in wildland and WUI areas (Bowker et al. 2005; Campbell et al. 2003; Machlis et al. 2002). A recent study at the broader national level pointed out that people with more fire knowledge tend to be less concerned about prescribed fire issues and to have more confidence in public land managers and government. They are also less likely to be bothered by the side effects of prescribed fire (Bowker et al. 2005). Public knowledge and perceptions of fire policies and fire hazards change over time. Public attitudes toward fire have changed significantly over the past two decades and public education about fire and managers' use of fire has had a positive effect on behavior in terms of its acceptance (Cortner et al. 1990).

Public perception of fire threat, like other threats, depends on a complex array of factors, such as historical, consequential, economic, and societal considerations. These factors play roles of varying importance in establishing an acceptable level of risk and hazard in any community. Past experience with wildfire is a major factor influencing respondents' perception of fire risk (Blanchard and Ryan 2007). An acceptable level of fire threat can be obtained through careful examination of the nature of fire threat through systematic assessment. In Florida, Loomis et al. (2001) surveyed central Florida residents' knowledge and attitudes about prescribed fire, finding the respondents became more knowledgeable and tolerant of prescribed fire after the introduction of educational information. Even though they may have had high knowledge and attitude scores, they were more supportive of the use of prescribed fire after the educational information's introduction. A recent study to assess perceptions of residents and landowners within the Plymouth Pine Barrens of southeastern Massachusetts indicated the residents had low threat perceptions, but still supported the use of fire hazard reduction strategies including prescribed fire, mechanical removal of trees, and firebreak construction (Blanchard and Ryan 2007).

Hands-on learning techniques can help people better understand wildfire ecology and management issues. A workshop utilizing the FireWorks program was conducted to measure knowledge, attitudes and belief of the rural communities of the northern Rocky Mountains and Intermountain area (Parkinson et al 2003). FireWorks was developed by the USDA Forest Service Rocky Mountain Research Station. This curriculum is available online, http://www.fs.fed.us/rm/pubs/rmrs_gtr65.html. The activities in FireWorks use

interdisciplinary, hands-on investigations to introduce participants to principles of wildland fire ecology and management. The result suggested adults in the general public who experienced hands-on learning with wildfire information were more knowledgeable about fire behavior, ecology, and management, as well as more supportive of fire management activities (Parkinson et al. 2003). The educational efforts in Alaska about fire prevention and what they could do to protect their families, homes and property before wildfires threatened ultimately help Alaskans understand how to move toward making fire prevention and preparedness a way of life (Clark and Hardy 1997). Monroe (2002) points out previous research indicates that educational programs are successful in increasing homeowners' awareness and knowledge about wildfire risks.

2.4 Public Perception of Fire Risk

People's perception of fire risks to their health or personal property will affect their opinion about fire and the ways they manage their properties. "Risk is sometimes defined as insufficient controllability" (Brun 1994). Often, however, people believe they are in more control than they actually are and have an "illusion of control" (Sjoberg et al. 2004). Several studies indicate people living in environmentally hazardous zones tend to be unrealistically optimistic about their own risk. "They often perceive their own risk is less than another person's risk and widely shared by other people, thereby reducing their estimate of their own risk" (Kumagai et al. 2004). There is a suggestion that such bias is often found among people who perceive hazards to be controllable by professionals (Harris 1996).

Numerous studies indicate various factors influence people to resist risk information about their vulnerability to hazard. People underestimate risk if the effects are slow to occur and less visible (Gardner and Stern 1996). There is also an optimistic belief technology can protect humans from any hazard, therefore reducing personal concern. Surviving past disaster experience has been found to lead people to feeling somewhat less concerned about a future event. Successful survivors tend to assume they should be safe again (Kumagai et al. 2004). There are some studies that examine risk perceptions of residents in wildfire hazard areas indicating the extent to which they are unduly optimistic about their risk (Kumagai et al. 2004). Being exposed to wildfire risk information does not always increase risk perception and preparedness for potentially destructive wildfire (Kumagai et al. 2004; McCaffrey 2004).

2.5 Risk Communication

Risk communication is defined by the U.S. National Research Council committee on risk perception and communication (1989) as “an interactive process of exchange of information and opinions among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management.” Risk communication is based on the science of understanding risk and how it is communicated within a socio-political structure.

The psychometric paradigm describes risk from a psychological perspective, drawing on various characteristics or dimensions that may be important in influencing risk perceptions (Slovic 1999). Of 47 known factors identified by psychological research, trust is the most important factor that influences the perception of risk (Covello 1983). Kumagai et al. (2004) suggests “risk communication should not be judged solely on the basis of how accurate or detailed the information is, but also on the basis of how it will be interpreted by its recipients.” Moreover, credibility and trust are important elements of risk communication. Credibility and trust toward agencies that disseminate hazard information often play a critical role in its acceptance and believability. In fact, the extent to which senders of risk information are trustworthy appears to be more important than to what extent risk information is accurate. Therefore, general attitudes toward particular state or federal agencies influence whether the public accepts risk information (Fessenden-Raden et al. 1987). There is some evidence trust can be established when individual agency officials work interactively and openly with local people, leading to greater believability of risk information (Kumagai et al. 2004).

Good communication with the public is the key to a successful wildfire prevention program and can influence public risk perceptions and attitudes (Kerns and Ager 2007). Therefore, it is important to keep in mind awareness of the public’s knowledge, attitudes, and perceptions as they play an important role in reducing wildfire risk during home construction, landscaping and maintenance (Loomis et al. 2001).

2.6 Risk Perception Assessment/Analysis

A risk assessment method is defined by Covello and Merkhofer (1994) as any self-contained systematic procedure conducted as part of a risk assessment that can be used to help generate a probability distribution for health or environmental consequences. Public perceptions of risk stem from several sources. Human perceptions are derived from personal experience, values, social norms, and knowledge. Williams et al. (1999) suggested “researchers should examine the specific determinants of risk perceptions in varied social, economic, political, and psychological contexts. Such examination may provide environmental managers with the information needed to effectively address the respective concerns of the public.”

Risk perceptions are shaped by the interaction of social and psychological factors. They are used to determine a protective course of action or response (Williams et al. 1999). As a psychological construct, risk perception stems from many factors, including but not limited to cognition, mental imagery, sensory perception, affect, and human development. As a social construct, risk perception is shaped by a consensus of social meaning, worldviews, cultural interpretation, social norms, and the dissemination of social information (Williams et al. 1999).

2.7 Protection Motivation Theory

Protection Motivation Theory (PMT) was developed to provide conceptual clarity to the understanding of fear appeals (the attempt to persuade someone to action by emphasizing the likelihood of an unpleasant outcome if the action is not taken) and is extended to a general theory of persuasive communication, emphasizing the cognitive processes mediating behavioral change. In this study, behavioral change would be homeowners taking actions to protect their homes and community from wildfire. There are three main stimulus variables in a fear appeal. They are (a) the magnitude of noxiousness or severity of an event (e.g. wildfire), (b) the probability of the event's occurrence if no protective behavior is adopted or existing behavior modified, and (c) the efficacy of a recommended coping response to reduce or eliminate the noxious event (Norman et al. 2005). It is assumed each of the three components of a fear appeal initiates a corresponding cognitive mediating process. Therefore, the magnitude of noxiousness of an event (wildfire) initiates perceptions of severity, the probability a wildfire will occur initiates perceptions of vulnerability, and the availability of an effective coping response initiates perceptions of response efficacy (Rogers 1983). The impact of the stimulus variables in a fear appeal (e.g., a community meeting about the threat of a wildfire, a brochure, or a website) is mediated by the perceived severity and vulnerability of the risk and perceived response efficacy (Figure 2.1).

According to Rogers (1983), sources of information initiating the cognitive mediating processes can be environmental or intrapersonal. Environmental sources include verbal

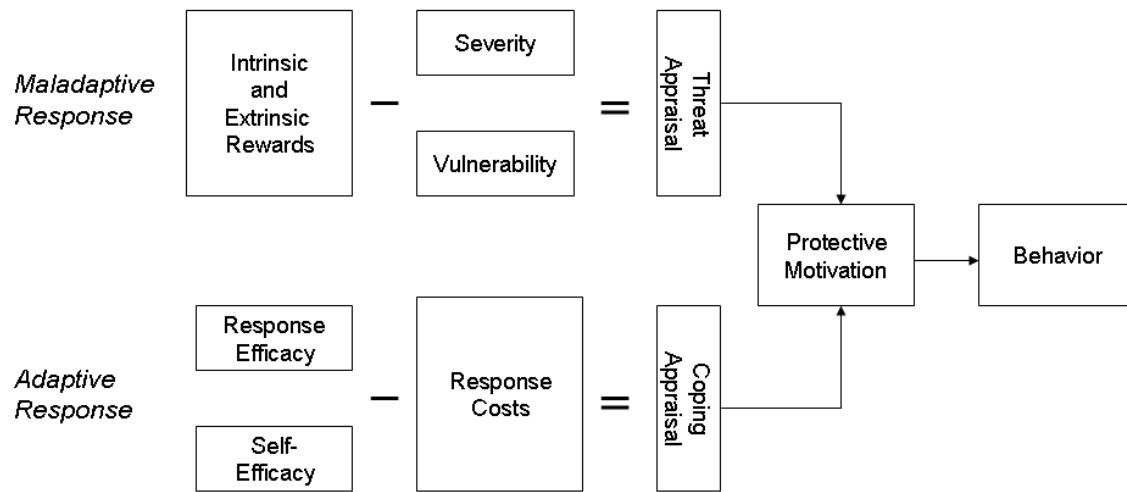


Figure 2.1 A Schematic Representation of the Cognitive Mediating Processes of Protection Motivation Theory (Norman et al 2005).

persuasion (public meeting), especially fear appeals, and observational learning (observing a wildfire on TV). The intrapersonal sources include personality variables and prior experiences with similar threats (wildfire). The sources of information initiate two appraisal processes, threat appraisal and coping appraisal. As threat appraisal and coping appraisals increase, protection motivation increases as well as the probability protective actions will be taken (Figure 2.2).

Threat appraisal is the estimated of the chance of contracting a risk (vulnerability) and estimated seriousness of a risk (severity). According to PMT theory, threat appraisal is mediated or lessened by intrinsic rewards (e.g. the joy of living in nature and having attractive landscaping around their house) and extrinsic rewards (e.g. social status of

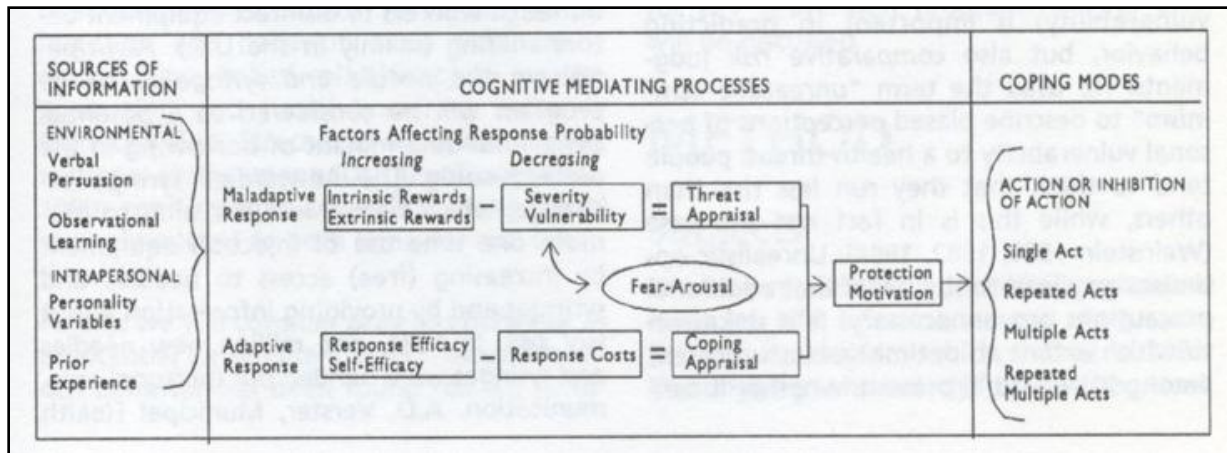


Figure 2.2 Protection Motivation Theory (adapted from Rogers 1983).

having a residence or second home in the forest and mountains). When perceived rewards lower the threat appraisals of a wildfire and decreases protection motivation. This is considered a maladaptive response.

Coping appraisal consists of response efficacy and self-efficacy. Response efficacy is the individual's expectancy that carrying out recommendations can reduce the threat. Self-efficacy is the belief in one's ability to execute the recommend courses of action successfully. Assessments of threats (severity, vulnerability, and rewards) and coping factors (self-efficacy, response efficacy, and response costs) combine to determine stakeholders' motivation to protect themselves from wildfire risks. As shown in Figure 2.2, one's coping appraisal is mediated by the perceived effectiveness of suggested actions, such as those used in the national Firewise Communities program, to reduce fire risk (response efficacy) and the level of confidence (self-efficacy) in one's ability to implement fire reduction behaviors (Norman et al. 2005). The factors decreasing the

probability of an adaptive response are the costs of adopting recommended preventive activities, for example, money, time, difficulty, or side effects. The protection motivation of property owners is determined by threat and coping appraisals. The higher the protection motivation, the more likely property owners are to engage in coping modes.

2.8 FARSITE Fire Simulator

Computer models can be used to predict fire behavior based on differences in fuels, weather, and topography. These models are used to support fire management decisions. They are also used as a training tool to improve fire management skills, and can help explain and display fire behavior and fire management strategies to the general public. These prediction models can possibly save time, money, and lives. A model is a decision support tool, however, not a tool that makes a decision (Stratton 2006). It is a simplification or approximation of reality and does not reflect all of the reality (Burnham and Anderson 2002).

Fire growth computerized models have been a subject of research for several decades. The approach has been to simulate fire growth across a landscape (Finney 1998). One such tool is FARSITE, which is a fire behavior and growth simulator. It is used to simulate fire growth for complex conditions of terrain, fuels, and weather (Finney 1998). It assumes a perfect elliptical fire under uniform conditions with the ignition located at the rear focus of the ellipse. FARSITE is widely used by the US National Park Service, USDA Forest Service, and other federal and state land management agencies to simulate

the spread of wildfires and fire use for resource benefit across the landscape. It is often used to help answer the questions: Where will the fire go? How large will the fire be? When might the fire reach a particular location? (Stratton 2006).

Each model has assumptions and limitations and can be applied differently. Therefore, it is important for users know how the model is used in the fire modeling system, and understand model limitations and assumptions. In FARSITE, for example, fire acceleration is assumed to be dependent on fuel type but independent of fire behavior, and variation in windspeed and directions at a higher frequency than the wind stream resolution are assumed not to affect the elliptical fire shape. For a full discussion of FARSITE limitations and assumptions see Finney (2004).

FARSITE requires the support of Geographical Information System (GIS) to generate, manage, and provide spatial data themes containing fuels, vegetation, and topography (Finney 1998). The five themes required to run FARSITE are elevation, slope, aspect, fuels, and canopy cover.

The concept of applying Huygens ' Principle to model fire growth as described by Finney (1998) involves using the fire environment at each vertex on the fire perimeter to dimension and orient an elliptical wavelet at each time step (Figure 2.3). Calculations at each vertex of the fire front are assumed independent of the others. The shape and direction of the ellipse are determined by the wind-slope vector while the size is determined by the spread rate and the length of the time step.

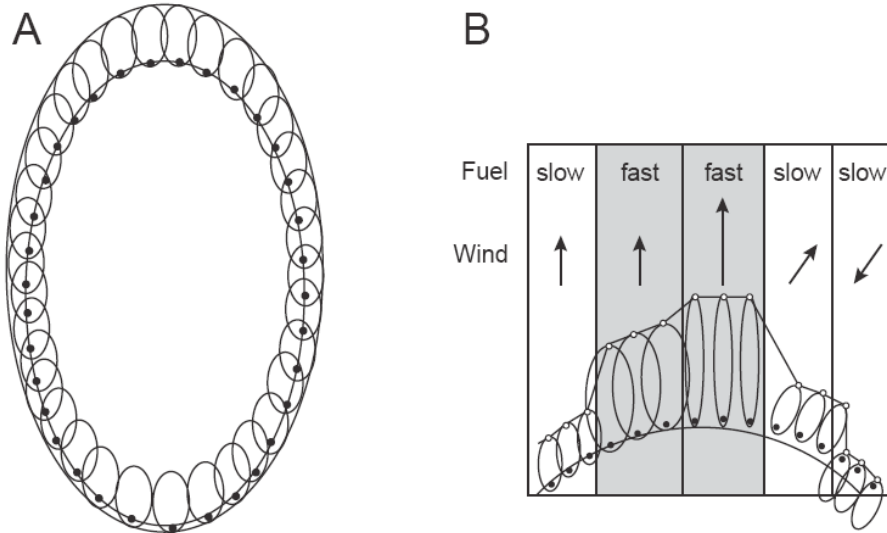


Figure 2.3 Illustration of Huygens' Principle Using Elliptical Wavelets. (A) Uniform conditions use wavelets of constant shape and size to maintain the elliptical fire shape over time. (B) Non-uniform conditions showing the dependency of wavelet size on the local fuel type but wavelet shape and orientation on the local wind-slope vector (Finney 1998).

The fire growth model employed Richards' elliptical growth model based on Huygens' Principle (Finney 1998). Richards' differential equations describe the expansion of an elliptical wave front from a series of vertices that define the edge of a fire. His equations also describe the growth of a forest fire front in time for variable fuel, weather and topographical conditions. Huygens' Principle assumes each vertex can serve as the source of an independent elliptical expansion (Richards 1990). The information required at each vertex includes:

- (1) The orientation of the vertex on the fire front in terms of component differentials (m) x_s, y_s ,
- (2) The direction of maximum fire spread rate θ (the resultant wind-slope vector, radians azimuth), and

- (3) The shape of an elliptical fire determined from the conditions local to that vertex in terms of dimensions a , b , c (m min^{-1} ; Figure 2.4).

From these inputs, Richards' (1990) equation computes the orthogonal spread rate differentials (m min^{-1}) X_t and Y_t for a given vertex.

According to Finney (1998) FARSITE incorporates existing models of surface fire, crown fire, point-source fire acceleration, spotting, and fuel moisture. The models are

$$X_t = \frac{a^2 \cos \theta (x_s \sin \theta + y_s \cos \theta) - b^2 \sin \theta (x_s \cos \theta - y_s \sin \theta)}{(b^2 (x_s \cos \theta + y_s \sin \theta)^2 - a^2 (x_s \sin \theta - y_s \cos \theta)^2)^{1/2}} + c \sin \theta \quad [1]$$

$$Y_t = \frac{-a^2 \sin \theta (x_s \sin \theta + y_s \cos \theta) - b^2 \cos \theta (x_s \cos \theta - y_s \sin \theta)}{(b^2 (x_s \cos \theta + y_s \sin \theta)^2 - a^2 (x_s \sin \theta - y_s \cos \theta)^2)^{1/2}} + c \cos \theta \quad [2]$$

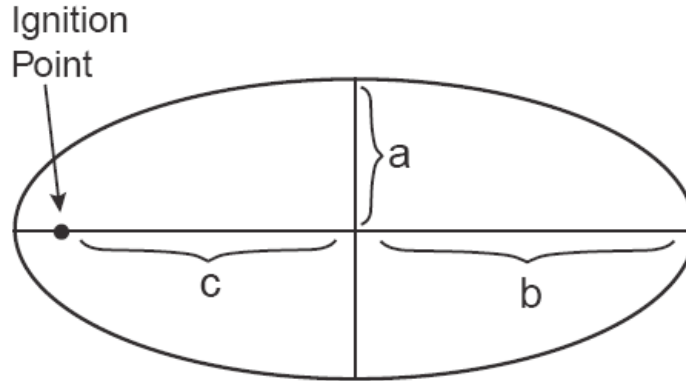


Figure 2.4 Dimensions of Elliptical Wavelets Used in Computing Fire Growth with Richards' Equations (1) and (2). Dimension a corresponds to $1/2$ the minor axis (lateral from the center), b identifies $1/2$ the major axis (forward from the center), and c is the distance forward of the ignition point to the center (generated from Finney 1998)

integrated using a vector propagation technique for fire perimeter expansion that controls for both space and time resolution of fire growth over the landscape. The model produces vector fire perimeters (polygons) at specified time intervals. The vertices of these polygons contain information on the fire's spread rate and intensity, which are interpolated to produce raster maps of fire behavior. Because fire behavior at each vertex is assumed independent of the others, the simulation outputs illustrate the strict spatial consequences to fire behavior of incorporating the models into a two-dimensional simulation. Simplified test conditions show that surface fire growth and intensity conform to idealized patterns. Similarities also exist between simulated crown fires and observed patterns of extreme wind-driven fires.

Fire statistics reveal the average annual area affected by destructive wildfires and the average area burned per fire in the Southeast is rather low compare to the West. However, expected climate changes will lead to a more pronounced climate characterized by a higher occurrence of droughts and fire danger in the East. Facing these climate-change projections it is advisable to proactively increase the preparedness for more extreme fire seasons. Consequently planning and fire management strategies must be improved. For this purpose, fire simulation models are useful to assess the potential behavior of forest fires and to support decision making for fire suppression. Additionally, fire simulation models can be used to identify effective prevention and suppression methods (Macie and Hermansen 2002).

3. METHODOLOGY

3.1 Introduction

This chapter presents the study area, population and sample, instrumentation, research design, and data analysis relative to the study.

3.2 Study Area

Chilhowee Mountain, located in Blount and Sevier counties in the Great Appalachian Valley, lies from the northeast to the southwest between the Great Smoky Mountains and the Tennessee Valley (Southworth et al 2005). It runs between 35° 50' 30" N and 84° 36' 30" W at the northeast end of Sevier County southwest to 35° 32' 30" N and 84° 05' 30" W to Tallassee on the Little Tennessee River in Blount County (Figure 3.1). Chilhowee Mountain ranges from 2 to 6 miles wide and is approximately 32 miles long. The area of the mountain is approximately 64,000 acres rising from an elevation of 823 feet at Tallassee to 3,069 feet at the state fire tower on the highest point of Greentop in Sevier County (Thomas 1966).

Chilhowee Mountain is 6 miles southeast of Maryville, 15 miles southeast of Knoxville, and 5 miles west of Pigeon Forge. The mountain covers the entire range of mountains

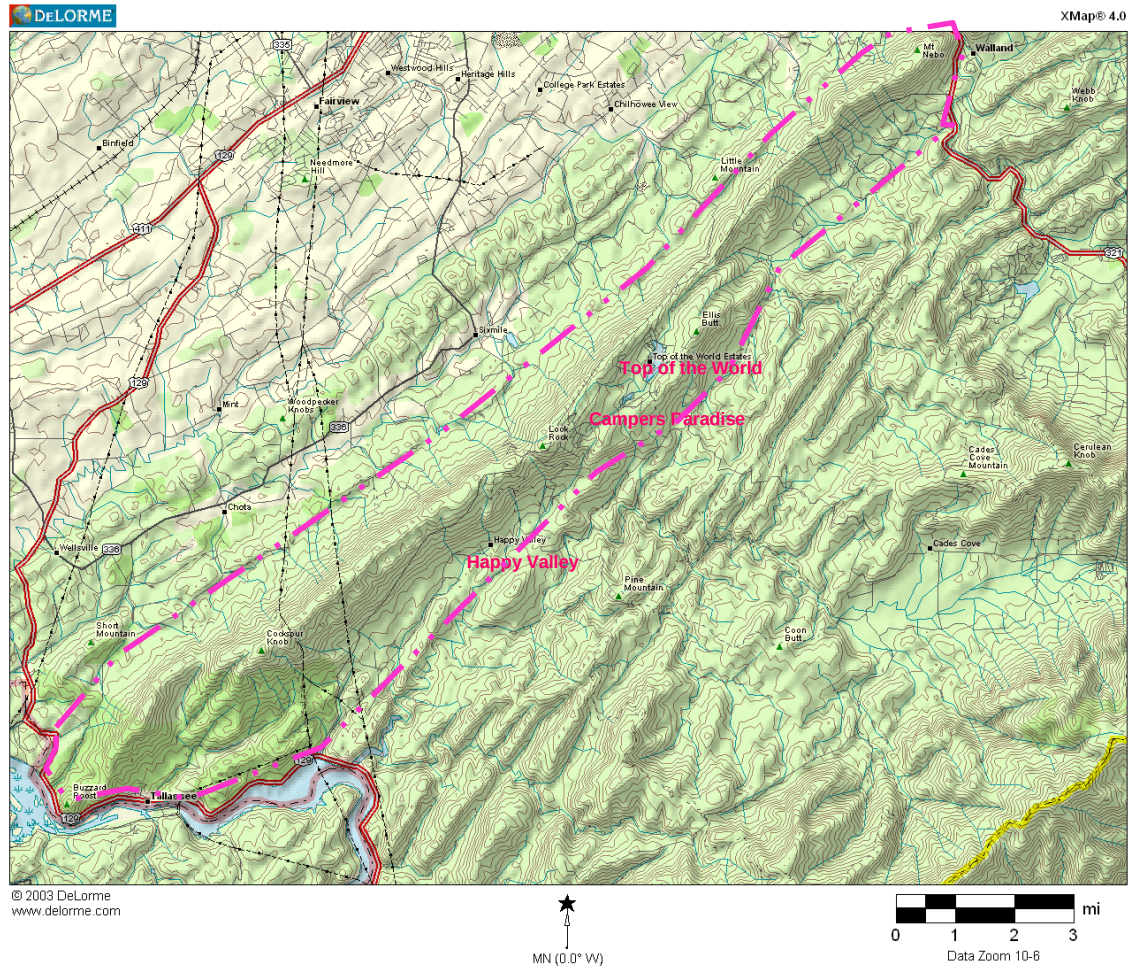


Figure 3.1 Map of Chilhowee Mountain showing location of the communities of Campers Paradise, Happy Valley, and Top of the World.

between the Little Tennessee River in Blount County on the southeast end and Bluff Mountain in Sevier County to the northeast. It adjoins the Great Smoky Mountains National Park on the south from Look Rock to the southwest end of Chilhowee Mountain. The distance from the Park boundary increases to a maximum of 8 miles from the northeast end of Chilhowee Mountain to Mt. Harrison on the park boundary. The study area is immediately to the northeast of the Look Rock tower weather station. This weather station is located 35° 37' 58" N 83° 56' 34" W and is operated by the Great Smoky Mountains National Park.

The mountain formation is of sandstone and other rocks of the Chilhowee period. Some of the sandstone beds contain the oldest indications of life in eastern Tennessee (King and Stupka 1950). The soils on Chilhowee Mountain, like any mountain, are affected by climate, particularly temperature and precipitation; living organisms, especially the native vegetation; the nature of parent material; topography of the area; and time parent materials are subjected to soil formation and people. For the parent material, the most important factor contributing to soil formation on Chilhowee Mountain is age, as affected by geological erosion and topography (Thomas 1966). The various soil types affect the distribution of plants on the mountain. For vegetation cover, the amount of available moisture is the most important factor. The deeper soils have a higher water-supplying capacity and are covered with mesophytic forests. The thin lithosols are very dry and are covered with scrubby oak-pine forests characteristic of drier habitats (Thomas 1989).

Chilhowee Mountain lies in the southeastern part of the Deciduous Forest Formation of North America (Thomas 1966). The use of land in the past has had an effect on the present vegetation pattern. In the 1920's, the entire south-facing slope of the mountain in Sevier County was covered by an almost pure shortleaf pine (*Pinus echinata*) stand. These mature trees were clear-cut. All the brush was left and later burned and subsequently the area was an *Andropogon-Smilax glauca* field. The vegetation is now an Oak-Pine Cover Type or the Second Growth Pine, South Slope, Cover Type, except for the south slope of the east end which is covered with Pitch Pine-Scarlet Oak Scrub Cover Type. This area was burned over regularly at one or two year intervals until the late 1950's which has greatly influenced the vegetation occurring there (Thomas 1966).

All the vegetation of the Chilhowee Mountain area has a history of heavy disturbance by Native Americans, settlers, loggers, and fire. All the forests have been heavily logged, and no virgin forests remain (Tennessee Historical Society 2002). According to the Society of American Foresters, Thomas (1989) divided the Chilhowee Mountain forests into 15 cover types descriptive of the species found. The 15 cover types, in order of percentage area of the mountain occupied, are Mixed Oak (40%), Oak-Pine (20%), Second Growth Pine on South Slopes (10%), Second Growth Yellow-Poplar (7%), Scrub Oak (5%), Oak-Hickory (5%), Virginia Pine-Pitch Pine, Selectively Cut (3%), Lowland Coves (3%), Red Oak (2%), Mixed Oak Flats (1%), Hemlock-White Pine (1%), Pitch-Pine Scarlet Oak Scrub (1%), Shortleaf Pine (<1%), Second Growth Pine on North Slopes (<1%), and Table Mountain Pine (<1%).

3.3 FARSITE Fire Simulator

The FARSITE fire simulator model (Finney 1998) was used to study its potential for use in assessing wildfire risk in the study area and its potential application as an educational tool for people living in wildfire risk zones. FARSITE is a fire-growth computer model which utilizes spatial information on fuels and topography and temporal information on fire weather to feed the required equations used to predict fire behavior. It is a spatially explicit extension of the surface fire spread model as described in Chapter 2. The FARSITE 4.0 simulator was utilized to estimate the potential size and speed of wildfires in the WUI of the Chilhowee Mountain area of Blount County under different weather conditions. FARSITE requires the support of GIS to provide and manage spatial adapt themes. Five GIS themes are required for FARSITE:

3.3.1 Elevation (meters)

Elevation is the height above sea level for any particular part of the landscape. It is a spatial theme derived from Digital Elevation Model (DEM) available from USGS that specifies an elevation value for each cell. A DEM is a digital representation of continuous variation of relief (Burrough 1986) and is used for elevation raster maps. Elevation theme is necessary for adiabatic adjustment of temperature and humidity and for conversion of fire spread between horizontal and slope distance. The elevation grid was retrieved from the USGS to use in this study and is in meters.

3.3.2 Slope (degrees)

Slope is the steepness of the landscape. It is derived from DEM by analyzing the elevation values of a neighborhood of adjacent cells utilizing a GIS application. The slope theme is necessary for computing slope effects on fire spread and is also used to compute solar irradiance in the fuel moisture module. The slope grid was derived from the elevation grid and is in degrees.

3.3.3 Aspect (degrees)

Aspect is the direction that a slope faces. It is derived from the DEM by looking at each slope facet and determining the direction it faces. It contains value for topographic aspect that depends on the GIS application providing the data. Aspect theme is used to compute solar irradiance in the fuel moisture module. The aspect grid was derived from the elevation grid and is in degrees.

3.3.4 Fuels (Fire behavior fuel model)

The fuel model theme specifies the fire behavior prediction system fuel model that applies to each part of the landscape. It is derived from USGS National Land Cover Data of 2001 (NLCD) utilizing a GIS application (Appendix 7).

FARSITE requires that fuels be quantified using Anderson's Fire Behavior Fuel Model (Finney 2001). This classification of different fuel types has 13 parameters based on a scientific measure of fuel loading. Fuel depth, fuel particle density and heat content of fuel are a few of the criteria used to classify fuels under this system (Anderson 1982). To generate a fuel model map, NLCD is reclassified following the National Forest Fire Laboratory (NFFL) 13 class fuel loads model (Table 3.1 and 3.2). The NFFL model has

served well, especially for making rapid estimates of fire spread on active fires at relative coarse time and space resolution (Scott and Burgan 2005). Model numbers 1-13 are reserved for standard NFFL fuel models. Fuel models numbers 0, 98, or 99 are used for non-fuel raster. Water is assumed represented by number 98 and is displayed as the color blue (Appendix 7). The NFFL fuel models are described in Appendix 8.

The vegetation index for a given area can vary from season to season and from year to year, especially for grasslands and scrublands. We can assess if there is a greater fuel load than normal and whether that can be dangerous if conditions become drier.

3.3.5 Canopy Cover (percent)

Canopy cover is the horizontal percentage of the ground surface that is covered by tree crowns. It is calculated and derived from NLCD utilizing a GIS application.

The five themes required for FARSITE (elevation, slope, aspect, fuel model and canopy cover) must be converted and exported as ASCII raster files in ArcGIS to be used in FARSITE. It is important to keep in mind that each of the grid themes created must be exactly the same extent, location and grid size. In this study, the projection was Albers Conical Equal-Area projection.

All fire growth simulations require spatial data representing fuels, weather and topographic elements of fire behavior (Finney 1998). In FARSITE, weather and winds

Table 3.1 Description of NFFL Fuel Models used in Fire Behavior (Anderson 1982).

Fuel Model	Typical fuel complex	Fuel loading				Fuel bed depth	Moisture of extinction dead fuels
		1h	10h	100h	Live		
		-----tons/acre-----				Feet	Percent
	Grass and Grass-Dominated						
1	Short grass (1 ft)	0.74	-	-	-	1.0	12
2	Timber (grass and understory)	2.0	1.0	0.50	0.50	1.0	15
3	Tall grass (2.5 ft)	3.0	-	-	-	2.5	25
	Chaparral and Shrub Fields						
4	Chaparral (6 ft)	5.0	4.0	2.0	5.0	66.0	20
5	Brush (2 ft)	1.0	.50	-	2.0	2.0	20
6	Dominant brush, hardwood slash	1.5	2.5	2.0	-	2.5	25
7	Southern rough	1.1	1.9	1.9	3.7	2.5	40
	Timber litter						
8	Closed timber litter	1.5	1.0	1.0	-	.2	30
9	Hardwood litter	2.9	.41	.41	-	.2	25
10	Timber (litter and understory)	3.0	2.0	2.0	2.0	1.0	25
	Slash						
11	Light logging slash	1.5	4.5	4.5	-	1.0	15
12	Medium logging slash	4.0	14.0	14.0	-	2.3	20
13	Heavy logging slash	7.0	23.0	23.0	-	3.0	25

Table 3.2 Land Cover Reclassification Followed NFFL Fuel Models.

Land cover class (USGS NLCD 2001)	NFFL fuel models
11 All areas of open water	98
21 Developed, open space, low intensity residential	99
22 Developed, low intensity residential	99
23 Developed, medium intensity residential	99
24 Developed, high intensity residential	99
31 Rock/ sand/ clay, vegetation < 15%	12
41 Deciduous forest	10
42 Evergreen forest	10
43 Mixed forest	10
52 Shrub/ scrub	1
71 Grassland	1
81 Pasture/ hay	1
82 Cultivated crops	1
90 Woody wetlands	5

are input as temporal streams data. The two data streams are involved in fire behavior and fuel moisture calculations. The hourly weather data was retrieved from the National Park Service Air Resources Division (http://12.45.109.6/pls/portal/data_request.mainfile). Fire ignition points and weather conditions during April 18-22, April 29-May 3, and August 23-31, 2007 (Appendix 9, Table 9-1 to 9-19) were selected to simulate in FARSITE to represent actual fires in the study area on April 20, May 1 and August 25-31, 2007.

3.4 Survey Instrument

A survey titled “Homeowner Survey: Wildfire Risk in the Chilhowee Mountain area of Blount County” (Appendix 4) was developed and mailed to 474 property owners in the WUI of the communities of Campers Paradise, Happy Valley, and Top of the World. Data were collected using a six-page mail survey consisting of 33 questions about respondents’ properties, residential status, experiences with wildfire, fire risk perceptions, and their preferences for wildfire reduction strategies as well as demographic information. The questions addressed four major areas: 1) the characteristics of the property, including residential status; 2) perceptions of wildfire risk; 3) behavior and interests in mitigating wildfire risk; and 4) socio-demographic characteristic of the property owners. A one page Definition of Terms: Reference Sheet (Appendix 5) was included with the survey to assist in the understanding of technical terms. All of the questions on the survey were either nominal or ordinal (Likert-type) in scale except those

questions that ask for respondents' comments. Approval for human subjects research was granted by the Office of Research, University of Tennessee (Appendix 3).

3.5 Population and Sample

Three communities in the Chilhowee Mountain Area of Blount County, Campers Paradise, Happy Valley and Top of the World, were identified as high risk areas for wildfire by the TDF and selected for this study. The survey population was all the property owners in these three communities as listed in the Blount County property tax records. The names and addresses of 474 permanent and seasonal home and landowners were identified from the tax records in the three interface communities and placed into three resident categories as shown in Table 3.3.

A modified Dillman (2000) four-wave mail procedure was employed starting January 10, 2007 and ending February 22. The questionnaire, a postage-paid return envelope, and an introductory letter explaining the purpose of the survey were initially sent to the property owners. Two weeks after the initial mailing, a follow-up postcard was mailed (Appendix 6) followed by the second mailing of the survey two weeks later. Two weeks after that, second reminder postcards were mailed to non-respondents. All surveys were processed by the Human Dimensions Research Lab in the Department of Forestry, Wildlife and Fisheries at The University of Tennessee.

Table 3.3 Survey Population for the Chilhowee Mountain Area of Blount County.

Resident Category	Top of the World	Campers Paradise	Happy Valley	Total
Permanent resident with home	24	12	45	81
Permanent resident with mobile home/camper/trailer	4	3	2	9
Absentee with home/mobile home/camper/trailer	36	48	19	103
Absentee with lots	175	58	48	281
Total	239	121	114	474

Of the 474 surveys mailed to the property owners in the WUI of the Chilhowee Mountain Area of Blount County, 15 were returned undeliverable or “no longer own property” resulting in a final sample size of 459. Of the 459 eligible property owners, 159 usable surveys were returned for a response rate of 35% (Table 3.4). As might be expected, resident homeowners, who would likely be at a greater risk to wildfire, had the highest return rate (51%), followed by absentee homeowners (36%) and lot owners (28%). Permanent residents with a home and permanent residents with a mobile home/camper/trailer as shown in Table 3.3 were combined as resident homeowners. Since the response rate for each residential status category did not equally represent each of the three groups, a weight variable was used to adjust for the differing probabilities of each case. Therefore, each case would carry the same weight in the analysis as would be expected if the response rate had been the same for each resident category in the study area.

Table 3.4 Residential Status and Response Rate of the Communities in the WUI of the Chilhowee Mountain Area of Blount County.

	Resident Homeowners	Absentee Homeowners	Lot Owners	Total
Mailed	90	103	266	459
Returned	46	39	74	159
Response Rate	51%	36%	28%	35%

After the surveys were returned, they were grouped into three property types. Those groups are resident homeowners who live full time, year-round and reside on Chilhowee Mountain (n=46), absentee homeowners who own a vacation home (n=39), and lot owners (n=74) who simply own an empty lot on Chilhowee Mountain. Sixty-three percent (63%) of the respondents were male.

3.6 Data Analysis

Data from this study were entered into and analyzed using SPSS 15.0 for Windows. Frequency distributions, means, and standard deviations were used to describe the characteristics of the respondents and variables. A test on the relation of perception of fire risk and their engagement to perform fire risk reduction activities were assessed using one-tailed bivariate correlation. A correlation coefficient measures the strength of the relationship between two variables. In comparing means, the t-test was utilized to look at the difference between 2 groups, for example, homeowners and lot owners as well as gender, while analysis of variance (ANOVA) was used for more than 2 groups.

3.6.1 Independent measures

To determine the effect of the cognitive processes on behavior and behavioral intentions, property owners' risk perceptions and self efficacy were determined.

3.6.1.1 Risk perception

Respondents were asked to rate risk severity and risk vulnerability.

3.6.1.2 Response efficacy

Respondents were asked to rate the effectiveness of the risk reduction behaviors.

3.6.1.3 Self-efficacy

Respondents were asked how confident they believe they are capable (or not) of performing risk mitigation activities.

3.6.1.4 Additional measures

Open-ended questions and some additional questions were asked to obtain a better understanding of property owners' motivations to protect themselves from the risk of wildfire, as well as their residential status, property characteristics, age, gender, income, and education.

3.6.2 Dependent measures

Wildfire risk reduction activities that property owners have engaged in are listed in Q 15 and Q 16 (Appendix 4).

4. RESULTS

4.1 Introduction

This chapter presents the results and discussion of the analysis of data. The results are divided into 6 sections: 1) **Actual Risk of Wildfire** assesses the risk of wildfire in the WUI of the Chilhowee Mountain area of Blount County, 2) **Property Owners Characteristics** describes the property type categories of the property owners and their demographic characteristics, 3) **Past Experience** examines various aspects of the property owners' past experience with wildfire, 4) **Perception of Wildfire Risk** relates to property owners' past perception of wildfire risk and current risk perception (risk severity and risk vulnerability), 5) **Perception of Reduction Strategies** investigates the property owners' perceptions of wildfire risk reduction strategies as well as their perceptions of the Tennessee Division of Forestry's (TDF) and the National Park Service's (NPS) effectiveness at protecting private landowners from wildfire and in land and resource management, and 6) **Preference for Wildfire Reduction Strategies** determines the property owners' interest in outreach programs and media as well as their acceptance of regulations to lessen wildfire risk and support for wildfire risk reduction policies.

4.2 Actual Risk of Wildfire

What is the wildfire risk in the WUI of the Chilhowee Mountain area of Blount County?

Tennessee Division of Forestry

The Tennessee Division of Forestry (TDF) identified the Chilhowee Mountain area in Blount County as being a high risk zone for wildfire (T. Dailey and N. Waters, pers. comm., 2006). The risk is due to the extremely steep slopes, southwest facing aspect which exposes the area to more sunlight, a long history of wildfire and an ecosystem with wildflowers, shrubs and trees, such as mountain laurel, galax, Virginia pine, and table mountain pine, which are dependent on and prone to fire. Table mountain pine, as an example, is serotinous vegetation, needing severe and frequent fire for seeds to open and regenerate. Moreover, the Little Tennessee River dissects Chilhowee Mountain and, with the Abrams Creek valley, creates very steep slopes which increase the probability of strong winds.

FARSITE Fire Simulator

FARSITE fire simulator was used to determine the simulator's potential for assessing wildfire risk under various weather conditions in the study area. Three ignition points were selected for the simulation (Table 4.1; Figure 4.1) based on fires that actually occurred in the study area in the spring and summer of 2007 (see Chapter 1 page 6).

Table 4.1 Formatted Ignition Points Variable used in Simulation.

Ignition Point	Elevation (m)	Slope (°)	Aspect (°)	Fuel model	Cover (%)
April fire	741	15	184	99	75%
May fire	629	4	0	10	83%
August fire	413	16	153	1	35%

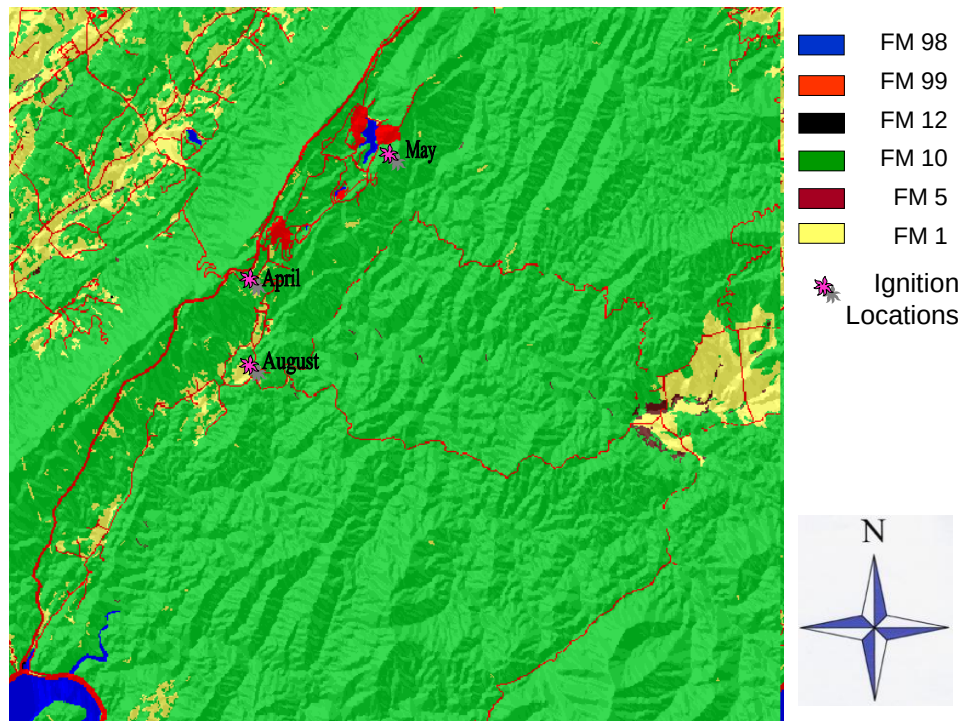


Figure 4.1 Landscape file for FARSITE showing ignition locations of April, May and August fires (FM = Fuel Model).

These fires occurred after the mail survey was completed by the property owners. Table 4.2 indicates the area burned for the different weather streams on April 20, May 1, and August 25-31, 2007. Data contain combined fire areas in hectares for all fires by actual time. The burn area was computed as the average of the horizontal fire and an estimate of the slope (topological or surface) area of the fire. The “Actual” column in Table 4.2 on the April, May and August fires shows the total number of hectares that actually burned for each fire as estimated by the Tennessee Division of Forestry fire reports. The “Normal” and “Extreme” columns show the area burned by elapsed time based on the FARSITE simulation using normal and extreme weather conditions for the three fires. The August fire actually burned for 152 hours (6 days and 8 hours). For the simulation, under extreme weather conditions after 71 hours (almost 3 days) the total area burned for the April fire was 5,435 ha (13,424 ac), 6,122 ha (15,121 ac) for the May fire and 10,030 ha (24,774 ac) for the August fire.

For the April 20th fire, the average area burned per hour under normal conditions over 71 hours was 0.57 acres, whereas the average area burned per hour under extreme weather conditions was 189 acres. One house and 5 acres in the Top of the World community also burned during the May 1st fire. Based on the simulation for the May 1st fire, the average area burned under normal conditions over 71 hours was 1.41 ac/hr, whereas the average area burned under extreme weather conditions was 213 ac/hr. For the August 25th to 31st fire, the average area burned under normal conditions over 152 hours was 2.22 ac/hr, whereas the average area burned under extreme weather conditions was 259 ac/hr.

Table 4.2 FARSITE Simulation Times and Fire Areas (ha) for April, May and August 2007 Fires under Different Weather Conditions.

Burn Time (hrs)	April 20 th Fire (ha)			May 1 st Fire** (ha)			August 25 th - 31 st Fire (ha)		
	Actual*	Normal	Extreme	Actual	Normal	Extreme	Actual	Normal	Extreme
1		0.32	0.53		0	0.65		10.85	15.75
2		0.11	2.51		0	1.55		18.50	25.40
4		0.18	4.65		0.20	2.98		21.50	44.30
6		0.24	6.87		0.40	4.16		22.80	75.40
9	60.7	0.55	10.74		0.96	5.13		24.73	110.25
12		1.14	20.11	2.02	2.35	32.18		25.15	206.10
18		6.34	108.54		8.90	177.78		27.05	500.25
24		8.84	286.52		14.70	474.70		36.15	1081.80
36		11.02	1004.84		20.45	1611.65		41.30	2521.35
48		12.65	1829.26		28.50	3404.80		52.75	4463.50
60		12.56	3390.70		31.95	4942.94		65.50	7381.55
71		16.57	5435.19		40.60	6122.01		79.45	10030.81
120								125.05	15369.13
152							80.94	137.55	15958.02
Mean (ha/hr)	6.74	0.23	76.55	0.18	0.57	86.23	0.53	0.90	104.99
Mean (ac/hr)	16.65	0.57	189.08	0.44	1.41	212.99	1.31	2.22	259.33

*Actual, Normal and Extreme weather conditions; 1 ha = 2.47 acre.

**Actual May 1st fire burned for 11 hours; one house also burned.

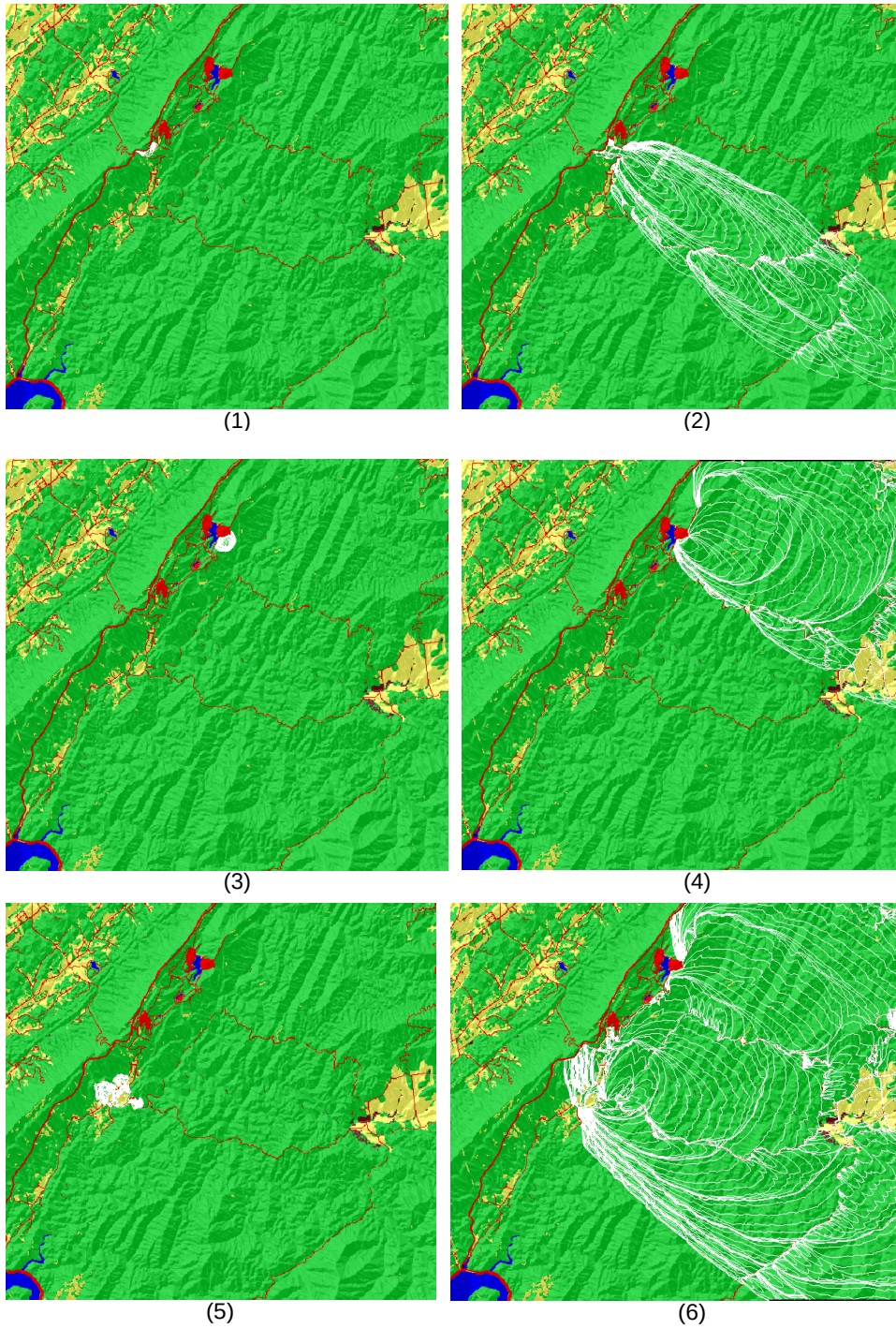


Figure 4.2 Fire Area for April 20th after 71 hours under Normal (1) and Extreme (2) Weather, May 1st (71 hours) under Normal (3) and Extreme (4) Weather, and August 25th – 31st (152 hours) under

Normal (5) and Extreme (6) Weather Conditions (based on FARSITE simulation).

Wildfire Risk Associated with Property Characteristics

What are the characteristics of the properties related to increased wildfire risk in the Chilhowee Mountain area?

In addition to the ecological and topographic characteristics that make the Chilhowee Mountain area susceptible to wildfire, there are other factors that influence the level of wildfire risk to people in the area. The lack of ability to fight a fire by not having a fire station nearby, not having access to water, and having fire prone vegetation within 30 feet of peoples' houses are significant constraints to providing community wildfire protection. Since there is no fire station in the study area, the distance to a fire station could be a major constraint on the ability to respond quickly to a fire threat resulting in a significant increase in wildfire risk. The minimum time it takes for a fire truck to reach the study area, however, is only 15 minutes. A longer elapsed time could be a factor in causing the area to have a higher level of wildfire risk thus increasing the risk level for property owners in the area.

Another factor affecting wildfire risk is having access to water nearby to protect one's property from wildfire. The property owners were asked whether they have a fire hydrant close to their property (within 500 feet) to use a fire hose to fight a fire. Ninety-nine percent (99%) indicated "No." The respondents were also asked about the distance

from their property to a water source, such as a fire hydrant, pond, lake, or stream that firefighters could use for a water source in case of fire. Seventy percent (70%) of their

Table 4.3 The Distance from the Property to Water Source (n = 113)

Distance from property to water source	n	Percent
< ½ mile	79	70.0%
0.51 - mile	21	18.5%
1.1 – 5 miles	9	8.0%
5.1 – 10 miles	1	0.8%
> 10 miles	3	2.6%
Total	113	100%

Note: 18.8% indicated “Don’t know” (n=26)

properties were less than ½ mile from a water source and 89% were within one mile. Nineteen percent (19%) responded “Don’t Know” (Table 4.3).

What kind of shrubby/brushy vegetation do homeowners have within 30 feet of their homes?

Many people may be unaware wildfire represents a threat to their property particularly in terms of the type of vegetation they have surrounding their home. If their properties are surrounded by forestland that is open, it is unlikely their properties are at a high risk of a wildfire. If they are surrounded by land that is heavily vegetated with a continuous layer of shrubs, trees, and vines and no clear view into undeveloped areas, they are at a greater risk of wildfire.

The survey included questions to determine the property characteristics related to these wildfire risks. The respondents were asked if the shrubby/brushy vegetation within 30 feet of their home on Chilhowee Mountain is primarily the kind that keeps its leaves year-round such as pine, mountain laurel, and rhododendron (6%), the kind that drops its leaves in the fall, such as dogwood, red bud, oak, black gum, sourwood, sumac, witch-hazel, and serviceberry (48%), or no shrubby/brushy vegetation within 30 feet of their home (14%) (Table 4.4). Thirty percent (30%) indicated having both types of vegetation (drop their leaves and keep their leaves) within 30 feet. Since rhododendron and pine contain oil and are prone to fire, particularly in dry winter, more than one-third (36%) of the homeowners are at a greater risk of a wildfire.

What is the type and extent of yard/landscape vegetation within 30 feet of their homes?

The property owners were also asked about the nature of the yard/landscape within 30 feet of their home. Thirty-eight percent (38%) said there were numerous trees, ground vegetation and leaves next to and around their homes, which means a wildfire would be a significant risk to the homeowners. At some risk were the twenty-six percent (26%) who had numerous trees next to their home, but leaves, shrubs and vines had mostly been removed. This was followed by 20% who had a few trees next to their home, but shrubs and vines had been removed. Only 17% had removed almost all trees, shrubs and vines next to their homes (Table 4.5).

Table 4.4 Type of Shrubby or Brushy Vegetation within 30 Feet of Home.

Shrubby/brushy vegetation within 30 ft	Resident Homeowners (n = 45)		Absentee Homeowners (n = 39)		Total (n = 84)	
	n	%	n	%	n	%
Keeps leaves year-round	3	6.7%	2	5.1%	5	6.0%
Mixed vegetation: some keep leaves/some drop leaves	14	31.1%	11	28.2%	25	29.8%
Drops leaves in the fall	22	48.9%	18	46.2%	40	47.6%
No vegetation within 30 ft.	6	13.3%	6	15.4%	12	14.3%

Table 4.5 Type of Yard or Landscape within 30 Feet of Home.

Yard/landscape	Resident Homeowners (n = 46)		Absentee Homeowners (n = 39)		Total (n = 85)	
	n	%	n	%	n	%
Numerous trees, ground vegetation and leaves next to and around home.	20	43.5%	12	30.8%	32	37.6%
Numerous trees next to home, but leaves, shrubs, and vines have mostly been removed.	10	21.7%	12	30.8%	22	25.9%
Few trees next to home, but shrubs and vines have been removed.	7	15.2%	10	25.6%	17	20.0%
Almost all trees, shrubs and vines next to and around home have been removed.	9	19.6%	5	12.8%	13	16.5%

4.3 Property Owners' Characteristics

What are the characteristics of the property owners in the wildfire risk zone?

Demographics

Understanding characteristics of the people who live in the communities in a wildfire risk zone would help the Tennessee Division of Forestry understand better how to work with those communities. As indicated in Table 3.4 in Chapter 3 “Methodology,” the property owners were divided into three categories: resident homeowners, absentee homeowners, and lot owners. Forty-two (42%) of the property owners in the Chilhowee Mountain area of Blount County were homeowners (n = 159). Of those 85 homeowners, 54% were resident homeowners and 46% were absentee homeowners. In addition to having a house on their property, the resident homeowners and the absentee homeowners also had barns, sheds, trailers, and campers with the largest having a barn or shed (50%) (Tables 4.6 and 4.7).

Table 4.6 Resident Homeowners and Property Types (n = 46).

Property Type	n	Percent	Insured	Percent
Home/house	46	100%	36	78.3%
Barn	13	28.3%	9	75.0%
Shed	24	52.2%	15	62.5%
Trailer	5	10.9%	2	40.0%
Camper	8	17.4%	5	62.5%

Table 4.7 Absentee Homeowners and Property Types (n = 39).

Property Type	n	Percent	Insured	Percent
Home/house	39	100%	30	76.9%
Barn	1	2.6%	1	100%
Shed	13	35.9%	11	78.6%
Trailer	3	7.7%	2	66.7%
Camper	2	5.1%	0	0

Whether or not homeowners have fire insurance is another indication of the economic risk that wildfire may pose. Almost one-fourth (23%) of the homeowners did not have insurance on their home. The structures covered by fire insurance (Table 4.8) were house (78%), barn (77%), shed (68%), trailer (50%), and camper (50%). One respondent mentioned insurance costs were very high and difficult to obtain due to the lack of a fire station nearby.

For the absentee homeowners, the duration of living in their vacation homes ranged from one week to 6 months each year (Table 4.9). A little below twenty percent (18.8%) spend one month or less in their vacation home while 41% spend between one and two months there. Almost 41%, however, spend more than two months a year (Table 4.9).

The property owners acquired their land as early as 1936 and as recently as 2006 (8%) (Table 4.10). One-third (33%) obtained their land between 2000 and 2006. Almost two-thirds (61%) have bought their land since 1990. Thirty-nine percent (39%) bought their

Table 4.8 Structure Type by Homeowners (n = 85).

Property Type	n	Percent	Insured	Percent
Home/house	85	100.0%	66	77.6%
Barn	14	16.5%	10	76.9%
Shed	38	44.7%	26	68.4%
Trailer	8	9.4%	4	50.0%
Camper	10	11.8%	5	50.0%

Table 4.9 Times Spent in Vacation Home (n = 32).

Time Spent	Percent
<= 2 weeks	9.4%
3 – 4 weeks	9.4%
5 – 8 weeks	40.6%
9 – 12 weeks	18.8%
13 – 24 weeks	15.6%
> 24 weeks	6.3%
Total	100%

Table 4.10 Year Land was Acquired (n = 144).

Year Land was Acquired	Percent
2000 - 2006	32.8%
1990 – 1999	27.9%
1980 - 1989	17.3%
1970 - 1979	7.7%
1960 - 1969	12.4%
1936 - 1959	1.9%
Total	100%

Table 4.11 Acreage Owned in the Chilhowee Mountain Area (n = 157).

Acres own	Percent
1 acre or less	54.6%
2 acres	14.4%
3 acres	6.2%
4 acres	2.8%
5 acres	4.1%
6-10 acres	2.8%
11-15 acres	2.0%
16-25 acres	5.4%
26-50 acres	3.8%
More than 50 acres	3.9%
Total	100%

land between 1960 and 1989. Slightly over half of the property owners own 1 acre or less (55%), 14% own 2 acres and 13% own between three and five acres. Fifteen percent (15%) own more than 10 acres (Table 4.11). There were only two homeowners who indicated they rent their property.

The respondents ranged in age from 22 to 98 with an average age of 61 (SD=13.5) and a median of 60. The property owners are highly educated with the majority of those surveyed having some college or a college degree (52%), and an additional 18% having a graduate or a post-graduate degree. Another 24% said they had completed high school, while 6% had not (Table X-1, Appendix 10). The respondents also represented an upper level of income. One third (36%) of the property owners indicated their household earned over \$75,000 a year (Table X-2, Appendix 10). Twenty percent (20%) had an

Table 4.12 Percentage of Homeowners with a Breathing Problem (n = 84).

Breathing Problem	Resident Homeowners	Absentee Homeowners	Total
Yes	35.6%	12.8%	25.0%
No	64.4%	87.2%	75.0%
Total	100%	100%	100%

annual income between \$50,000-\$74,999 for a total of 56% with \$50,000 or more in annual income. Sixteen percent (16%) earned between \$35,000 and \$50,000. Twenty-eight percent (28%) had less than \$35,000 in annual income with 6% being less than \$15,000 (Table X-2, Appendix 10).

All survey participants were asked “Does anyone in your household suffer from a respiratory or breathing problem.” Thirty-six percent (36%) of the resident homeowners indicated having someone with a breathing problem in their home (Table 4.12). One-fourth of all homeowners (25%), including absentee homeowners, had someone in their household with a breathing problem.

4.4 Past Experience

What is the property owners' past experience with wildfire, fire reduction activities and outreach programs?

Past experience with wildfire

Survey questions concerning “Past experience with wildfire” (at any time in their lives) included 11 statements from Q8 and two from Q9 as shown in Table 4.13. Almost two-thirds (65%) of property owners indicated some experience with wildfire by checking off at least one of the 12 statements. One-third (33%) have personally witnessed a wildfire, and 24% had a wildfire occur near their home. Twenty-three percent (23%) had “experienced discomfort from smoke caused by wildfire,” and forty-nine percent (49%) had “observed the effects of fires on forests and wildlands.” Twelve percent (12%) had “felt fear or anxiety as a result of wildfire.” Other experiences the respondents wrote in are listed in Appendix 11, such as being either a firefighter or volunteer fireman in the past, having a house hit by lightning, experiencing severe wildfire near home, participating in a prescribed burn, and seeing areas burn on Chilhowee Mountain.

Do resident homeowners have more past experience with wildfire than absentee homeowners or lot owners?

A Past Experience Index was created by summing positive responses to statements 1-12 listed in Table 4.13. While ANOVA shows some statistical difference ($p \leq .05$) among

Table 4.13 Past Experiences of the Property Owners with Wildfire (n = 159).

Experiences	Percent
1.* Observed the effects of fires on forests and wildlands.	48.7%
2. Personally witnessed a wildfire.	33.1%
3. A wildfire has occurred near my home.	23.9%
4. Experienced discomfort from smoke caused by wildfire.	22.6%
5. Felt fear or anxiety as a result of a wildfire.	12.1%
6. A prescribed burn has occurred near my home.	11.2%
7. Friends, family and/or neighbors suffered property damage due to wildfire.	11.6%
8. Experienced a road closure due to wildfire.	8.3%
9. A mechanical fuel reduction to decrease wildfire fuels has occurred near my home.	6.3%
10. Been injured or suffered property damage from a wildfire.	4.4%
11. Been required to remove flammable vegetation on my property.	0.8%
12.* Evacuated my home or office due to wildfire.	0.4%
13. Have experienced NONE of the items listed above.	34.5%

* From Q9; all other questions from Q8.

Table 4.14 Past Experiences with Wildfire by Property Type Status.

Property Type Status	n	Mean	SD
Resident Homeowners	46	2.52	2.32
Absentee Homeowners	39	1.54	1.79
Lot Owners	74	1.72	1.99

Note: ($p \leq .05$).

the three property owner groups on the Past Experience Index, there may be a tendency for resident homeowners' past experience with wildfire to be higher than absentee homeowners and lot owners (Table 4.14).

Cross-tabulations were used to determine if general experience with wildfire is related to various socio-demographic characteristics (Table XII-1 to Table XII-11, Appendix 12). Overall there was very little variation demographically; although males appeared more likely than females to have indicated past experiences with wildfire. In addition, those under age 70 were more likely to have a wildfire to have occurred near their home (Table XII-2, Appendix 12).

Past experience with wildfire reduction activities

What is the property owners' past experience with wildfire reduction activities?

To examine property owners' past experience with wildfire reduction activities, 11 items describing wildfire reduction activities were created using items 1 to 6 from Q9 and items 7 to 11 from comments under "Other actions" (Q9a) as listed in Table 4.15. Of these

activities, “Removed vegetation on my property to protect my home from fire” were engaged in most often by homeowners (54%) followed by “Read information on protecting homes from wildfires” (46%). Less frequent activities engaged in were: “Worked with local fire department on neighborhood and community fire protection” (13%), “Attended a public meeting about wildfire” (8%), “Asked local fire officials about how to reduce risk of property damage from wildfire” (7%) and “Called authorities about neighbors being careless with their outdoor burning” (2%). Comments listed under other actions (Q9a) with less than 5% were: “Used fire resistant construction,” “Followed burning rules,” “Created/maintained access to water,” “Obtained firefighting tools” and “Used best practices” (Table 4.15). Forty percent (40%) of all the respondents indicated they have obtained a burning permit in the past. While wildfires can occur at any time, there are two fire seasons in Tennessee. The spring fire season begins about February 15 and ends around May 15th, and the fall fire season begins October 15th and ends around December 15.th According to the Tennessee Division of Forestry, a burning permit is required for outdoor burning between October 15th and May 15.th

In addition to actions the respondent had checked off in Q9, other actions they wrote in to help reduce wildfire risk in the Chilhowee Mountain are listed in Table XIII-1, Appendix 13. Interestingly, 51% of all the respondents did not indicate taking any action (Table XIII-2, Appendix 13); however, the majority of those taking no action were lot owners (68%) (Table 4.16). Twenty-seven percent (27%) of the homeowners indicated they have taken no actions to help reduce the risk of wildfire at anytime in the past, which

Table 4.15 Wildfire Risk Reduction Activities by Homeowners (n = 85).

Wildfire Risk Reduction Activities	Percent
6.* Removed vegetation on my property to protect my home from fire.	54.1%
2. Read information on protecting homes from wildfires.	45.9%
5. Worked with local fire department on neighborhood and community fire protection.	12.9%
3. Attended a public meeting about wildfire.	8.2%
1. Asked local fire officials about how to reduce risk of property damage from wildfire.	7.1%
7. Used fire resistant construction.	3.5%
9. Followed burning rules.	3.5%
4. Called authorities about neighbors being careless with their outdoor burning.	2.4%
8. Created/maintained access to water.	2.4%
10. Obtained firefighting tools.	2.4%
11. Used best practices (limit burns on property, camp and picnic responsibly, etc).	2.4%

** Numbers correspond to list in Appendix 13. Items 1-6 from Q9; items 7-11 from Q9a, other actions listed by respondents.*

means 73% have taken at least one action. Only 32% of the lot owners have taken at least one or more actions to reduce risk. Fifty-eight percent of the homeowners (58%) have taken at least one or two actions. Twenty-two percent (22%) of the resident homeowners have taken three or more actions compared to just 8% for the absentee homeowners. Only 8% of the lot owners have taken more than one action at anytime in their life (Table 4.16).

The Fire Reduction Activities Index was created by summing the number of risk reduction activities engaged in resulting in a “fire reduction activity score” for each individual. As might be expected, resident homeowners have engaged in more fire reduction activities than absentee homeowners and lot owners ($p < .05$) (Table 4.17). There is no statistical difference in involvement in fire reduction activities, however, among those property owners of different age groups, gender, educational levels and annual income.

Outreach Effort Evaluation

What is the property owners’ past experience with outreach programs?

Property owners were asked how familiar they were with an article from the TDF and with the TDF website about protecting their home from wildfire (Q23). Their responses were based on a 1-5 scale running from “Not at all familiar” to “Very familiar.” Overall, 78% of respondents said they were “Not at all familiar” with the programs while only 2%

Table 4.16 Number of Actions Taken at any Time in Their Lives to Help Reduce the Risk of Wildfire by Property Type Status (n = 159).

Number of Actions Taken		Resident Homeowners		Absentee Homeowners		Lot Owners	
# Act	n	n	%	n	%	n	%
0	73	12	26.1%	11	28.2%	50	67.6%
1	43	11	23.9%	14	35.9%	18	24.3%
2	29	13	28.3%	11	28.2%	5	6.8%
3	6	4	8.7%	2	5.1%	0	0%
4	6	5	10.9%	1	2.6%	0	0%
5	1	0	0%	0	0%	1	1.4%
8	1	1	2.2%	0	0%	0	0%
Total	159	46	100%	39	100%	74	100%

Does participation in fire reduction behaviors vary by demographic characteristics?

Table 4.17 Fire Reduction Activities Index by Property Type Status.

Property Type Status	n	Mean	SD
Resident Homeowners	46	1.67	1.59
Absentee Homeowners	39	1.18	1.00
Lot Owners	74	0.45	0.81

Note: (p = .000).

were “Very familiar” with the programs (Table 4.18). A familiarity index score was developed by combining responses to Q23a to Q23c. Overall, the property owners were very unfamiliar (mean = 1.38) with the TDF outreach programs (Table 4.18).

The respondents were also asked if they had ever obtained information about FIREWISE from the FIREWISE.ORG website or from a government agency. Only 1% indicated they had obtained information about FIREWISE from the website, and only 6% indicated they had received information about FIREWISE from a government agency.

Table 4.18 Property Owners’ Familiarity with Government Outreach Programs.

Outreach Efforts	n	Mean*	SD	Not at all Familiar	Very Familiar
An article from the TDF about protecting your home from wildfire.	153	1.38	0.88	79.8%	1.8%
The TDF website about learning how to protect your home from burning in the event of a wildfire.	152	1.27	0.80	86.5%	2.2%
The FIREWISE program on how to protect one’s home from burning in the event of a wildfire.	151	1.45	1.00	78.8%	2.8%
Familiarity Index	154	1.38	0.85	77.5%	1.9%

** 5 point scale: 1 = “Not at all familiar” and 5 = “Very familiar.”*

Are permanent resident homeowners more informed and familiar with wildfire and how it might be mitigated than absentee homeowners or lot owners?

While familiarity overall was very low across all three groups, resident homeowners tended to be more familiar with the outreach programs than absentee homeowners and lot owners, (Table 4.19).

4.5 Perception of Fire Risk

What is the property owners' perception of wildfire risk in the Chilhowee Mountain area?

To examine property owners' past perception of wildfire risk, they were asked to what extent they considered the possible occurrence of a wildfire around their current home and/or property in the Chilhowee Mountain area when they bought the property or moved there. Forty-eight percent (48%) indicated they did not consider the possibility of wildfire at all when they bought their property (indicated "1" on the scale), with 5% having considered it very much a possibility (indicated "5"). Seventy-three (73%) of the property owners indicated it should be required as a part of the real estate transaction for homebuyers to be informed when a home or property is in a fire risk/fire susceptible area.

The property owners were asked about their level of concern that a wildfire in the Chilhowee Mountain area could change their quality of life. Responses ranged from "Not

Table 4.19 Mean Level of Familiarity with Government Outreach Programs by Property Type Status.

Outreach Efforts	<i>p</i>	Resident Homeowners (n = 44)		Absentee Homeowners (n = 39)		Lot Owners (n = 71)	
		Mean	SD	Mean	SD	Mean	SD
An article from the TDF about protecting your home from wildfire.	.01	1.82	1.37	1.34	0.82	1.25	0.63
The TDF website about learning how to protect your home from burning in the event of a wildfire.	.03	1.60	1.35	1.24	0.68	1.17	0.53
The FIREWISE program on how to protect one's home from burning in the event of a wildfire.	.01	1.91	1.46	1.49	1.02	1.28	0.70

at all concerned” to “Extremely concerned” on a 1-5 Likert scale. Overall, the average level of concern was 2.5 (SD=1.35) with a median of 2.0. Half (50.5%) of the property owners had a low level of concern, while 25% were highly concerned (Table 4.20). For resident homeowners, however, the average level of concern was 3.28 (SD=1.31) with 44% being highly concerned. For absentees, the mean was 3.10 (SD=1.39) with 41% being highly concerned. Lot owners’ level of concern was much lower at 1.94 (SD=1.08) (Table 4.21). As expected, 68% of lot owners expressed a low level of concern. With no building on the property, their actual level of financial risk in the event of wildfire is much less than for the property owners with homes, etc.

Risk severity and risk vulnerability are the critical risk perception measures in the Protection Motivation Theory (PMT). Risk severity was examined using two five-point Likert scales. The respondents were asked how seriously do they feel the negative

Table 4.20 Level of Concern by Property Type Status.

Property Type Status	n	Mean	SD	Level of Concern*		
				Low	Medium	High
All Property owners	153	2.49	1.35	50.5%	24.6%	24.9%
Resident homeowners	46	3.28	1.31	21.7%	34.8%	43.5%
Absentee homeowners	39	3.10	1.39	33.3%	25.6%	41.1%
Lot owners	69	1.94	1.08	68.1%	20.3%	11.6%

**5 point scale: Low = 1 and 2 combined; Medium = 3; High = 4 and 5 combined.*

Table 4.21 Mean and Frequency of Risk Severity and Risk Vulnerability.

Perception of Risk severity & Risk vulnerability	n	Mean	SD	Not at all	Extremely
Q11. How serious would negative consequences of wildfires be to you personally?	154	2.94	1.39	21.8%	16.9%
Q12. How severe would the impact of a wildfire be where you live?	127	3.09	1.51	25.1%	22.6%
Q13. How vulnerable do you feel about the possibility of a wildfire physically affecting you/your family?	146	2.27	1.36	41.5%	10.4%
Q14. How vulnerable do you feel about the possibility of a wildfire physically affecting your property or possessions?	153	2.71	1.41	27.8%	14.2%

consequences of wildfires in the Chilhowee Mountain area would be to them personally, where 1 represented “Not at all serious” and 5 represented “Extremely serious.” Overall, the average level of seriousness was 2.94 (SD=1.39) with a median of 3.0 (Table 4.21). Twenty-two percent (22%) indicated “Not at all serious,” while 17% said “Extremely serious.” The second question was how severe would the impact of a wildfire be where they live, where 1 represented “No harm at all” and 5 represented “Extremely devastating.” The average severity was 3.09 (SD=1.51) with a median of 3.0 (Table 4.21). Twenty-five percent (25%) indicated “No harm at all,” while 23% said “Extremely devastating.”

Risk vulnerability was also examined using two five-point Likert scales. The respondents were asked how vulnerable they felt about the possibility of a wildfire in the

Chilhowee Mountain area physically affecting them or their family with 1 representing “Not at all vulnerable” and 5 representing “Extremely vulnerable.” Overall, the average vulnerability was 2.27 (SD=1.36) with a median of 2.0 (Table 4.21). Forty-two percent (42%) indicated “Not at all vulnerable,” while only 10% said “Extremely vulnerable.” The second question was how vulnerable do they feel about the possibility of a wildfire physically affecting their property or possessions. The average vulnerability overall was 2.71 (SD=1.41) with a median of 3.0 (Table 4.21). Twenty-eight percent (28%) indicated “Not at all vulnerable,” while 14% said “Extremely vulnerable.”

Do resident homeowners perceive risk severity and risk vulnerability differently from absentee homeowners and lot owners?

Not surprisingly, cross-tabulation analyses in Table 4.22 and Table 4.23 show homeowners’ perception of risk severity and risk vulnerability was much greater than lot owners.’ While more than one-third to almost three-fourths (39% to 73%) of respondents who perceived all four items on risk severity and risk vulnerability as high were homeowners, only 5% to 21% of the lot owners perceived all four items on risk severity and risk vulnerability as high. At the other extreme, the lot owners reporting a low level of risk (57% to 88%), whereas homeowners with a perceived low level of risk severity and risk vulnerability ranged from only 10% to 31%.

The Risk Severity Index and the Risk Vulnerability Index were constructed to examine the property owners’ perception of risk severity and vulnerability in relation to property

Table 4.22 Perception of Risk Severity and Risk Vulnerability by Homeowners.

Perception of Risk Severity & Risk Vulnerability	n	Low*	Medium	High
Q11. How serious would negative consequences of wildfires be to you personally?	83	13.3%	22.9%	63.9%
Q12. How severe would the impact of a wildfire be where you live?	85	10.6%	16.5%	72.9%
Q13. How vulnerable do you feel about the possibility of a wildfire physically affecting you/your family?	84	31.0%	29.8%	39.3%
Q14. How vulnerable do you feel about the possibility of a wildfire physically affecting your property or possessions?	84	21.4%	23.8%	54.8%

** 5 point scale: Low = 1 and 2 combined; Medium = 3; High = 4 and 5 combined.*

Table 4.23 Perception of Risk Severity and Risk Vulnerability by Lot Owners.

Perception of Risk Severity & Risk Vulnerability	n	Low*	Medium	High
Q11. How serious negative consequences of wildfires would be to you personally?	71	57.7%	22.5%	19.7%
Q12. How severe would the impact of a wildfire be where you live?	48	66.7%	12.5%	20.8%
Q13. How vulnerable do you feel about the possibility of a wildfire physically affecting you/your family?	64	87.5%	7.8%	4.7%
Q14. How vulnerable do you feel about the possibility of a wildfire physically affecting your property or possessions?	70	67.1%	18.6%	14.3%

** 5 point scale: Low = 1 and 2 combined; Medium = 3; High = 4 and 5 combined.*

type status and socio-demographic characteristics. The Risk Severity Index is the mean of Q11 and Q12 while the Risk Vulnerability Index is the mean of Q13 and Q14 on the survey. Interestingly, the risk severity scores were slightly higher than the risk vulnerability scores within each property type status. As shown in Table 4.24, analysis of variance (ANOVA) shows a significant difference ($p = .000$) in risk severity and risk vulnerability perceptions and property type status. Both resident homeowners and absentee homeowners perceive risk severity and risk vulnerability higher than lot owners. Objectively speaking, homeowners and absentee homeowners have more to lose in the event of a wildfire striking their property than lot owners and are more likely to be in the area when a wildfire occurs.

Table 4.24 Risk Severity and Risk Vulnerability by Resident Homeowners, Absentee Homeowners and Lot Owners (n = 159).

Index	Property Status	n	Mean	SD
Risk Severity*	Resident Homeowners	46	3.97	1.18
	Absentee Homeowners	39	3.76	1.07
	Lot Owners	72	2.26	1.12
Risk Vulnerability*	Resident Homeowners	45	3.40	1.30
	Absentee Homeowners	39	3.31	1.17
	Lot Owners	70	1.85	0.90

* ($p = .000$)

Is age related to how people perceive risk severity and risk vulnerability?

While there is no statistical difference, older people, especially those 61 years of age and over, may tend to perceive risk severity to be lower relative to other age groups ($p > .05$) (Table 4.25). People in the age groups of 22-50 and 51-60 years have the highest mean perceptions on both risk severity (mean = 4.17, SD = 0.66 for 22-50 and mean = 4.24, SD = 0.82 for 51-60) and risk vulnerability (mean 3.62, SD = 0.96 for 22-50 and mean = 3.61, SD = 1.16 for 51-60).

Table 4.25 Risk Severity and Risk Vulnerability of Homeowners by Age (n = 85).

Index	Age	n	Mean	SD
Risk Severity*	22 - 50	18	4.17	0.66
	51 - 60	23	4.24	0.82
	61 - 70	25	3.70	1.10
	> 70	17	3.50	1.56
Risk Vulnerability*	22 - 50	17	3.62	0.96
	51 - 60	23	3.61	1.16
	61 - 70	25	3.08	1.10
	> 70	17	3.33	1.64

* ($p > .05$)

Is the perception of risk severity and risk vulnerability associated with engagement in fire risk reduction activities?

According to the Protection Motivation Theory (PMT) discussed in Chapter 2, property owners' protection motivation is the result of the threat appraisal and the coping appraisal. Threat appraisal is the expectancy of being exposed to a wildfire (wildfire risk vulnerability) and estimates of the seriousness of a wildfire (wildfire risk severity). Bivariate correlations were used to measure the strength of a linear association between risk severity as well as vulnerability and the engagement in fire risk reduction behaviors (Q9). The correlation coefficient, r , indicates risk severity and risk vulnerability are positively associated with engagement in fire risk reduction behaviors (Table 4.26).

However, there is no significant relationship between risk severity, risk vulnerability and engagement in risk reduction behavior by homeowners (Table 4.27). Moreover, past experience with wildfire had no significant relationship with the respondents' perception of fire risk (Table 4.28)

Table 4.26 The Correlation between Risk Severity, Risk Vulnerability and Engagement in Risk Reduction Behaviors.

Risk Reduction Behavior Index	<i>r</i>	<i>p</i>	<i>n</i>
Risk Severity Index	.360	.000	157
Risk Vulnerability Index	.394	.000	154

Table 4.27 The Correlation between Risk Severity, Risk Vulnerability and Engagement in Risk Reduction Behaviors by Homeowners.

Risk Reduction Behavior Index	<i>r</i>	<i>p</i>	n
Risk Severity Index	.204	.061	85
Risk Vulnerability Index	.159	.148	84

Table 4.28 The Correlation between Risk Severity, Risk Vulnerability and Past Experience with Wildfire.

Past Experience with Wildfire Index	<i>r</i>	<i>p</i>	n
Risk Severity Index	.112	.164	157
Risk Vulnerability Index	.107	.185	154

4.6 Perception of Risk Reduction Activities

What is the property owners' perception of wildfire risk reduction activities?

Response efficacy

How do property owners perceive the effectiveness of fire reduction activities (response efficacy)?

The respondents were asked to rate the effectiveness (response efficacy) of 13 specific activities for reducing the risk of fire impacting their property and lives in the Chilhowee Mountain area (Q15). Items were rated using a five-point Likert scale, where 1

represented “Not at all effective” and 5 represented “Very effective.” Lot owners rated only the first four items (Q15a to Q15d) since they did not have a home or structure on their property. Resident homeowners strongly believed in the effectiveness of the following actions in terms of reducing the risk of fire impacting their property and lives: “Make sure their home is easily identifiable and accessible from a main road” (Mean = 4.55), “Remove any dead branches/leaves/pine needles from home’s roof and around the chimney” (Mean = 4.39), and “Put fire resistant barriers to the undersides of decks” (Mean = 4.13), with significantly higher means than the absentee homeowners ($p < .05$) (Table 4.29 and Figure 4.3). Other actions rated highly in response efficacy were “Put a fire resistant roof on home,” “Remove flammable vegetation within 30 ft.” and “Plant fire resistant plants around home.” There was moderate support for the remaining items, such as “County or Local ordinances requiring realtors to provide wildfire prevention information,” “Stack firewood and wood piles at least 30 ft. from any structure,” “Make sure trees are away from structures” and “Contact local fire department for fire safety inspection.” Relatively, the lowest rated items were “County or Local ordinances requiring accessibility, fire retardant construction materials, and other Firewise practices,” “Work with neighbors to clear common areas” and “Make sure trees are away from utility lines” (Table 4.29).

Table 4.29 Mean Response Efficacy in Rank Order by Resident Homeowners.

Risk Reduction Activities	Resident Homeowners	Absentee Homeowners	Lot Owners	Significance
l. Make sure home is accessible from a main road.	4.55	3.97		.018
k. Remove dead branches/leaves from roof.	4.39	3.83		.044
j. Put a fire resistant roof on home.	4.32	3.82		NS
m. Put fire resistant barriers to the undersides of decks.	4.13	3.48		.031
h. Remove flammable vegetation within 30 ft.	3.90	3.91		NS
i. Plant fire resistant plants around home.	3.82	3.66		NS
d. County or Local ordinances requiring realtors to provide wildfire prevention information.	3.68	3.44	3.40	NS
f. Stack firewood and wood piles at least 30 feet from any structure.	3.58	3.74		NS
e. Make sure trees are away from structures.	3.49	3.26		NS
g. Contact local fire dept. for fire safety inspection.	3.39	3.32		NS
a. Make sure trees are away from utility lines.	3.30	3.80	3.45	NS
b. Work with neighbors to clear common areas.	3.28	3.69	3.40	NS
c. County or Local ordinances requiring accessibility, fire retardant construction materials, and other Firewise practices.	3.28	3.42	3.30	NS

Note: ($p > .05$); NS = No significant differences between groups.

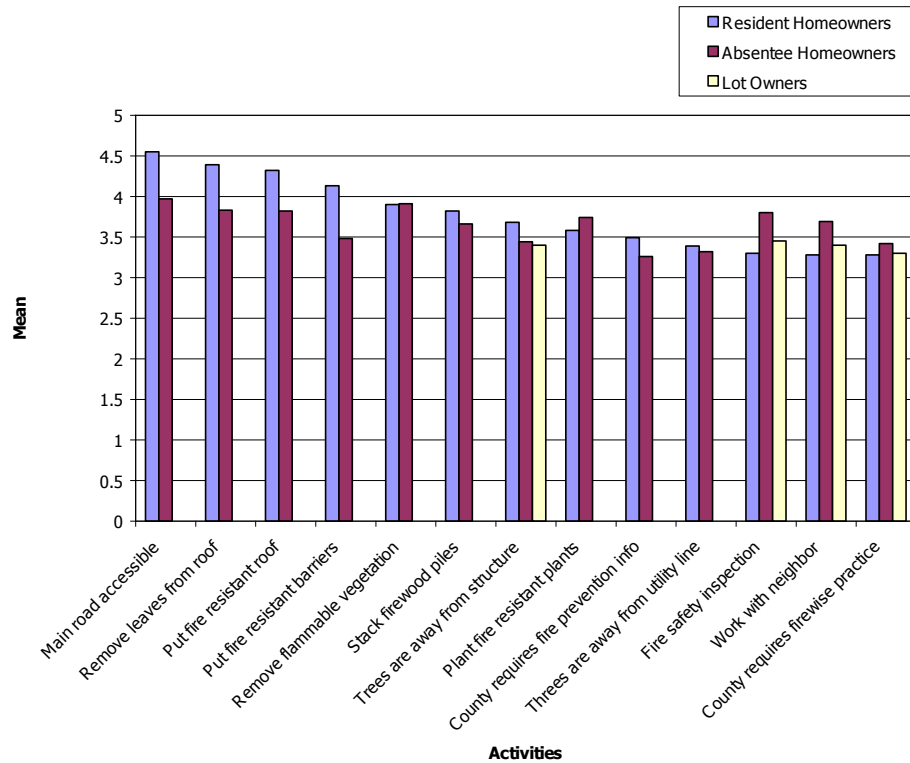


Figure 4.3 Mean Response Efficacy by Property Type Status.

Does the perception of the effectiveness of fire reduction activities (response efficacy) vary by property type status, gender, age groups, education levels, or income?

The Response Efficacy Index is the mean of the 13 items in Q15. It was used to examine the property owners' response efficacy in relation to property type status and socio-demographic characteristics. The Response Efficacy Index indicates no statistical difference in the perception of fire reduction effectiveness by property type status or socio-demographic characteristics (Table 4.30) ($p > .05$).

Table 4.30 Mean of Response Efficacy Index by Property Type Status.

Property Type Status	n	Mean	SD
Resident Homeowners	45	3.62	0.99
Absentee Homeowners	37	3.66	1.00
Lot Owners	52	3.45	1.14

Personal Control (Self-efficacy)

How confident are property owners in their ability to perform fire risk reduction activities?

Personal control (self-efficacy) in this study is the level of confidence in one's ability to perform specific wildfire risk reduction activities. The respondents were asked to rate "How confident do you feel in your ability to do the following?" followed by a list of twelve fire risk reduction activities. The activities were rated on a five-point Likert scale, where 1 represented "Not at all confident" and 5 represented "Very confident." Since lot owners had no home on the property, they rated only the first four items (Q16a to Q16d), while resident homeowners and absentee homeowners rated all 12 items. There were no significant differences between the responses of resident homeowners and absentee homeowners on any of the self-efficacy related activities.

Homeowners showed they were very confident in their ability to "Remove any dead branches/leaves/pine needles from your home's roof and around the chimney" (Mean =

4.29, SD = 1.13), “Make sure home is identified and accessible from a main road (Mean = 4.24, SD = 1.13) and “Stack firewood and scrap wood piles at least 30 feet away from any structure” (Mean = 4.24, SD = 1.09) (Table 4.31 and Figure 4.4). In addition, the homeowners self-efficacy was somewhat high (Mean between 3.81-3.92) on “Remove flammable vegetation within 30 feet of home,” “Put a fire resistant roof on home” and “Assess what you need to do to protect property from wildfire (Table 4.31 and Figure 4.4). Other relatively low scores were “Contact local fire department for fire safety inspection,” “Put fire resistant barriers to the undersides of decks” and “Make sure all the trees are away from utility lines.” Interestingly, the lowest self-efficacy score for all property owner categories was their confidence in their ability to “Work with neighbors to clear/prune common areas by all property owners.” The self-efficacy of homeowners was significantly higher than for lot owners solely in their ability to “Assess what they need to do to protect property from wildfire” ($p = .004$) (Table 4.31 and Figure 4.4).

Does the confidence in the property owners’ ability to perform fire risk reduction activities vary by property type status, age groups, gender, education level, or annual income?

A Self-Efficacy Index was created for the homeowners and the lot owners. For the lot owners, it is the mean of the first four items and for the homeowners, it is the mean of all 12 items of Q16 in the survey. The Self-Efficacy Index (Table 4.32) shows significant difference by property type status particularly between the homeowners’ and lot owners’ confidence in their ability to perform the wildfire risk reduction activities ($p < .05$).

Table 4.31 Means Self-Efficacy by Property Type Status.

Risk Reduction Activities	Resident Homeowners	Absentee Homeowners	Lot Owners	Significance Levels
j. Remove dead branches/leaves/needles from roof.	4.30	4.28		NS
k. Make sure home is identified and accessible from a main road.	4.28	4.20		NS
f. Stack firewood and wood piles 30 feet from any structure.	4.00	4.49		NS
g. Remove flammable vegetation within 30 feet of home.	3.89	3.95		NS
i. Put a fire resistant roof on home.	3.89	3.72		NS
c. Assess what you need to do to protect property from wildfire.	3.83	3.97	3.07	.004
h. Plant low growing fire resistant plants around home.	3.78	3.76		NS
e. Make sure all the trees are away from structures.	3.50	3.74		NS
a. Make sure all the trees are away from utility lines.	3.49	3.42	3.19	NS
l. Put fire resistant barriers to the undersides of decks.	3.48	3.18		NS
d. Contact local fire dept. for fire safety inspection.	3.15	3.50	3.05	NS
b. Work with neighbors to clear/prune common areas.	2.83	2.97	2.89	NS

Note: ($p > .05$); NS = No significant differences between groups. Rank order by Resident Homeowners.

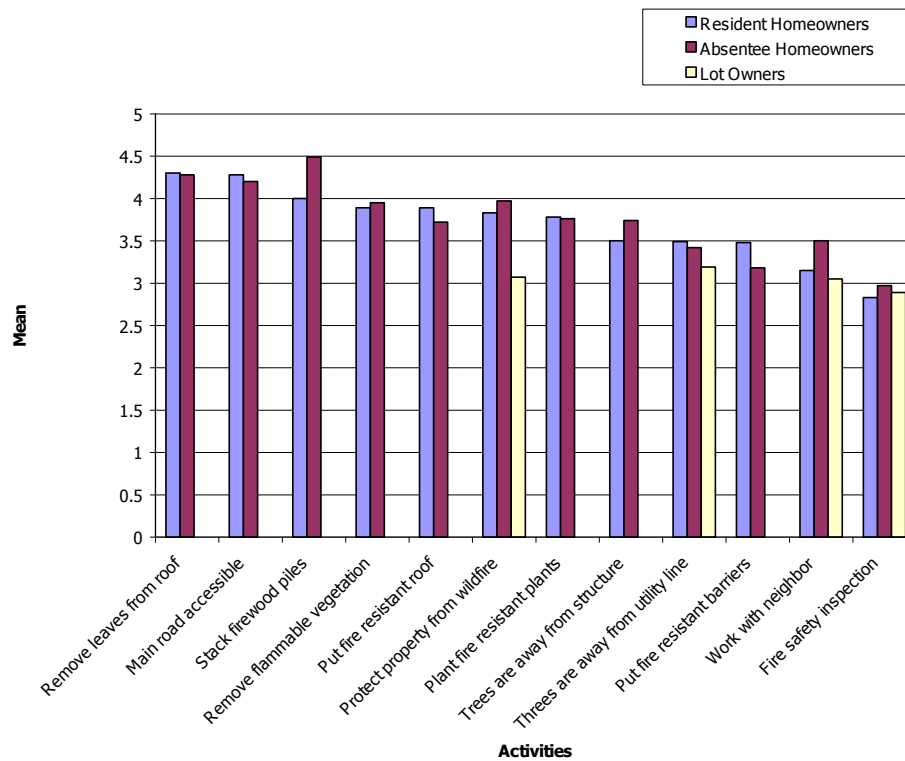


Figure 4.4 Mean Self-Efficacy by Property Type Status.

Table 4.32 Mean Self-Efficacy Index by Property Type Status.

Property Type Status	n	Mean	SD
Resident Homeowners	45	3.60	0.93
Absentee Homeowners	38	3.79	0.85
Lot Owners	51	3.06	1.56

Note: ($p < .05$)

Table 4.33 Mean Self-Efficacy by Age Group.

Age	n	Mean	SD
22 - 50	31	4.02	0.81
51 - 60	44	3.30	1.37
61 - 70	32	3.08	1.37
> 70	19	3.14	1.28
Total	126	3.40	1.28

Note: ($p < .01$)

There are some statistical differences among the property owners' self-efficacy as related to socio-demographic variables. Not surprisingly, age has a strong relationship with the property owners' confidence in their ability to perform risk reduction activities. Property owners aged 22-50 years old had the highest self-efficacy, while those older than 70 had the lowest self-efficacy ($p < .05$) (Table 4.33). There is no statistical difference in the property owners' self-efficacy by their annual income, gender and education level ($p > .05$).

Response Costs (Obstacles)

What are the property owners' response costs (obstacles) associated with taking actions to protect their property?

The property owners were asked "What would be your biggest obstacle to taking some of the actions listed in Q16 to protect your property from the impact of wildfire?" (Q17). The response costs (obstacles) were parsed into 13 categories using Martin et al (2007) and are listed in rank order by number of comments: vacation home/not living there (27),

cost (25), age/physical ability (13), lack of fire fighting equipment/water (13), time (12), only so much one can do (10), neighbor/others pose risk (9), vacation home (8), aesthetics (4), no obstacle/not aware (4), interest or motivation (3) and government agencies' mismanagement poses risk (1) (Table 4.34).

External Control

What is the property owners' perception of the Tennessee Division of Forestry and the National Park Service ability to protect private property from wildfire?

To investigate the perceptions of the Tennessee Division of Forestry (TDF) and the National Park Service (NPS), six statements addressed the level of how respondents see the government agencies involved in land and resource management. The scale ran from 1-5, where "1" represented "Strongly disagree," "5" represented "Strongly agree." Forty-four percent (44%) indicated they agreed both TDF and NPS does a good job of protecting private property from wildfires, while less than one-quarter disagreed (21% and 22%, (Table 4.36). Almost two-thirds (65%) of the respondents trusted the NPS to make the proper decisions about the use of prescribed burning, and 56% agreed the NPS does a good job of notifying the public about upcoming prescribed burns. Forty-seven (47%) agreed the TDF and NPS do a good job communicating with the public about forest issues. Only 14% disagreed that the NPS (22% for TDF) does a good job of communicating with the public (Table 4.35). As expected, most of the property owners who said "Don't know" for all statements were lot owners.

Table 4.34 Response Costs: Expressed Obstacles to taking Action to Protect their Property (n = 159).

Categories*	Obstacles	n
1. Vacation home/ not living there	• Not living in the area. • Live in FL. Out of sight, out of mind. • Only visit property every 2-3 years. • Only have a trailer.	27
2. Cost	• Cost of installing a fire resistant roof. • Money. • Do not have financial ability to clear property. • How to borrow money and hire someone to do work.	25
3. Age/physical ability	• 90 years old. • Not in good health. • Disabled.	13
4. Lack of fire fighting equipment/water or equipment for cleaning (clearing vegetation).	• Need fire department at Top of the World. Also EMS & Police. • No fire department closes by. • Locally available equipment. • Water. • Equipment for cleaning. • Tools/ safety knowledge to perform tasks.	13
5. Time	• Taking time to do it.	12
6. Only so much one can do	• Removal of pines killed by pine beetle. • Need trees cut down. • Do not have equipment to prune around power lines. • Put fire resistant barriers to underside of deck. • Clean up brush and trees.	10
7. Neighbors/others pose risks	• Lack of interest by neighbors. • Getting neighbor involved. • Having neighbor clean their property. • Careless visitors/homeowners.	9
8. Aesthetics	• Not sure if I want to remove all trees within 30 ft. of home. • Do not want to disturb natural vegetation. • Natural wood we can't clear.	4
9. No obstacle/not aware	• In 68 years, there has never been a house destroyed by a wildfire in this area. • All necessary precautions have been done.	4
10. Interest (motivation)	• Unwillingness. • Motivation, ambition.	3
11. Government agencies' mismanagement poses risk	• Contact your local fire department, would they come out?	1

* *Martin et al 2007*

Table 4.35 Mean Property Owner’s Perceptions of Government Agencies in Rank Order.

Agency Perceptions	n	Mean	SD	Disagree	Agree
Trust the NPS to make the proper decisions about the use of prescribed burning.	125	3.71	1.13	12.8%	65.1%
NPS does a good job of notifying the public about upcoming prescribed burns.	98	3.61	1.16	13.5%	55.5%
NPS does a good job communicating with the public about forest issues.	120	3.42	1.05	13.7%	47.3%
TDF does a good job communicating with the public about forest issues.	98	3.37	1.21	21.7%	46.4%
TDF does a good job of protecting private property from wildfires.	91	3.29	1.21	21.0%	43.7%
NPS does a good job of protecting private property from wildfires.	101	3.27	1.16	21.8%	44.2%

Note: 5 point scale: Disagree = 1 and 2 combined; Agree = 4 and 5 combined.

Do resident homeowners perceive the land and resource management of NPS and TDF differently from absentee homeowners or lot owners?

TDF and NPS Indices were created to compare perception of both agencies by property type status. The NPS Index is the mean of Q19a to Q19d in the survey, and the TDF Index is the mean of Q19e and Q19f in the survey. There is no statistical difference ($p > .05$) in property owners’ perception of the TDF and NPS management of land and natural resources (Table 4.36). While not statistically different, lot owners may have a slight tendency to be more favorable toward both agencies. Resident homeowners, on the other hand, may tend to have a slightly less favorable perception of both agencies (Table 4.36).

Table 4.36 Mean and Standard Deviation of Perception of National Park Service (NPS) and Tennessee Division of Forestry (TDF) Index.

Agency Perceptions	Resident Homeowners (n = 45)		Absentee Homeowners (n = 35)		Lot Owners (n = 56)	
	Mean	SD	Mean	SD	Mean	SD
TDF Index	3.13	1.18	3.22	1.21	3.51	1.02
NPS Index	3.26	0.97	3.42	1.24	3.72	0.79

Note: ($p > .05$)

Overall, however, all property owners tend to have a moderate perception of both agencies (neither overly positive nor negative).

Does the property owners' perception of the Tennessee Division of Forestry and the National Park Service ability to protect private property from wildfire vary by property type status and socio-demographic characteristics?

Cross-tabulations of property owner's perception of TDF and NPS ability to protect private property from wildfire by property types status and socio-demographic characteristics are shown in Table XIV-1 and Table XIV-2 of Appendix 14. ANOVA and t-tests show no significant difference in the respondents' perceptions of the NPS ability to protect private property from wildfire by property type status and socio-demographic characteristics. For TDF, however, the property owners with annual income less than \$25,000 have rated the TDF high in their effectiveness in protecting private property from wildfire (71%). Only 35-37% of the people with incomes of \$25,000 and above rated TDF high in effectiveness.

4.7 Preference for Reduction Strategies

What is the property owners' preference for education programs and regulations concerning wildfire reduction strategies?

Education

How much interest is there in learning about prescribed burning, mechanical fuel reduction, and defensible space?

Respondents' desire to be informed about specific techniques for reducing wildfire risk is shown in Tables 4.37 and 4.38. Only about one-fourth to one-third (25% to 30%) of the property owners indicated high interest in learning more about prescribed burning, mechanical fuel reduction, and defensible space. The homeowners, however, showed greater interest in learning more about each topic (38% - 45%) than lot owners (15% -

Table 4.37 Homeowners' Interest in Learning about Specific Wildfire Reduction Techniques.

Fire Reduction Techniques	n	Low	Medium	High
Prescribed Burning	82	30.5%	24.4%	45.1%
Mechanical Fuel Reduction	80	36.3%	26.3%	37.5%
Defensible Space	78	32.1%	24.4%	43.6%

Note: 5 point scale: Low = 1 and 2 combine; 3 = Medium; High = 4 and 5 combined.

Table 4.38 Lot Owners' Interest in Learning about Specific Wildfire Reduction Techniques.

Fire Reduction Techniques	n	Low	Medium	High
Prescribed Burning	68	54.4%	26.5%	19.1%
Mechanical Fuel Reduction	66	60.6%	24.2%	15.2%
Defensible Space	68	55.9%	23.5%	20.6%

Note: 5 point scale: Low = 1 and 2 combine; 3 = Medium; High = 4 and 5 combined

21%). More than half of the lot owners (54% – 61%) indicated low interest in learning more (Table 4.38).

Table 4.39 indicates a significant relationship ($p < .05$) between property ownership categories and expression of interest in learning about approaches to risk reduction. Resident homeowners expressed a higher level of interest in learning more about approaches to risk reduction (prescribed burning, mean = 3.34; mechanical fuel reduction, mean = 3.21; and defensible space, mean = 3.22). Those least interested in learning about approaches to risk reduction were lot owners (prescribed burning, mean = 2.34; mechanical fuel reduction, mean = 2.18; and defensible space, mean = 2.37).

Table 4.39 Mean and Standard Deviation of Property Owners' Interest in Learning Specific Fire Reduction Techniques by Property Type Status.

Fire Reduction Techniques	<i>p</i>	Resident Homeowners			Absentee Homeowners			Lot Owners		
		n	Mean	SD	n	Mean	SD	n	Mean	SD
Prescribed Burning	.001	44	3.34	1.35	38	3.16	1.55	68	2.34	1.40
Mechanical Fuel Reduction	.001	43	3.21	1.41	37	2.70	1.45	66	2.18	1.29
Defensible Space	.004	41	3.22	1.46	37	3.14	1.51	68	2.37	1.39

What are the preferred methods for learning more about prescribed burning, mechanical fuel reduction, and defensible space?

When asked about the preferred method of learning more about the above topics, the respondents indicated the highest interest in brochures (50%) and a website (48%) (Table 4.40). Twenty-eight percent (28%) indicated an interest in a telephone hotline, and only 16% preferred a public meeting. Other methods the property owners preferred and listed under comments were: newspaper, visit the community center, classroom type setting, email and education.

Table 4.40 Mean and Standard Deviation of Property Owners' Preferred Method of Learning about Fuel Reduction/Activities.

Media	n	Mean	SD	Low	Medium	High
Brochure	141	3.32	1.48	29.4%	20.6%	50.0%
Website	131	3.05	1.69	39.7%	12.0%	48.3%
Telephone hotline	121	2.25	1.53	62.0%	9.6%	28.4%
Public meeting	124	2.05	1.39	67.2%	16.8%	16.0%

Note: 5 point scale: Low = 1 and 2 combined; Medium = 3; High = 4 and 5 combined.

Government Regulations

What are the property owners' attitudes toward regulations involving preventive measures to enhance homeowners' safety from wildfire?

Wildfire mitigation planning is crucial in the Wildland Urban Interface. To examine public support for different policies, six actions related to preventive measures to enhance homeowner safety from wildfire were presented to see if a county building permit should be required when people want to construct new developments. The scale was "1=should not be required for a permit," "2=should be encouraged through voluntary compliance," "3=should be required for a permit." Greater than 61% of the property owners indicated road signs in new developments made of reflective metal should be required for a permit. Other preventive measures with considerable support were roads accessible to fire trucks in new subdivisions (55%) and a water source for fire control purposes (49%). There was less support for restrictions or limits on construction in areas highly susceptible to

wildfire (38%); a 30 foot fire-safe zone around homes (31%) and Class A fire resistant roofs (24%) (Table 4.41).

The respondents were also asked whether it should be required that homebuyers be informed as part of the real estate transaction process when a home or property is in a fire risk/fire susceptible area. Almost three-fourths (73%) indicated it should be required (indicated 4 or 5 on the scale), while only 10% indicated it should not (indicated 1 or 2) (Table 4.42). The respondents were also asked “When purchasing a home in a fire risk/fire susceptible area, to what extent would you be willing to spend more money on a home with features that make it more fire resistant.” Forty-nine percent (49%) said they were willing to spend more money for a fire resistant home (indicated 4 or 5 on the scale)

Table 4.41 Property Owners’ Attitudes toward Government Regulations.

Regulations	n	Should not be required for a permit	Should be encouraged through voluntary compliance	Should be required for a permit
Road signs in new developments made of reflective metal	131	10.5%	28.3%	61.2%
Roads accessible to fire trucks in new subdivisions.	133	11.4%	33.1%	55.4%
A water source for fire control purpose.	127	14.2%	36.7%	49.1%
A restriction or limit on construction in areas highly susceptible to wildfire.	132	22.6%	39.4%	38.0%
A 30 foot fire-safe zone around a home (defensible space).	130	19.0%	50.4%	30.7%
Class A fire resistant roofs on new construction within the county.	136	20.5%	55.5%	24.0%

Table 4.42 Mean and Standard Deviation of Property Owners' Attitudes toward Real Estate Concerns.

Real Estate Concerns	n	Mean	SD	Low	Medium	High
Required to be informed when home is in fire risk area as part of the real estate transaction.	151	4.04	1.16	10.0%	16.8%	73.2%
Willing to spend more money on fire resistant home.	149	3.39	1.30	22.4%	28.2%	49.4%

Note: 5 point scale: Low = 1 and 2 combined; Medium = 3; High = 4 and 5 combined.

compared to 22% who indicated little willingness to spend money for such features (Table 4.42).

Does support for government regulation vary by property type status and socio-demographic characteristics?

Across each of the six preventive measure items, ANOVA indicates no statistical difference ($p > .05$) among means by property type status and their attitude toward the requirement for a county building permit (Table 4.43).

Examining the cross-tabulation in Table XV-1 to XV-6 of Appendix 15, it appears socio-demographic characteristics can be related to the respondents' attitudes toward the requirement of a county building permit. Age appears highly correlated with the requirement of the preventive measures, with older people being most favorable. The

support for government regulations also appears to be positively related to one's education level and income.

Table 4.43 Mean and Standard Deviation of Attitude toward Preventive Measures by Property Type Status in Rank order of Resident Homeowner's Attitudes.

Regulations	Resident Homeowners (n = 44)		Absentee Homeowners (n = 38)		Lot Owners (n = 57)	
	Mean	SD	Mean	SD	Mean	SD
Road signs in new developments made of reflective metal	2.59	0.62	2.39	0.77	2.53	0.66
Roads accessible to fire trucks on new subdivisions.	2.37	0.76	2.39	0.77	2.49	0.63
A water source for fire control purpose.	2.33	0.78	2.43	0.82	2.32	0.64
A restriction or limit on construction in areas highly susceptible to wildfire.	2.29	0.81	2.03	0.80	2.16	0.73
Class A fire resistant roofs on new construction within the county.	2.02	0.70	1.97	0.64	2.07	0.68
A 30 foot fire-safe zone around a home (defensible space).	1.98	0.67	2.03	0.75	2.23	0.67

Note: ($p > .05$)

5. SUMMARY AND DISCUSSION

5.1 Summary

The growing Wildland Urban Interface (WUI) community in the Chilhowee Mountain area of Blount County, Tennessee, like many other forested areas in the mountains and hills of East Tennessee, was identified by the staff of the Tennessee Division of Forestry (TDF) as being a high risk area for wildfire. With housing developments increasing in the area in the near future, there will be an ever-growing threat to homeowners from wildfire. Decision makers and TDF staff concerned with developing policies to reduce the threat of wildfire understand their success depends on the support of property owners and their willingness to implement risk reduction activities to decrease wildfire risk on their properties and communal areas.

The purpose of this dissertation was to assess actual wildfire risk in the Chilhowee Mountain area of Blount County and to identify the property owners' perceptions of wildfire risk and reduction strategies in the communities of Campers Paradise, Happy Valley, and Top of the World, as well as their preferences for wildfire education programs and reduction activities. The findings are intended to help managers and decisions makers better understand how to facilitate fire protection and mitigation in the area.

A mail survey was sent to the 474 property owners in the Chilhowee Mountain area that were identified from the Blount County property tax records. The survey contained 33 questions related to property characteristics, residential status, experiences with wildfire, fire risk perception, and preferences for wildfire reduction strategies as well as demographic information. A total of 159 property owners participated in the survey with an overall response rate of 35%. The response rate for resident homeowners was 51%, 36% for absentee homeowners and 28% for lot owners. The data were weighted to represent the correct proportion of the three property groups. Men outnumbered women respondents 63% to 37%. The data gathered were analyzed using SPSS 15.0 for Windows. One-tailed bivariate correlation was performed to examine the strength of the relationship between perception of fire risk and their engagement in fire risk reduction activities. T-tests and ANOVA were performed where mean values were computed.

The FARSITE fire simulator was used to make a preliminary assessment of wildfire risk in the Chilhowee Mountain area and to determine its potential use in the future. FARSITE provides the rate of burn and the size of the burn area in relation to weather conditions. The greater the speed a wildfire moves across the landscape, the larger the burn area will be for a specified time period and the greater the risk will be to home and property owners.

Actual risk of wildfire

What is the actual risk of wildfire?

Three ignition points on Chilhowee Mountain were selected for the FARSITE fire simulation based on fires that actually occurred in the study area in the spring and summer of 2007. It produced data for wildfire behavior at all three locations within the study area under normal and extreme weather conditions. The average area burned under normal conditions for the April 20th fire over 71 hours was 0.57 ac/hr, whereas the average area burned under extreme weather conditions was 189.08 ac/hr. One house and 5 acres in the Top of the World community also burned during the May 1st fire. Based on the simulation for the May 1st fire, the average area burned under normal conditions over 71 hours was 1.41 ac/hr, compared to 212.99 ac/hr burned under extreme weather conditions. For the August 25th to 31st fire, the average area burned under normal conditions over 152 hours was 2.22 ac/hr, whereas the average area burned under extreme weather conditions was 259.33 ac/hr or a total of 39,416 acres. While these simulation results suggest wildfire risk is a major concern, results would be more robust if fuel models were available for this area of the eastern U.S. (as opposed to the current western fuel models) and if the simulation was replicated multiple times with a variety of ignition points and under diverse weather conditions.

In determining the property characteristics related to wildfire risk, there is no fire station and there are no fire hydrants in the study area. The only water source for firefighters is a small lake. Thirty-six percent (38%) of the property owners have vegetation within 30

feet of their home that keep their leaves year-round, for example pine, mountain laurel, and rhododendron, which are more prone to wildfire, or mixed vegetation (some drop their leaves and others keep their leaves). Since rhododendron and pine contain oil and are prone to fire, particularly in dry winters, more than one-third (38%) of the homeowners are at a greater risk of a wildfire. Thirty-eight (38%) of the respondents also have numerous trees, ground vegetation and leaves within 30 feet of their home, which also increases their wildfire risk. Only 17% had removed almost all trees, shrubs and vines next to their homes.

In summary, the Chilhowee Mountain area is a high risk area for wildfire given the species composition of the area, the terrain, the somewhat diminished fire fighting capability (no fire hydrants and distance to a fire station) and the type and amount of vegetation close to people's homes. This high risk assessment was further confirmed by three actual wildfires that occurred in the area in the months after the survey was completed, including the burning of one home.

Property owners' characteristics

What are the characteristics of the property owners in the wildfire risk zone?

There are three property type categories: resident homeowners who live full time, year-round on Chilhowee Mountain, absentee homeowners who own a vacation home, and simply lot owners. Forty-two percent (42%) of all property owners had a home on their land and were almost evenly divided between resident homeowners (54%) and absentee

homeowners (46%). A little over one in five homeowners (23%) do not have insurance on their property. This may be due to high insurance rates when there is no fire hydrant or fire station nearby (as is the case on Chilhowee Mountain). Approximately 50% also have a barn or shed on their property, and some owners have trailers and campers as well. Overall, acreage owned is fairly small with 75% owning three acres or less.

There are a significant number of newcomers in the area since one-third purchased their land in the last six years. Eighty-one percent (81%) of the absentee homeowners spend more than one month per year at their vacation homes and 41% spend more than two months. Property owners tend to be older, well educated with higher incomes. One in four homes has someone with a breathing problem.

Past Experience

What is the property owners' past experience with wildfire and fire reduction activities?

Overall, property owners have some experience with wildfire, but few have experienced a significant wildfire event, such as a wildfire occurring near their home (24%) or felt fear or anxiety as a result of a wildfire (12%). Not surprisingly, residents had more experience with wildfire and engaged in more fire reduction activities than other owner categories.

In terms of wildfire reduction activities, about half of the respondents had removed vegetation from their property to protect their home from fire or read information about

protecting their home from wildfire. On the other hand, only 13% of the respondents had worked with the local fire department on community fire protection and only 8% had attended a public meeting about wildfire. About one in five were familiar with outreach efforts by the Tennessee Division of Forestry or the Firewise Communities program.

Perception of wildfire risk

What is the property owners' perception of wildfire risk?

Almost half (48%) indicated they did not consider the possibility of wildfire at all when they bought their home, with 5% having considered wildfire very much a possibility. Less than half (42%) of the homeowners were highly concerned a wildfire could change the quality of their lives and only about one in four were "Extremely concerned." Homeowners' perception of risk severity (3.87) was somewhat higher than their perception of risk vulnerability (3.36) or their overall level of concern (3.20). This seems to indicate homeowners do not see a wildfire affecting them personally as much as affecting their property or possessions in the Chilhowee Mountain area. As predicted by Protection Motivation Theory (Rogers 1983), perceived risk severity and risk vulnerability are positively correlated with engagement in fire risk reduction behaviors. Those who rate risks higher tend to engage in more risk reduction behaviors. Past experience with wildfire, however, had no relationship to the respondents' perception of wildfire risk, nor did age.

Perception of reduction activities

What is the property owners' perception of wildfire risk reduction activities?

The homeowners' perception of the effectiveness of fire reduction activities (response efficacy) was moderate to high with the range of means between 3.28 to 4.55 for resident homeowners and 3.26 to 3.97 for absentee homeowners. Scoring relatively high in effectiveness were making their home easily identifiable and accessible by road, removing leaves and branches from their roof and having a fire resistant roof. The lowest scores in effectiveness were working with neighbors to clean common areas and implementing county and local ordinances requiring accessibility, fire retardant construction materials and other Firewise practices.

Homeowners were quite confident in their ability (self-efficacy) to remove leaves and branches from their roof, make their home identifiable and accessible from the main road and to stack firewood 30 ft. away from their home. Working with neighbors and contacting their local fire department for a fire safety inspection were ranked lowest in confidence as far as their ability to implement these activities. Property owners in the 22-50 age category had a much higher reported self-efficacy than respondents older than 70 years of age, who report the lowest self-efficacy of any age category. As people get older, they tend to may feel more vulnerable and less able to protect their property.

There was no statistical difference among property ownership categories and their perceptions of the Tennessee Division of Forestry and the National Park Service. Forty-

four percent (44%) agreed both the TDF and the NPS do a good job protecting private property from wildfires, while less than one-quarter disagreed. Almost half (47%) felt the TDF and NPS were doing a good job in communicating with the public about forest issues.

Preference for wildfire reduction strategies

What are the property owners' preferences for education programs and regulations concerning wildfire reduction strategies?

A significant number of homeowners show fairly high interest in learning about prescribed burning (45%), defensible space (44%) and mechanical fuel reduction (38%) compared to about one third who show little or no interest. The preferred methods for learning about these risk aversion techniques were through brochures (50% of respondents) and websites (48%). A telephone hotline (28%) and public meetings (16%) were not preferred methods.

Overall, homeowners, regardless of ownership category, tend to be more in favor of county planning measures that do not transfer the costs directly to themselves, i.e., road signs in new developments (61%), road accessibility to fire trucks (55%) and having a water source (49%). They were less favorable toward those measures that restrict their opportunities or transfer costs directly to themselves: restricting construction in areas highly susceptible to wildfire (38%), requiring Class A fire resistant roofs on new construction (24%), or enforcing a 30-foot defensible space around housing (31%).

There were no differences between resident homeowners, absentee homeowners or lot owners in their support or lack of support for restrictive permitting for wildfire mitigation planning.

On the other hand, more than 70% of the homeowners indicated it should be required that potential buyers be notified in real estate transactions whether a property is in an area with a high wildfire risk or susceptibility. Almost half (49%) were also generally willing to spend more money for a fire-resistant home.

5.2 Discussion

As the Wildland Urban Interface has continued to grow, the difficulty of preventing property loss or damage by wildfire has significantly increased. The human dimensions of fire management are very complex and attitudes and perceptions vary across numerous variables. It is important to keep in mind that knowledge of and experience with wildfire and fuels management also vary across WUI communities in different regions of the United States. There has been very little research conducted on the knowledge, attitudes and behaviors of homeowners toward fire management in the southeast, especially in Tennessee. People's perceptions of fire risks to their health or personal property affect their opinion about fire and the ways they manage their property. This study helped identify patterns of human response to wildfire to aid managers in designing more effective fire mitigation strategies in the Chilhowee Mountain area of Blount County.

Protection Motivation Theory

According to Protection Motivation Theory (PMT), people can be motivated to engage in desirable risk reduction activities not only to avoid risk from wildfire but also to avoid social or interpersonal risk (Rogers 1983). Outside sources of information, such as TDF or other media, about wildfire initiate appraisals of the fire threat and possible coping actions. According to the model (Figure 2.2), people's desire to live by the forest and natural amenities and to enjoy the status of having a vacation home in the woods decreases their perception of wildfire risk severity and risk vulnerability. This leads to a maladaptive response, that is, a lower threat appraisal. Other studies have found past experience with wildfire is a major factor influencing respondents' perception of fire risk (Blanchard and Ryan 2007, Cortner et al. 2003, Schultz 2002). This appears to not be the case in this study as there was no significant relationship between perception of risk severity or risk vulnerability and past experience with wildfire. Understanding the communities enables managers to identify areas where such conflicting perceptions may exist. For example, homeowners who value shade, privacy and nature amenities may believe creating defensible space will run counter to their preferences as indicated in the PMT (Figure 2.2). On the other hand, as predicted by the theory, property owners' assessment of risk severity and risk vulnerability was positively correlated with their engagement in fire risk reduction behaviors.

Although the property owners' perceptions of risk severity and risk vulnerability were moderate, their perception of risk severity was higher than risk vulnerability.

Homeowners did not see a wildfire affecting them personally as much as affecting their property or possessions where they. While people's motivations or intentions to protect themselves from threat are affected by four critical perceptions, risk severity, risk vulnerability, self-efficacy and response efficacy, their intentions are weakened by the perceived costs of the risk reduction behaviors (Rogers 1983). Vacation home/not living there and cost were listed as the most critical obstacles to implementing protective measures, but also listed were age/physical ability, lack of fire fighting equipment/water or equipment for clearing, time, so much one can do, and neighbors/others pose risks. Those property owners with annual income of less than \$25,000, for whom costs would be more of a burden, rated the Tennessee Division of Forestry highest in effectiveness in protecting private property from wildfire.

The property owners generally believe the wildfire risk reduction activities are effective (response efficacy) and they are also generally confident in their ability to perform the risk reduction behaviors. Response costs (obstacles), however, may prevent them from performing these reduction activities, thus lowering the appraisal of their ability to actually implement coping actions to protect their home and property. They also believe the Tennessee Division of Forestry and the National Park Service are doing a good job of protecting their property from wildfire. The belief that someone else will protect them from wildfire may lead to a lack of motivation as well. Therefore, it is important to provide property owners more information on wildfire risk and risk reduction activities to help protect their lives and property from wildfire.

Education

Almost half of the property owners did not consider the possibility of wildfire risk at all when they bought their property and only one in five were extremely concerned a wildfire could change the quality of their lives. This is cause for considerable concern as to how to motivate property owners to engage in protective behaviors. Even though approximately half of the property owners indicated an interest in learning about fire risk reduction techniques, it is the Tennessee Division of Forestry's and related agencies' challenge to work with the communities and get them involved, particularly when the property owners' preferred method of learning did not involve personal contact. Not only is it important to provide information on wildfire risk and risk mitigation to residents, but also to absentee homeowners and lot owners. People preferred learning about wildfire reduction techniques from a brochure or website and significantly less from a telephone-hotline or public meetings. This is consistent with the Tennessee Division of Forestry's experience with conducting public meetings about wildfire protection in the past, which were poorly attended (T. Dailey and N. Waters, pers. comm., 2006).

FARSITE fire area simulator used in this study may be a useful educational tool in the development of a decision support system for facilitating fire protection planning within the communities. In this situation, the first and most important step is to get the community to recognize there is a significant threat from wildfire. This is often the most difficult part of the educational process. The wildfire simulations may make the risk more real to the homeowners and increase their threat appraisal, particularly under extreme weather conditions. FARSITE fire area simulation can be used to educate the

residents in the Chilhowee Mountain area during their annual community association annual meeting.

It might also be more effective for a multi-agency team to help a community to recognize the wildfire risk by having the property owners hear the message from multiple sources. An obvious time to educate property owners is when someone in the community initiates contact with an agency seeking guidance in dealing with wildfire issues. Getting the community to recognize and take ownership of their fire problem is crucial.

Moreover, understanding and developing a relationship with a community is important to determining how to move forward in the education process. The socio-demographics and pattern of the public response to wildfire in this study may help fire agencies in the initial stages of developing a relationship with a target community. The agency representative may be able to enact an ordinance that requires fire resistant roofing materials on new construction or other Firewise practices. Otherwise, they may only be able to suggest agency representatives work hard on outreach approaches in the community. In order to reach a community, agency personnel might schedule a presentation as part of regularly attended community board meetings, which will not require any extra time from community members.

Regulation

Property owners clearly believe (73%) potential buyers should be informed about wildfire risk in the area when they are considering buying property. Only half of them, however, indicated they were very willing to spend more money for a fire resistant home. The homeowners do tend to be more in favor of county protective measures that do not transfer costs directly to them, such as road signs in new developments made of reflective metal, roads accessible to fire trucks in new subdivisions and a water source for fire control purposes. They are less favorable toward those measures that transfer costs more directly to themselves: restricting construction in areas highly susceptible to wildfire, requiring Class A fire resistant roofs on new construction, or enforcing a 30-foot defensible space around housing.

Since protection motivation in the Chilhowee Mountain area is lower than experts believe it should be based on the potential risk, it may be left to the local government to implement stricter regulations to protect homeowners from wildfire. While fire-resistant roofs may not cost more than asphalt shingle roofs, homeowners may not want to use metal roofing unless it is required. Nevertheless, support for stricter regulations may not emerge until a serious fire with extensive damage or loss of life occurs.

Collaboration

Very few property owners indicated having worked with a local fire department or attending a public meeting. However, the most important point in wildfire risk mitigation efforts is sharing responsibility. There is a need for communication and cooperation among people in at risk communities and various agencies that have the technical expertise and responsibility for developing and implementing strategies for preventing and suppressing wildfires, including the development of land use plans, and providing wildfire protection for community residents.

Public agencies

There is a considerable need for local fire people from TDF, NPS-GSMNP, the Blount County fire department and fire volunteers as well as the county planning department to work collaboratively in order to develop effective wildfire protection programs in communities like Chilhowee Mountain. With a multi-agency team, a strong, coordinated message can be delivered to WUI communities and the issue can be addressed from several perspectives. It may also become apparent to the residents when speaking with various agency staff that there really is a wildfire issue. As knowledge and understanding increases, residents are more likely to accept mitigation strategies. In addition, public natural resource agencies should consider the potential to coordinate with other public agencies, such as those concerned with economics and community development, planning, transportation, and health, in developing education programs across several disciplines that would include components of wildfire education. Residents may be more

likely to be engaged if education programs addressed multiple interests as opposed to only those regarding wildfire risk.

Neighbors/community members

It appears working with neighbors is perceived to be a challenge among the homeowners in this study. Getting people with diverse interests and assets to the table can be difficult. It is essential that they all feel they have something to gain in order to invest, share, and compromise. For wildfire risk mitigation to be effective over the long run, a community must be able to sustain involvement in wildfire risk reduction strategies/activities into the future. As fire agencies and related resources cannot be there all the time, communities need to recognize and maintain their shared responsibility for wildfire risk mitigation. People trained in collaboration techniques, however, may be needed to help facilitate these processes.

Incentive Programs

Another approach to mitigating the risk of wildfire is for TDF, NPS and other agencies to promote a variety of programs for strengthening wildfire risk reduction activities using incentives. Incentives can increase motivation to perform a fire reduction activity or to perform it more effectively. The Firewise Communities program, combined with incentives, can encourage residents to engage in protective behaviors, such as creating defensible space around their homes, replacing their roofs with metal, or placing fire proof material underneath decks. Prizes, raffles, and recognition for Firewise landscapes

are examples of incentive programs. Incentive programs are often used to mobilize social change because they help raise awareness and generate individual actions. Recognition among neighbors may affect social norms in their communities and encourage others to use protective measures (Boyce and Geller 2000).

5.3 Recommendations for Future Work

One limitation of this study was the relatively small population size (474) which constrained the number of possible surveys returned. If repeated, the study would be more robust if there were more or larger communities with a larger number of survey participants. Implementing this study over several communities would provide a clearer picture of the similarities and variations across communities in wildfire risk zones in East Tennessee.

Additional research using FARSITE with fuel models for the eastern U.S. and multiple simulations is recommended. This approach would provide more valid data on actual fire risk. A related research project would be to use FARSITE at community meetings to simulate wildfire risk to homeowners and then determine its effect on their protection motivation.

In future research, the integration of fire simulation and socio-demographic analysis could be used at the local level to study wildfire protection in Thailand, my home country.

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APPENDICES

Appendix 1

Fire Danger Rating System

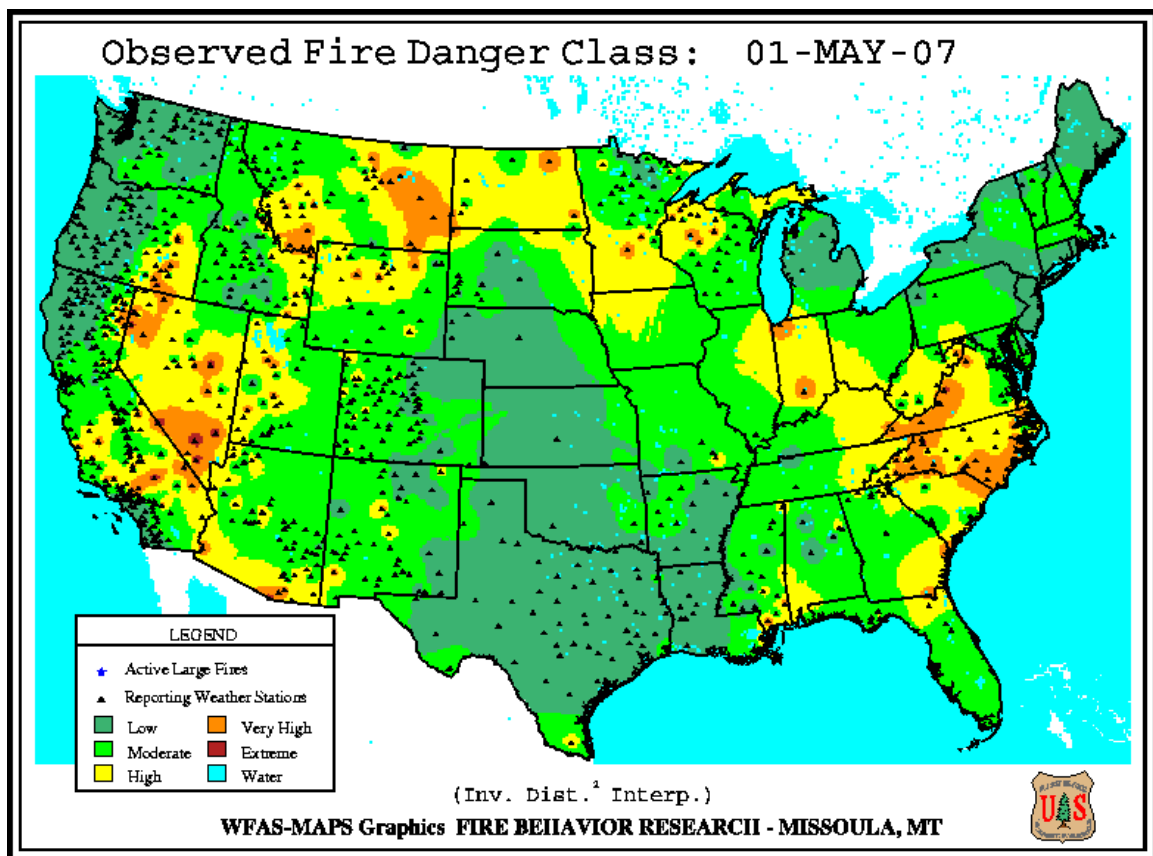


Figure I 1 Fire Danger Rating System on May 1, 2007 (U.S. Forest Service – Wildland Fire Assessment System http://www.fs.fed.us/cgi-bin/html_driver.cgi?year=2007&month=05&day=01&type=FD).

Appendix 2

Lower Atmosphere Stability Index

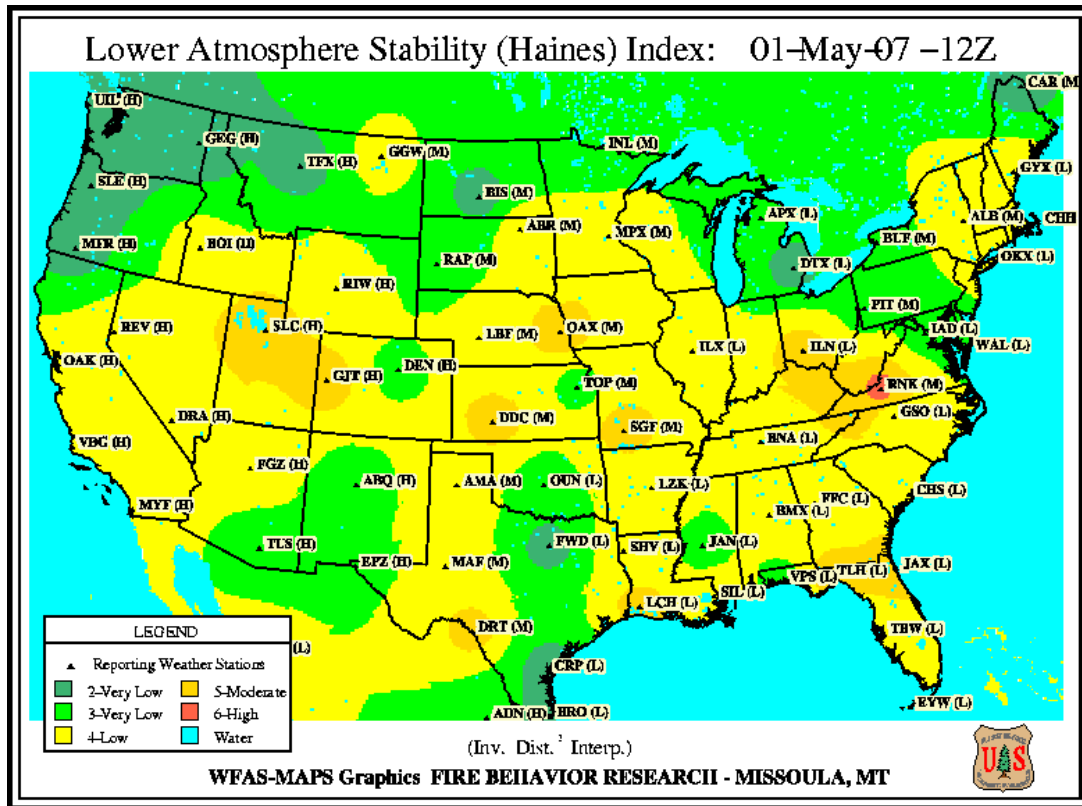


Figure II 1 Haines Index on May 1, 2007.

It is used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire. It is calculated by combining the stability and moisture content of the lower atmosphere into a number that correlates well with large fire growth. The stability term is determined by the temperature difference between two atmospheric layers; the moisture term is determined by the temperature and dew point difference. This index has been shown to be correlated with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior U.S. Forest Service –Wildland Fire Assessment System http://www.fs.fed.us/cgi-bin/html_driver.cgi?year=2007&month=05&day=01&type=HA). The Haines Index can range between 2 and 6. The drier and more unstable the lower atmosphere is, the higher the index.

2 : Very Low Potential -- (Moist Stable Lower Atmosphere); 3 : Very Low Potential
4 : Low Potential; 5 : Moderate Potential;
6 : High Potential ----- (Dry Unstable Lower Atmosphere)

Appendix 3

University of Tennessee Human Subjects (FORM A)

FORM A

IRB # _____

Certification for Exemption from IRB Review for Research Involving Human Subjects

A. PRINCIPAL INVESTIGATOR:

Piyarat Chimchome and Dr. Mark Fly

B. DEPARTMENT:

Forestry, Wildlife & Fisheries

C. COMPLETE MAILING ADDRESS AND PHONE NUMBER OF PI(s):

University of Tennessee
Dept. of Forestry, Wildlife & Fisheries
2431 Joe Johnson Rd.
274 Ellington Plant Science Bldg.
Knoxville, TN 37996-4563

Phone: (865) 974-7126

E-mail: noina@utk.edu and markfly@utk.edu

D. TITLE OF PROJECT:

Assessment of Fire Risk and Community Wildfire Management Planning in the Wildland Urban Interface of the Chilhowee Mountain Area of Blount County: A Case Study

E. EXTERNAL FUNDING AGENCY:

None

F. GRANT SUBMISSION DEADLINE:

None

G. STARTING DATE:

Upon IRB Approval

H. ESTIMATED COMPLETION DATE:

December 31, 2010

I. RESEARCH PROJECT:

1. Objectives of the Project

The objective of this project is to develop a greater understanding of property owners' knowledge, behavior, perceptions, attitudes and preferences related to wildfire risk in the Chilhowee Mountain area of Blount County, Tennessee. This knowledge can then be used by states, local, and federal agencies to develop and implement programs to encourage and facilitate fire protection activities by property owners.

2. Subjects

Approximately 490 people who own property in the Campers Paradise, Happy Valley, and Top of the World communities in the Chilhowie Mountain area of Blount County will be surveyed. Names and addresses have been obtained from Blount County property tax records.

3. Methods or Procedures

The attached mail questionnaire will be sent to each property owner. They will be asked questions about property characteristics (size, structures, vegetation, and landscape management), experiences with and actions taken concerning wildfire, perceptions of risk and effective actions, government services, including preferences for regulatory action and education, and demographics.

To maintain confidentiality, an identifying number will be used to track surveys but at no time will the name of the person completing the survey appear directly on the survey. This will allow us to determine if a participant has already returned their survey so reminders will not be sent to a participant who has already returned their survey. The name and address database will be kept separately from the data. Once the surveys are returned, the code number will be deleted from the name and address list so the data can no longer be associated with the participant. Responses will be aggregated for analysis purposes and at no time will individual responses be associated with a participant.

The list of participants and associated ID numbers will only be accessible to the research staff, Becky Stephens, Senior Research Associate, April Griffin, Senior Research Technician, and Liz Didier, Research Associate and will be stored in room 240 of the Plant Biotechnology Building, which is a locked room. The risk to participants in this study is minimal and not considered to be any greater than ordinarily encountered in daily life. The survey does not deal with sensitive subjects or behavior. The survey does not involve information that might place the subjects at risk for civil or criminal liability, nor could the information be damaging to the participants' reputation or financial or job standing. Participation in the study is voluntary and participants may refuse to answer any questions at any time.

4. CATEGORY FOR EXEMPT RESEARCH PER 45 CFR 46.101(b) 2

J. CERTIFICATION: The research described herein is in compliance with 45 CFR 46.101(b) and presents subjects with no more than minimal risk as defined by applicable regulations.

Principal Investigator: Piyyarat Chimchome

_____ (signature)_____ (date)

Student Advisor:

Dr. Mark Fly

_____ (signature)_____ (date)

Dept. Review

Committee Chair

Dr. Don Hodges

_____ (signature)_____ (date)

APPROVED:

Dept. Head

Dr. Larry Wilson

_____ (signature)_____ (date)

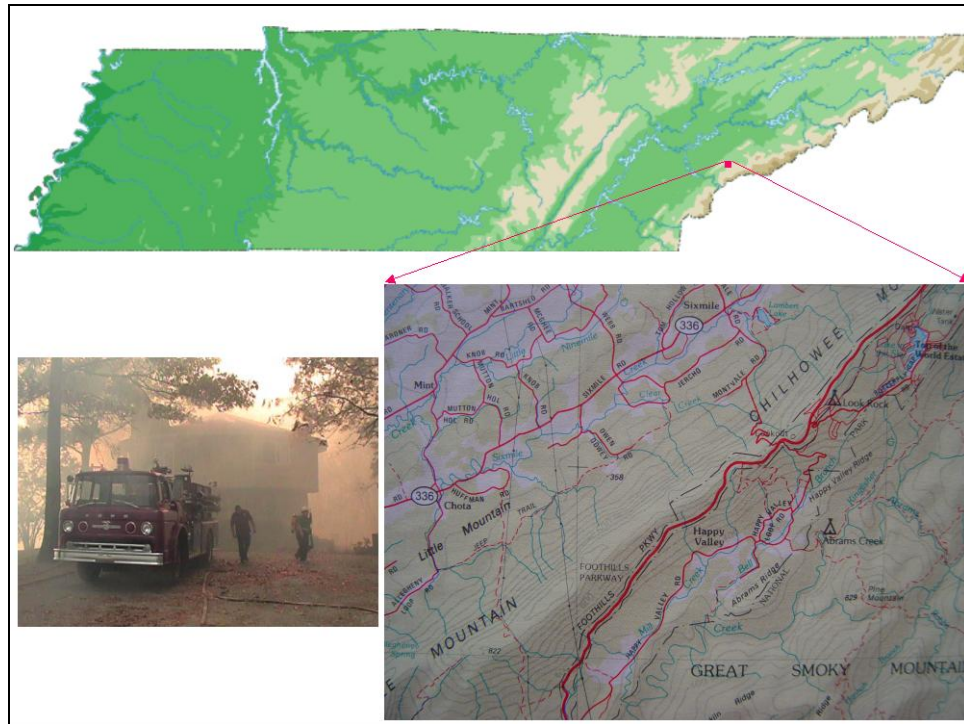
**COPY OF THIS COMPLETED FORM MUST BE SENT TO COMPLIANCE OFFICE
IMMEDIATELY UPON COMPLETION**

Appendix 4

Questionnaire

HOMEOWNER SURVEY: WILDFIRE RISK

In the Chilhowee Mountain Area of Blount County



The University of Tennessee

Department of Forestry, Wildlife & Fisheries

The University of Tennessee Department of Forestry, Wildlife, and Fisheries is surveying property owner opinions of wildfire risk in the Chilhowee Mountain area of Blount County, Tennessee, including Top of the World, Campers Paradise, and Happy Valley communities. Your participation is voluntary and your responses are strictly confidential. The information you provide will not be associated with your name.

We would like to begin by asking you some questions about your residence.

1. Which of the following statements best describes your residential status in the Chilhowee Mountain area of Blount County?

(Please ✓ one)

- ☐ I am a full-time, year-round homeowner and resident on Chilhowee Mountain.
- ☐ I am a full-time, year-round renter on Chilhowee Mountain.
- ☐ I own a vacation home on Chilhowee Mountain. (Please continue with 1a.)
- 1a. How many months/weeks per year do you live in this vacation home?
_____ months or _____ weeks
- 1b. Do you plan to move to this vacation home? _____ Yes _____ No
(IF YES) In what year? 20 ____
- 1c. What is the zip code for your primary/current residence?
_____ zip code
- ☐ None of the above describes my residential status on Chilhowee Mountain.
Please explain:_____

2. What year did you acquire, through ownership or as a rental, your property in the Chilhowee Mountain area of Blount County?

19 ____ or 200 ____

3. How many acres do you own or rent in the Chilhowee Mountain area?

- | | |
|---|---|
| ☐ 1 acre or less | ☐ 6 – 10 acres |
| ☐ 2 acres | ☐ 11 – 15 acres |
| ☐ 3 acres | ☐ 16 – 25 acres |
| ☐ 4 acres | ☐ 26 – 50 acres |
| ☐ 5 acres | ☐ More than 50 acres |
| | ☐ Don't know |

4. Is there a fire hydrant close enough to your property to use a fire hose to fight a fire (within 500 feet)?

☐ Yes ☐ No

- 4a. IF NO, what is the distance from your property to a water source, such as a fire hydrant, pond/lake or stream, firefighters could use?

☐ Less than ½ mile ☐ 5.1 – 10 miles
☐ 0.51 - 1 mile ☐ Over 10 miles
☐ 1.1 - 5 miles ☐ Don't know

5. Do you have any of the following on your property in the Chilhowee Mountain area of Blount County? IF YES, is it covered by fire insurance?

My Property Has a:		Is it Covered by Fire Insurance?
☐ Home/house	→ ☐ Yes ☐ No	
☐ Barn	→ ☐ Yes ☐ No	
☐ Shed	→ ☐ Yes ☐ No	
☐ Trailer	→ ☐ Yes ☐ No	
☐ Camper	→ ☐ Yes ☐ No	

If you do not have a home in the Chilhowee Mountain area, please GO TO Q8.

6. Is the shrubby/brushy vegetation within 30 feet of your home on Chilhowee Mountain primarily..... (Please ✓ all that apply)

☐ the kind that drops its leaves in the fall (like dogwood, red bud, oak, black gum, sourwood, sumac, witch-hazel, and serviceberry)?
☐ the kind that keeps its leaves year-round (like laurel, rhododendron and pine)?
☐ There is no shrubby/brushy vegetation within 30 feet of my home.
☐ Don't know

7. Which one of the following statements best describes your yard/landscape within 30 feet of your home in the Chilhowee Mountain area? (Please ✓ one)

☐ There are numerous trees, ground vegetation and leaves next to and around my home.
☐ There are numerous trees next to my home, but leaves, shrubs and vines have mostly been removed.
☐ There are a few trees next to my home, but shrubs and vines have been removed
☐ Almost all trees, shrubs and vines next to and around my home have been removed.

Next, we would like to know about your experiences and thoughts about fire.

8. Which of the following fire related experiences have you had at any time in your life?

(Please ✓ all that apply)

- ☐ Been injured or suffered property damage from a **wildfire**. (See green sheet for "Definition of Terms" reference sheet)
 - ☐ A wildfire has occurred near my home.
 - ☐ A **prescribed burn** has occurred near my home.
 - ☐ A **mechanical fuel reduction** to decrease wildfire fuels has occurred near my home.
 - ☐ Experienced a road closure due to wildfire.
 - ☐ Been required to remove flammable vegetation on my property.
 - ☐ Friends, family and/or neighbors suffered property damage due to wildfire.
 - ☐ Personally witnessed a wildfire.
 - ☐ Experienced discomfort from smoke caused by wildfire.
 - ☐ Felt fear or anxiety as a result of a wildfire.
 - ☐ I have experienced none of the items listed above in my life.
 - ☐ Other fire experience (Please describe):
-
-

9. Which of the following actions have you taken at any time in your life?

(Please ✓ all that apply)

- ☐ Asked local fire officials about how to reduce risk of property damage from wildfire.
- ☐ Read information on protecting homes from wildfires.
- ☐ Attended a park or forest interpretive program about wildfire.
- ☐ Attended a public meeting about wildfire.
- ☐ Observed neighbors being careless with their outdoor burning.
- ☐ Called authorities about neighbors being careless with their outdoor burning.
- ☐ Observed the effects of fires on forests and **wildlands**.
- ☐ Worked with local fire department on neighborhood and community fire protection.
- ☐ Evacuated my home or office due to wildfire.
- ☐ Worked with wildfires as a part of my job or as a volunteer.
- ☐ Removed vegetation on my property to protect my home from fire.
- ☐ Removed vegetation on my property for reasons other than fire.
- ☐ I have not taken any of the actions listed above in the past.

9a. Please list other actions you have taken to help reduce the risk of fire in the Chilhowee Mountain area impacting your property and lives, if any.

10. How concerned are you a wildfire in the Chilhowee Mountain area could change your quality of life? (Please circle one number)

Not at all concerned ----- Extremely concerned
1 2 3 4 5

11. How serious do you feel the negative consequences of wildfires in the Chilhowee Mountain area would be to you personally?

Not at all serious ----- Extremely serious
1 2 3 4 5

12. How severe would the impact of a wildfire be where you live in the Chilhowee Mountain area?

No harm at all ----- Extremely devastating
1 2 3 4 5

13. How vulnerable do you feel about the possibility of a wildfire in the Chilhowee Mountain area physically affecting you or your family?

Not at all vulnerable ----- Extremely vulnerable
1 2 3 4 5

14. How vulnerable do you feel about the possibility of a wildfire physically affecting your property or possessions in the Chilhowee Mountain area?

Not at all vulnerable ----- Extremely vulnerable
1 2 3 4 5

15. How effective would the following actions be at helping to reduce the risk of fire impacting your property and lives in the Chilhowee Mountain area?

(Please circle one number for each statement; DK = "Don't Know")

	Not at all Effective			Very Effective	DK	
a. Making sure all the trees on or near your property are away from utility lines	1	2	3	4	5	9
b. Working with neighbors to clear common areas and prune areas of heavy vegetation.	1	2	3	4	5	9
c. County or Local ordinances requiring accessibility, fire retardant construction materials, and other Firewise practices.....	1	2	3	4	5	9
d. County or Local ordinance requiring realtors to provide wildfire prevention information to new homeowners	1	2	3	4	5	9

If you do not have a structure or a home in the Chilhowee Mountain area, GO TO Q16.

e. Making sure all the trees on or near your property are away from structures ...	1	2	3	4	5	9
f. Stacking firewood and scrap wood piles at least 30 feet from any structure	1	2	3	4	5	9

If you do not have a home in the Chilhowee Mountain area, GO TO Q16.

g. Contacting your local fire department to get a personal fire safety inspection at your home and property	1	2	3	4	5	9
h. Removing flammable vegetation/brush/ leaves within 30 feet of your home	1	2	3	4	5	9
i. Planting low-growing, fire resistant plants around your home	1	2	3	4	5	9
j. Putting a fire <u>resistant</u> roof on your home	1 2	3	4	5	9	
k. Removing any dead branches/leaves/ pine needles from your home's roof and around the chimney	1	2	3	4	5	9
l. Making sure your home is easily identifiable and accessible from a main road	1	2	3	4	5	9
m. Putting fire <u>resistant</u> barriers to the under-sides of any decks/balconies on your home	1	2	3	4	5	9
☐ I do not have deck or balcony.						

16. How confident do you feel in your ability to do the following?

(Please circle one number for each statement; DK = "Don't Know")

	Not at all Confident		Confident	Very DK		
a. Make sure all the trees on or near your property are away from utility lines.....	1	2	3	4	5	9
b. Work with neighbors to clear common areas and prune areas of heavy vegetation.....	1	2	3	4	5	9
c. Assess what you need to do to protect your property from wildfire	1	2	3	4	5	9
d. Contact your local fire department to get a personal fire safety inspection at your home and property	1	2	3	4	5	9

If you do not have a structure or a home in the Chilhowee Mountain area, GO TO Q17.

e. Make sure all the trees on or near your property are away from structures	1	2	3	4	5	9
f. Stack firewood and scrap wood piles at least 30 feet from any structure.....	1	2	3	4	5	9

If you do not have a home in the Chilhowee Mountain area, GO TO Q17.

g. Remove flammable vegetation/brush/leaves within 30 feet of your home.....	1	2	3	4	5	9
h. Plant low-growing, fire resistant plants around your home	1	2	3	4	5	9
i. Put a fire <u>resistant</u> roof on your home	1	2	3	4	5	9
j. Remove any dead branches/leaves/ pine needles from your home's roof and around the chimney	1	2	3	4	5	9
k. Make sure your home is easily identifiable and accessible from a main road	1	2	3	4	5	9
l. Put fire <u>resistant</u> barriers to the undersides of any decks/balconies on your home	1	2	3	4	5	9
☐ I do not have deck or balcony						

17. What would be your biggest obstacle to taking some of the actions listed in Q16 to protect your property from the impact of wildfire?

18. How confident do you feel in general about your ability to protect yourself and your property from wildfire?

Not at all confident ----- Very confident
1 2 3 4 5

19. To what extent do you agree or disagree with the following statements about government agencies in your area involved in land and resource management?

(Please circle one number for each statement; DK = "Don't Know")

	Strongly Disagree		Neutral		Strongly Agree	DK
a. The National Park Service does a good job communicating with the public about forest issues	1	2	3	4	5	9
b. The National Park Service does a good job of protecting private property from wildfires	1	2	3	4	5	9
c. I trust the National Park Service to make the proper decisions about the use of prescribed burning	1	2	3	4	5	9
d. The National Park Service does a good job of notifying the public about upcoming prescribed burns	1	2	3	4	5	9
e. The Tennessee Division of Forestry does a good job communicating with the public about forest issues	1	2	3	4	5	9
f. The Tennessee Division of Forestry does a good job of protecting private property from wildfires.....	1	2	3	4	5	9

20. The following actions are several preventive measures to enhance homeowner safety from wildfires. To construct a new building in Blount County, a county permit must be obtained. Should the preventive measures listed below be a requirement for a county building permit?

(Please circle one number for each statement; DK = "Don't Know")

	Should Not be Required For a Permit	Should be Encouraged Through Voluntary Compliance	Should be Required For a Permit	DK
a. Class A fire resistant roofs on new construction within the county	1	2	3	9
b. Roads accessible to fire trucks (maximum slope/minimum width) on new subdivisions in the county	1	2	3	9
c. A restriction or limit on construction in areas highly susceptible to wildfire, i.e. ridgetops.....	1	2	3	9
d. Road signs in new developments made of reflective metal	1	2	3	9
e. A water source for fire control purpose, i.e. dry hydrant or pressurized hydrant accessible to firefighters	1	2	3	9
f. A 30 foot fire-safe zone around a home (defensible space)	1	2	3	9

21. How interested are you in learning more about the following?

(Please circle one number for each statement)

	Not at all Interested	1	2	3	Very Interested	5
a. Prescribed burning	1	2	3	4	5	
b. Mechanical fuel reduction	1	2	3	4	5	
c. Defensible space	1	2	3	4	5	
d. Other (Please specify):						

22. What would be your preferred method of learning more about the topics listed in the previous question (Q21)?

(Please circle one number for each statement)

	Not at all Interested			Very Interested	
a. Brochure.....	1	2	3	4	5
b. Public meeting	1	2	3	4	5
c. Web-site	1	2	3	4	5
d. Telephone hotline.....	1	2	3	4	5
e. Other (Please describe): _____					

23. How familiar are you with the following?

(Please circle one number for each statement)

	Not at all Familiar			Very Familiar	
a. An article from the Tennessee Division of Forestry (TDF) about protecting your home from wildfire	1	2	3	4	5
b. The TDF website about learning how to protect your home from burning in the event of a wildfire	1	2	3	4	5
c. The FIREWISE program on how to protect one's home from burning in the event of a wildfire	1	2	3	4	5

24. Have you ever obtained a burning permit?

☐ Yes

☐ No

25. Have you ever obtained information about FIREWISE from:

☐ the website **FIREWISE.ORG?** ☐ Yes ☐ No

☐ a government agency? ☐ Yes ☐ No

26. To what extent did you consider the possible occurrence of a wildfire around your current home and/or property in the Chilhowee Mountain area when you bought/moved there, if at all?

Not at all -----Very much
1 2 3 4 5

27. When purchasing a home in a fire risk/fire susceptible area, to what extent would you be willing to spend more money on a home with features that make it more fire resistant?

Not at all -----Very much
1 2 3 4 5

28. Should it be required for homebuyers to be informed when a home or property is in a fire risk/fire susceptible area as part of the real estate transaction process (similar to the current requirement for notification of property at risk to flooding)?

Not at all -----Very much
1 2 3 4 5

Finally, we would like to learn about your background. Please be assured your answers are confidential and will only be used for group comparisons. No question you answer on this survey will be linked to you personally in any analysis or report.

29. What year were you born? 19_____

30. Are you: _____ Male _____ Female

31. Does anyone in your household suffer from respiratory or breathing problems?

☐ Yes ☐ No

32. What is your highest level of education completed?

- | | |
|--|--|
| ☐ Some high school | ☐ College degree |
| ☐ High School | ☐ Graduate degree |
| ☐ Some college | ☐ Postgraduate work |
| ☐ Other (please specify): _____ | |

33. Please check the category which best fits your household income level per year:

- | | |
|--|--|
| ☐ Less than \$15,000 | ☐ \$35,000 - \$49,999 |
| ☐ \$15,000 - \$24,999 | ☐ \$50,000 - \$74,999 |
| ☐ \$25,000 - \$34,999 | ☐ \$75,000 or more |

**Thank you for participating in this survey. If you have any additional
comments about wildfire and your home or community,
please write them in the space below.**

Department of Forestry, Wildlife and Fisheries-1075
2021 Stephenson Dr. Ste 131
Knoxville, TN 37996

Appendix 5

Definition of Terms: Reference Sheet

Definition of Terms:

Reference Sheet

The following technical terms or phrases appear in **green** at different places throughout the survey starting with question 8. These definitions are provided for your reference as you proceed through the survey.

Thanks again for your help!

Class A resistant roof: Roof withstands the most severe fire exposure, is not readily flammable, does not contribute to the spread of fire across the roof, affords a high degree of protection to the roof deck, and will not produce flying firebrands.

Dry hydrant: A non-pressurized pipe system permanently installed in existing lakes, ponds and streams that provides a suction supply of water to a fire department tank truck.

Firewise: A program that enables communities in all parts of the United States to achieve a high level of protection against wildland/urban interface fire. Its goal is to encourage and acknowledge action that minimizes home loss to wildfire.

Fuel management approaches: Methods developed by foresters and fire professionals to reduce the extent and damage of wildfires on federal, state and private land. This survey addresses these three fuel management approaches.

- **Defensible space:** A fire-safe zone within 30 feet of a home which is created and maintained by removing flammable plants that contain resins, oils and waxes that burn readily, such as eastern red cedar and pine. Large, leafy hardwood trees are pruned so the lowest branches are at least 6 to 10 feet high to prevent a fire on the ground from spreading to the tree tops.
- **Mechanical fuel reduction:** These methods vary widely. Resource managers can use chainsaws, brush mowers, or other specialized machines to reduce the number of shrubs and small trees where they are so numerous they increase the risk and size of wildfires.
- **Prescribed burn/burning:** Involves intentionally setting fires in ways that can be controlled to produce desired conditions and protect against undesired results, such as a major wildfire (also called controlled burning).

Wildfire: An unplanned fire burning out of control on a forest or grassland. It can be started by lightning or by people, either accidentally or intentionally.

Wildland: Land that is predominantly natural and composed of trees and/or native grasses in which development is essentially nonexistent, except for roads, railroads, and power lines. Structures, if any, are widely scattered.

Appendix 6

Introductory Letters and Reminder Postcards

First questionnaire mailing letter

January 8, 2007

Dear Campers Paradise/Happy Valley/Top of the World Property Owner,

My name is Piyarat Chimchome and I am a graduate student in natural resources at the University of Tennessee in Knoxville. I am asking you to help me by completing and returning the enclosed survey, which is part of my research requirement for the Ph.D. in Natural Resources. The purpose of this survey is to investigate fire risk issues and gain a better understanding of property owner opinions of wildfire risk in the Chilhowee Mountain area of Blount County, Tennessee including the Top of the World, Campers Paradise and Happy Valley communities. For our results to be valid, we need to hear from as many people as possible.

Your name was obtained from a Blount County database of property owners. If you no longer or have never owned property in Campers Paradise area, please return this letter to us in the enclosed business reply envelope. You may notice the survey is marked with an identification number. This number corresponds with your name and address and provides a means by which a reminder can be sent, if necessary, without further imposing on those who have completed and returned their survey.

Completing this survey is voluntary and the information you give us is strictly confidential. Return of this survey constitutes consent to participate in this study. Once the survey is returned, your name will be deleted from our contact list and your responses will not be associated with your name. All results are presented in aggregate format.

If possible, please place the completed survey in the pre-addressed stamped envelope we have provided for you. Please return your completed survey within two weeks. Your time and effort are greatly appreciated.

If you have any questions, please feel free to contact Dr. Mark Fly at (865) 974-7979 or markfly@utk.edu.

Sincerely,

Piyarat Chimchome
Graduate Assistant
noina@utk.edu

Mark Fly, Ph.D.
Professor
markfly@utk.edu
(865) 974-7979

First reminder postcard

Dear Campers Paradise/Happy Valley/Top of the World Property Owner:

A few days ago, we sent you a questionnaire for the property owners in the Chilhowee mountain area of Blount County survey to fill out and return by mail. If you have completed the questionnaire and mailed it back to us, we would like to express our sincere thanks. All of the responses will be very helpful for an important survey I am conducting as a part of my Doctoral degree at the University of Tennessee in Knoxville.

If you have not returned the survey, we would appreciate you doing so at your earliest convenience. The higher the response rate, the more valid my research results will be. Again, thank you for your participation. If you need more information or a new survey, please contact us at the address below.

Sincerely,

Piyarat Chimchome
Graduate Assistant
noina@utk.edu

J. Mark Fly, Professor
Department of Forestry, Wildlife and Fisheries
The University of Tennessee
274 Ellington Plant Sciences
Knoxville, TN 37996-4563
markfly@utk.edu, (865) 974-7979

Second questionnaire mailing letter

February 1, 2007

Dear Campers Paradise Property Owner,

A few weeks ago, we mailed you a survey concerning wildfire risk in the Campers Paradise, Happy Valley, and Top of the World communities in the Chilhowee mountain area of Blount County. If you have already completed and returned the survey, please accept our sincere thanks. If you have not returned the survey, please do so at your earliest convenience. If for any reason you do not wish to participate, please return the blank survey in the envelope provided.

This study will help local lawmakers, government agencies, and interested property owners have a better and more objective understanding of views related to wildfire risk. The results of this study will be published as part of Piyyarat's Doctoral research at the University of Tennessee. Perhaps more importantly, this study is an opportunity for your voice to be heard regarding wildfire risk in the area.

You may notice the survey is marked with an identification number. This number corresponds with your name and address and provides a means by which a reminder can be sent, if necessary, without further imposing on those who have completed and returned their survey. We appreciate you taking the time to complete and return the survey, as your participation will greatly improve the study's accuracy.

Completing this survey is voluntary and the information you give us is strictly confidential. Return of this survey constitutes consent to participate in this study. Once the survey is returned, your name will be deleted from our contact list and your responses will not be associated with your name. All results are presented in aggregate format.

If you have any questions, please feel free to contact us by email or at the telephone number provided below. Thanks again for your assistance in this research project.

Sincerely,

Piyyarat Chimchome
Graduate Assistant
noina@utk.edu

Mark Fly, Ph.D.
Professor
markfly@utk.edu
(865) 974-7979

Second reminder postcard

Greetings Again!

A few weeks ago we sent you a questionnaire for an important survey concerning wildfire risk in the Campers Paradise, Happy Valley, and Top of the World communities in the Chilhowee Mountain area of Blount County. This study is an opportunity for your voice to be heard regarding wildfire risk in the area. If you have already completed and returned the survey, please accept our sincere thanks. If you have not completed and returned the survey, we would appreciate you doing so at your earliest convenience. The higher the response rate, the more valid our research results will be.

If you do not have a copy of the questionnaire or have questions about this study, please contact us at the address below.

We appreciate your help!

Piyarat Chimchome
Graduate Assistant
noina@utk.edu

J. Mark Fly, Professor
Department of Forestry, Wildlife, and Fisheries
The University of Tennessee, Knoxville
274 Ellington Plant Sciences
Knoxville, TN 37996-4563
markfly@utk.edu, (865) 974-7979

Appendix 7

Land Cover Reclassification

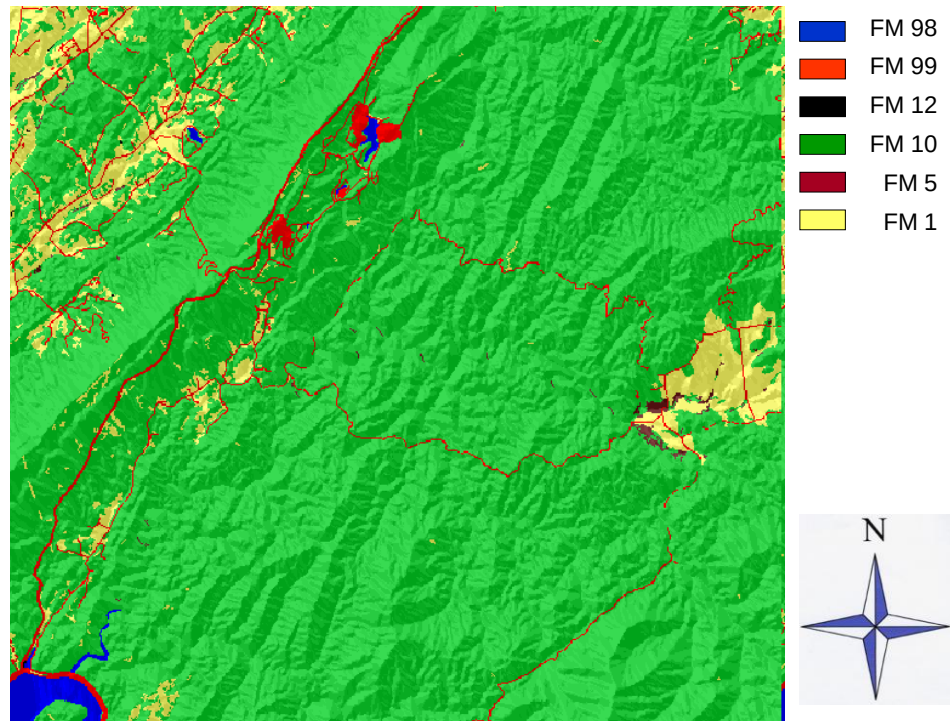


Figure VII 1 Land Cover Reclassification.

Appendix 8

National Forest Fire Laboratory (NFFL) Fuel Model

NFFL fuel models descriptions as described by Anderson (1982).

Grass Group

Fire behavior fuel model 1.-Fire spread is governed by the fine herbaceous fuels that have cured or are nearly cured. Fires move rapidly through cured grass and associated material. Very little shrub or timber is present, generally less than one-third of the area.

Grasslands and savanna are represented along with stubble, grass tundra, and grass-shrub combinations that meet the above area constraint. Annual and perennial grasses are included in this fuel model.

Fire behavior fuel model 2.-Fire spread is primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous material, besides litter and dead-down stemwood from the open shrub or timber overstory, contribute to the fire intensity. Open shrub lands and pine stands or scrub oak stands that cover one-third or two-thirds of the area may generally fit this model, but may include clumps of fuels that generate higher intensities and may produce firebrands. Some pinyon-juniper may be in this model.

Fire behavior fuel model 3.-Fires in this fuel are the most intense of the grass group and display high rates of spread under the influence of wind. The fire may be driven into the upper heights of the grass stand by the wind and cross standing water. Stands are tall, averaging about 3 ft, but may vary considerably. Approximately one-third or more of the stand is considered dead or cured and maintains the fire. Wild or cultivated grains that have not been harvested can be considered similar to tall prairie and marshland grasses.

Shrub Group

Fire behavior fuel model 4. Fire intensity and fast-spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory. Stands of mature shrub, 6 or more feet tall, such as California mixed chaparral, the high pocosins along the east coast, the pine barren of New Jersey, or the closed jack pine stands of the North Central States are typical candidates. Besides flammable foliage, there is dead woody material in the stand that significantly contributes to the fire intensity. Height of stands qualifying for this model depends on local conditions. There may be also a deep litter layer that confounds suppression efforts.

Fire behavior fuel model 5. Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs, and the grasses or forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the shrubs are young with little dead material, and the foliage contains little volatile material. Shrubs are generally not tall, but have nearly total coverage of the area. Young, green stands such as laurel, vine maple, alder, or even chaparral, manzanita, or chamise with no deadwood would qualify.

Fire behavior fuel model 6. Fire carries through the shrub layer where the foliage is more flammable than fuel model 5, but requires moderate winds, greater than 8 mi/h at mid-flame height. Fire will drop to the ground at low windspeeds or openings in the stand. The shrubs are older, but not as tall as shrub types of model 4, nor do they contain as much fuel as model 4. A broad range of shrub conditions is covered by this model. Fuel situations to consider include intermediate-aged stands of chamise, chaparral, oak brush, and low pocosin. Even hardwood slash that has cured out can be considered. Pinyon juniper shrublands may be represented, but the rate of spread may be overpredicted at windspeeds less than 20 mi/h.

Fire behavior fuel model 7. Fires burn through the surface and shrub strata with equal ease and can occur at higher dead fuel moisture contents because of the flammable nature of live foliage and other live material. Stands of shrubs are generally between 2 and 6 ft high. Palmetto-gallberry understory within pine overstory sites are typical and low pocosins may be represented. Black spruce-shrub combinations in Alaska may also be represented.

Timber Group

Fire behavior fuel model 8. Slow-burning ground fires with low flame heights are the rule, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidities, and high winds do the fuels pose fire hazards. Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact Under layer.

This layer is mainly needles, leaves, and some twigs since little undergrowth is present in the stand. Representative conifer types are white pines, lodgepole pine, spruce, fir, and larch.

Fire behavior fuel model 9. Fires run through the surface litter faster than model 8 and have higher flame height. Both long-needle conifer and hardwood stands, especially the oak-hickory types, are typical. Fall fires in hardwoods are representative, but high winds will actually cause higher rates of spread than predicted. This is due to spotting caused by rolling and blowing leaves. Closed stands of long-needled pine like ponderosa, Jeffrey, and red pines or southern pine plantations are grouped in this model. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowning.

Fire behavior fuel model 10. The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead down fuels include greater quantities of 3-inch or larger limbwood resulting from over-maturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees is more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; for example, insect- or disease-ridden stands, wind-thrown stands, over-mature stands with deadfall, and aged slash from thinning or partial cutting.

Logging Slash Group

Fire behavior fuel model 11. Fires are fairly active in the slash and herbaceous material intermixed with the slash. The spacing of the rather light fuel load, shading from overstory, or the aging of the fine fuels can contribute to limiting the fire potential. Light partial cuts or thinning operations in mixed conifer stands, hardwood stands, and southern pine harvests are considered. Clearcut operations generally produce more slash than represented here. The less-than-3-inch material load is less than 12 tons per acre. The greater-than-3-inch material is represented by not more than 10 pieces, 4 inches in diameter, along a 50-ft transect.

Fire behavior fuel model 12. Rapidly spreading fires with high intensities capable of generating firebrands can occur. When fire starts, it is generally sustained until a fuel break or change in fuels is encountered. The visual impression is dominated by slash, much of it less than 3 inches in diameter. These fuels total less than 35 tons per acre and seem well distributed. Heavily thinned conifer stands, clearcuts, and medium or heavy partial cuts are represented. The greater-than-3-inch material is represented by encountering 11 pieces, 6 inches in diameter, along a 50-ft transect.

Fire behavior fuel model 13. Fire is generally carried across the area by a continuous layer of slash. Large quantities of greater-than-3-inch material are present. Fires spread quickly through the lime fuels and intensity builds up more slowly as the large fuels start burning. Active flaming is sustained for long periods and firebrands of various sizes may be generated. These contribute to spotting problems as the weather conditions become more severe. Clearcuts and heavy partial cuts in mature and over-mature stands are

depicted where the slash load is dominated by the greater-than-3-inch material. The total load may exceed 200 tons per acre, but the less-than-3-inch fuel is generally only 10 percent of the total load. Situations where the slash still has "red" needles attached but the total load is lighter, more like model 12, can be represented because of the earlier high intensity and quicker area involvement.

Appendix 9

Weather and Wind Data

*(Retrieved from the National Park Service Air Resources Division,
http://12.45.109.6/pls/portal/data_request.mainfile)*

Table IX 1 Weather and Wind Data on April 18, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	5	57	55	32	0
1:00	5	65	55	32	0
2:00	4	68	55	32	0
3:00	4	98	55	32	0
4:00	4	104	55	32	0
5:00	5	140	54	33	0
6:00	5	137	54	34	0
7:00	4	65	56	36	0
8:00	6	38	56	36	0
9:00	5	42	57	36	0
10:00	5	53	57	35	0
11:00	5	64	58	40	0
12:00	6	43	60	40	0
13:00	9	354	62	38	0
14:00	10	353	62	41	0
15:00	9	342	63	40	0
16:00	8	332	63	41	0
17:00	8	323	62	46	0
18:00	16	331	55	66	0
19:00	6	65	52	79	0
20:00	6	136	53	77	0
21:00	5	138	53	72	0
22:00	3	171	55	64	0
23:00	3	190	54	67	0

Table IX 2 Weather and Wind Data on April 19, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	3	194	55	61	0
1:00	2	255	56	54	0
2:00	3	223	54	61	0
3:00	4	223	53	63	0
4:00	3	227	52	69	0
5:00	4	209	51	73	0
6:00	5	178	50	74	0
7:00	4	219	52	70	0
8:00	5	280	50	76	0
9:00	6	294	52	71	0
10:00	9	304	53	66	0
11:00	9	302	54	57	0
12:00	10	305	54	53	0
13:00	11	308	53	52	0
14:00	11	307	54	48	0
15:00	12	301	52	51	0
16:00	13	313	52	50	0
17:00	16	321	51	52	0
18:00	10	325	51	51	0
19:00	8	323	49	57	0
20:00	9	329	48	59	0
21:00	10	342	46	67	0
22:00	12	351	43	79	0
23:00	7	51	43	81	0

Table IX 3 Weather and Wind Data on April 20, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	5	93	42	83	0
1:00	6	56	42	84	0
2:00	9	22	42	86	0
3:00	6	59	42	86	0
4:00	5	93	42	86	0
5:00	7	43	43	85	0
6:00	7	47	43	86	0
7:00	6	89	44	83	0
8:00	6	61	47	78	0
9:00	5	60	50	67	0
10:00	9	32	52	59	0
11:00	8	14	54	57	0
12:00	9	2	55	54	0
13:00	11	346	57	48	0
14:00	10	341	58	47	0
15:00	10	349	59	44	0
16:00	10	337	60	42	0
17:00	8	357	60	42	0
18:00	7	16	58	44	0
19:00	6	64	56	48	0
20:00	5	96	55	49	0
21:00	6	116	55	50	0
22:00	6	129	55	49	0
23:00	6	135	55	46	0

Table IX 4 Weather and Wind Data on April 21, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	7	141	56	46	0
1:00	7	145	55	57	0
2:00	2	111	55	60	0
3:00	5	309	54	58	0
4:00	5	299	54	58	0
5:00	3	283	54	61	0
6:00	5	310	53	63	0
7:00	4	327	54	61	0
8:00	2	320	54	60	0
9:00	5	335	55	59	0
10:00	7	331	58	55	0
11:00	7	330	60	51	0
12:00	7	334	61	47	0
13:00	7	328	63	44	0
14:00	7	326	65	42	0
15:00	6	332	65	40	0
16:00	7	333	66	40	0
17:00	7	330	66	41	0
18:00	8	329	65	42	0
19:00	7	344	64	43	0
20:00	5	4	64	43	0
21:00	4	52	63	44	0
22:00	4	142	61	48	0
23:00	6	147	61	48	0

Table IX 5 Weather and Wind Data on April 22, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	7	152	61	47	0
1:00	7	156	60	47	0
2:00	7	159	60	47	0
3:00	6	156	60	45	0
4:00	5	151	60	45	0
5:00	5	155	60	45	0
6:00	6	167	60	44	0
7:00	5	166	59	47	0
8:00	3	285	61	46	0
9:00	3	299	62	48	0
10:00	3	193	66	36	0
11:00	6	329	66	38	0
12:00	10	325	67	37	0
13:00	10	324	68	35	0
14:00	7	312	70	34	0
15:00	6	314	71	31	0
16:00	8	308	71	30	0
17:00	7	300	71	34	0
18:00	6	299	69	37	0
19:00	6	281	67	35	0
20:00	4	257	66	35	0
21:00	5	164	64	37	0
22:00	6	166	63	37	0
23:00	8	167	62	38	0

Table IX 6 Weather and Wind Data on April 29, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	7	304	59	55	0
1:00	9	303	59	52	0
2:00	9	301	58	54	0
3:00	6	297	57	58	0
4:00	6	294	56	61	0
5:00	5	294	55	63	0
6:00	3	283	55	63	0
7:00	4	288	56	61	0
8:00	3	285	57	58	0
9:00	5	301	59	56	0
10:00	7	311	61	47	0
11:00	9	317	64	42	0
12:00	8	315	65	40	0
13:00	9	316	66	38	0
14:00	8	318	67	36	0
15:00	9	315	69	33	0
16:00	8	318	69	31	0
17:00	6	312	70	31	0
18:00	6	302	69	31	0
19:00	5	297	67	34	0
20:00	6	318	67	34	0
21:00	6	330	66	33	0
22:00	6	352	65	34	0
23:00	8	24	65	35	0

Table IX 7 Weather and Wind Data on April 30, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	6	46	65	34	0
1:00	3	83	64	35	0
2:00	4	80	64	36	0
3:00	4	93	64	36	0
4:00	3	120	64	36	0
5:00	4	173	64	37	0
6:00	3	204	64	38	0
7:00	4	188	65	39	0
8:00	3	194	66	39	0
9:00	4	309	67	40	0
10:00	6	336	68	40	0
11:00	8	323	70	39	0
12:00	8	321	72	37	0
13:00	7	310	73	37	0
14:00	8	314	74	37	0
15:00	8	314	75	34	0
16:00	6	311	76	33	0
17:00	5	303	76	34	0
18:00	4	299	75	34	0
19:00	4	180	73	36	0
20:00	5	166	73	38	0
21:00	5	172	72	39	0
22:00	4	195	72	39	0
23:00	3	215	71	40	0

Table IX 8 Weather and Wind Data on May 1, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	3	221	71	40	0
1:00	3	207	70	41	0
2:00	3	219	69	41	0
3:00	3	209	69	42	0
4:00	3	193	68	43	0
5:00	4	182	67	45	0
6:00	4	204	68	44	0
7:00	3	199	69	43	0
8:00	3	187	71	41	0
9:00	4	296	71	47	0
10:00	7	310	72	44	0
11:00	7	307	73	40	0
12:00	7	306	75	38	-999
13:00	7	305	77	37	0
14:00	7	299	78	34	0
15:00	9	300	79	34	0
16:00	8	296	79	35	0
17:00	6	286	79	34	0
18:00	5	281	77	35	0
19:00	6	263	75	37	0
20:00	6	253	74	38	0
21:00	5	241	73	39	0
22:00	6	265	72	43	0
23:00	5	279	71	45	0

Table IX 9 Weather and Wind Data on May 2, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	4	246	70	46	0
1:00	3	226	69	47	0
2:00	4	186	69	48	0
3:00	4	177	68	49	0
4:00	3	233	68	49	0
5:00	3	204	67	51	0
6:00	3	195	67	52	0
7:00	3	204	69	51	0
8:00	3	214	70	50	0
9:00	2	275	72	49	0
10:00	4	275	73	48	0
11:00	5	285	73	48	0
12:00	7	301	74	46	0
13:00	7	294	76	41	0
14:00	8	305	76	38	0
15:00	9	304	76	35	0
16:00	8	303	76	37	0
17:00	6	300	76	35	0
18:00	5	304	74	40	0
19:00	4	291	73	46	0
20:00	4	290	72	50	0
21:00	2	263	72	51	0
22:00	6	358	70	54	0
23:00	4	73	69	60	0

Table IX 10 Weather and Wind Data on May 3, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	3	123	68	58	0
1:00	5	156	67	59	0
2:00	4	165	66	61	0
3:00	4	166	65	64	0
4:00	4	173	66	62	0
5:00	4	185	66	62	0
6:00	2	229	66	62	0
7:00	2	187	67	62	0
8:00	3	278	65	70	0
9:00	3	285	66	69	0
10:00	4	306	67	69	0
11:00	5	297	70	59	0
12:00	6	297	71	55	0
13:00	7	300	72	49	0
14:00	7	297	74	46	0
15:00	6	296	72	53	0
16:00	8	316	69	64	0
17:00	7	341	66	76	0
18:00	5	37	66	75	0.1
19:00	6	99	65	80	0
20:00	6	93	64	85	0
21:00	6	108	64	79	0
22:00	5	137	65	74	0
23:00	6	139	65	71	0

Table IX 11 Weather and Wind Data on August 23, 2007.

Time	Wind speed (mph)	Vector wind direction 1(degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	2	133	83	49	0
1:00	4	150	82	51	0
2:00	4	150	82	51	0
3:00	4	167	82	51	0
4:00	3	178	82	51	0
5:00	3	178	81	52	0
6:00	2	291	81	55	0
7:00	3	160	81	55	0
8:00	3	167	82	54	0
9:00	3	237	82	57	0
10:00	3	311	83	61	0
11:00	4	324	84	55	0
12:00	5	317	88	44	0
13:00	5	310	89	39	0
14:00	4	308	90	37	0
15:00	4	174	90	40	0
16:00	4	290	90	40	0
17:00	5	278	85	47	0
18:00	4	144	83	55	0
19:00	4	148	82	59	0
20:00	6	148	80	63	0
21:00	6	148	79	66	0
22:00	7	162	79	68	0
23:00	7	151	78	67	0

Table IX 12 Weather and Wind Data on August 24, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	7	149	78	66	0
1:00	7	152	77	71	0
2:00	6	154	77	73	0
3:00	5	159	76	74	0
4:00	6	153	74	81	0
5:00	6	147	74	81	0
6:00	6	149	74	80	0
7:00	4	153	75	79	0
8:00	3	176	77	75	0
9:00	3	203	79	69	0
10:00	3	269	81	65	0
11:00	6	306	82	62	0
12:00	5	314	84	55	0
13:00	5	313	86	47	0
14:00	5	335	88	44	0
15:00	6	152	86	48	0
16:00	7	157	80	59	0
17:00	7	151	77	65	0
18:00	9	154	75	69	0
19:00	8	153	76	65	0
20:00	9	151	76	67	0
21:00	7	154	76	66	0
22:00	6	169	74	69	0
23:00	5	169	73	71	0

Table IX 13 Weather and Wind Data on August 25, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	5	160	73	71	0
1:00	4	247	73	70	0
2:00	5	258	71	78	0
3:00	4	244	71	80	0
4:00	3	226	70	82	0
5:00	3	217	71	81	0
6:00	6	149	70	82	0
7:00	6	148	71	78	0
8:00	5	317	73	71	0
9:00	4	303	74	72	0
10:00	4	315	77	61	0
11:00	5	326	80	52	0
12:00	7	319	82	48	0
13:00	-999	-999	-999	-999	-999
14:00	-999	-999	-999	-999	-999
15:00	-999	-999	-999	-999	-999
16:00	-999	-999	-999	-999	-999
17:00	-999	-999	-999	-999	-999
18:00	-999	-999	-999	-999	-999
19:00	-999	-999	-999	-999	-999
20:00	-999	-999	-999	-999	-999
21:00	-999	-999	-999	-999	-999
22:00	-999	-999	-999	-999	-999
23:00	-999	-999	-999	-999	-999

Table IX 14 Weather and Wind Data on August 26, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	3	304	74	69	0
1:00	5	298	72	76	0
2:00	4	303	71	81	0
3:00	4	337	69	86	0
4:00	5	137	60	87	0
5:00	5	139	70	83	0
6:00	5	104	71	79	0
7:00	4	343	72	80	0
8:00	6	12	69	89	0.8
9:00	5	165	68	96	0
10:00	4	159	71	88	0
11:00	3	115	75	74	0
12:00	3	57	78	66	0
13:00	2	192	80	62	0
14:00	3	56	81	60	0
15:00	4	170	78	68	0
16:00	4	154	78	68	0
17:00	4	150	77	67	0
18:00	4	169	77	70	0
19:00	3	11	77	65	0
20:00	3	140	75	72	0
21:00	5	155	74	76	0
22:00	4	163	75	72	0
23:00	3	304	74	69	0

Table IX 15 Weather and Wind Data on August 27, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	3	246	76	69	0
1:00	3	309	73	77	0
2:00	3	288	72	76	0
3:00	3	282	73	75	0
4:00	4	327	71	82	0
5:00	3	160	71	81	0
6:00	3	24	71	79	0
7:00	2	7	71	82	0
8:00	2	337	72	82	0
9:00	2	340	74	76	0
10:00	5	344	76	72	0
11:00	5	339	77	67	0
12:00	5	332	80	61	0
13:00	4	350	81	58	0
14:00	4	357	83	54	0
15:00	4	158	80	59	0
16:00	6	155	79	60	0
17:00	6	153	78	65	0
18:00	6	152	77	72	0
19:00	7	150	76	76	0
20:00	6	148	76	74	0
21:00	7	150	75	76	0
22:00	6	155	74	77	0
23:00	6	151	73	78	0

Table IX 16 Weather and Wind Data on August 28, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	7	150	73	80	0
1:00	6	155	72	83	0
2:00	3	164	73	79	0
3:00	4	155	72	80	0
4:00	4	143	72	82	0
5:00	4	42	72	80	0
6:00	4	102	71	82	0
7:00	5	147	72	80	0
8:00	3	157	74	75	0
9:00	3	317	74	78	0
10:00	4	317	76	73	0
11:00	4	327	77	72	-999
12:00	4	326	78	67	0
13:00	3	139	78	65	0
14:00	4	149	83	56	0
15:00	4	162	83	54	0
16:00	4	156	84	52	0
17:00	3	154	82	58	0
18:00	5	153	79	65	0
19:00	6	153	77	70	0
20:00	4	161	76	72	0
21:00	3	267	76	71	0
22:00	3	188	75	73	0
23:00	2	207	74	74	0

Table IX 17 Weather and Wind Data on August 29, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	2	193	75	74	0
1:00	4	164	75	74	0
2:00	3	164	74	77	0
3:00	3	167	73	80	0
4:00	3	255	73	80	0
5:00	3	251	73	81	0
6:00	2	228	72	82	0
7:00	2	191	73	80	0
8:00	2	265	74	78	0
9:00	2	254	75	76	0
10:00	3	304	76	73	0
11:00	4	308	78	68	0
12:00	5	310	80	61	0
13:00	3	340	81	61	0
14:00	2	349	81	60	0
15:00	3	319	80	62	0
16:00	5	192	76	66	0.2
17:00	5	110	75	69	0
18:00	7	118	70	83	0
19:00	6	161	72	78	0
20:00	3	169	73	75	0
21:00	3	172	73	80	0
22:00	2	200	72	81	0
23:00	2	217	71	84	0.2

Table IX 18 Weather and Wind Data on August 30, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	2	255	71	87	0
1:00	2	237	71	86	0
2:00	2	191	70	86	0
3:00	2	186	70	88	0
4:00	2	191	71	89	0
5:00	3	329	71	90	0
6:00	4	338	70	90	0
7:00	4	340	70	92	0
8:00	5	337	70	92	0
9:00	6	353	69	96	0
10:00	7	46	68	95	1.3
11:00	5	96	67	98	3.6
12:00	5	102	68	94	0.6
13:00	3	79	70	88	0.1
14:00	3	22	70	93	0
15:00	3	26	69	95	0
16:00	4	26	69	95	0
17:00	4	32	69	95	0
18:00	5	56	69	95	0
19:00	4	113	69	96	0
20:00	4	109	70	93	0
21:00	5	79	71	88	0
22:00	4	92	70	88	0
23:00	3	100	71	85	0

Table IX 19 Weather and Wind Data on August 31, 2007.

Time	Wind speed (mph)	Vector wind direction (degrees)	Temperature (degrees Fahrenheit)	Relative humidity (%)	Precipitation (millimeters/hr)
0:00	7	33	72	76	0
1:00	7	37	71	84	0
2:00	4	82	69	89	0
3:00	4	84	69	95	0
4:00	4	103	68	97	0
5:00	4	64	68	95	0
6:00	5	58	67	98	0
7:00	4	58	66	99	0
8:00	4	56	67	99	0
9:00	3	16	69	94	0
10:00	3	355	72	83	0
11:00	6	356	74	79	0
12:00	6	353	75	74	0
13:00	7	358	77	69	0
14:00	6	8	78	64	0
15:00	5	354	79	63	0
16:00	4	35	78	65	0
17:00	5	36	77	67	0
18:00	7	43	73	77	0
19:00	6	101	67	89	7.4
20:00	5	148	68	90	0
21:00	4	115	71	80	0
22:00	4	63	71	79	0
23:00	7	36	70	84	0

Appendix 10

Education Level and Annual Income

Table X 1 Education Level (n = 152).

Education Level	Percent
Some high school	5.7%
High school	24.3%
Some college	30.5%
College degree	21.5%
Graduate degree	10.2%
Post graduate work	7.9%

Table X 2 Annual Income (n = 137).

Annual Income	Percent
< \$15,000	5.5%
\$15,000 - \$24,999	12.2%
\$25,000 - \$34,999	10.3%
\$35,000 - \$49,999	15.9%
\$50,000 - \$74,999	20.1%
\$75,000 or more	36.0%

Appendix 11

Q8. Other Fire Experience.

Other fire experience:-

- at age 16 joined bucket brigade passing water when village church caught fire in NC.
- retired firefighter.
- was a firefighter in the Navy for 23 yrs.
- was a firefighter for 15 years.
- was a volunteer fireman.
- husband was a volunteer fire fighter.
- helped put fire out at night in 1950's near Montvale.
- experience from wildfire in FL.
- electrical fire bad cord on lamp .
- house hit by lightning.
- had a trash burning very nearly "get away", scary.
- area homes have burned.
- house burned in 1996.
- home fire in a child bedroom.
- a wildfire burned property and the surrounding area a few years back.
- experience severe wildfire near home in Central FL in 1999 and 2001
- small wildfire near residence rural metro contained and extinguished it.
- put out woods fire started by lightning.
- have fought many wildfires on Chilhowee Mountain and surrounding areas of Blount County.
- participated in a prescribed burn.
- saw hugh Everglades fire on the way to Miami, scary looking!
- seen areas burn on Chilhowee Mountain.
- only fire was on Chilhowee Mountain at Chilhowee lake, but never threatened.

Appendix 12

Q8. Past Experience in Relation to Wildfire

Table XII 1 Have you been injured or suffered property damage from a wildfire at any time in your life? (Q8, n = 159).

Population weighted	4.4%
Property type status	
Resident Homeowner	10.9%
Absentee Homeowner	10.3%
Lot Owner	0%
Gender	
Male	5.1%
Female	3.5%
Age Group	
22 - 50	9.1%
51 - 60	2.2%
61 - 70	5.3%
> 70	2.7%
Education	
High School	6.5%
Some College	4.3%
College Degree	3.0%
Graduate & Postgraduate	3.6%
Income	
< \$25,000	8.0%
\$25,000 - < \$50,000	13.9%
\$50,000 - < \$75,000	0%
> 75,000	2.0%

Table XII 2 Has a wildfire occurred near your home at any time in your life (Q8, n = 159)?

Population weighted	23.9%
Property type status	
Resident Homeowner	30.4%
Absentee Homeowner	20.5%
Lot Owner	23.0%
Gender	
Male	26.3%
Female	19.3 %
Age Group	
22 - 50	32.4%
51 - 60	32.6%
61 - 70	23.7%
> 70	5.4%
Education	
High School	13.3%
Some College	28.3%
College Degree	24.2%
Graduate & Postgraduate	33.3%
Income	
< \$25,000	12.5%
\$25,000 - < \$50,000	22.2%
\$50,000 - < \$75,000	17.5%
> 75,000	34.7%

Table XII 3 Has a prescribed burn occurred near your home at any time in your life (Q8, n = 159)?

Population weighted	11.2%
Property type status	
Resident Homeowner	19.6%
Absentee Homeowner	15.4%
Lot Owner	6.8%
Gender	
Male	14.3%
Female	5.2%
Age Group	
22 - 50	17.6%
51 - 60	6.5%
61 - 70	12.8%
> 70	10.5%
Education	
High School	4.4%
Some College	15.2%
College Degree	12.1%
Graduate & Postgraduate	14.8%
Income	
< \$25,000	12.0%
\$25,000 - < \$50,000	13.9%
\$50,000 - < \$75,000	14.3%
> 75,000	12.2%

Table XII 4 Have you experienced a mechanical fuel reduction to decrease wildfire fuels near your home at any time in your life (Q8, n = 159)?

Population weighted	6.3%
Property type status	
Resident Homeowner	6.5%
Absentee Homeowner	5.1%
Lot Owner	6.8%
Gender	
Male	6.1%
Female	5.2%
Age Group	
22 - 50	2.9%
51 - 60	6.5%
61 - 70	10.5%
> 70	2.7%
Education	
High School	4.4%
Some College	2.2%
College Degree	12.1%
Graduate & Postgraduate	11.1%
Income	
< \$25,000	4.2%
\$25,000 - < \$50,000	8.6%
\$50,000 - < \$75,000	0%
> 75,000	10.0%

Table XII 5 Have you experienced a road closure due to wildfire at any time in your life (Q8, n = 159)?

Population weighted	8.3%
Property type status	
Resident Homeowner	8.7%
Absentee Homeowner	5.1%
Lot Owner	9.5%
Gender	
Male	8.1%
Female	8.6%
Age Group	
22 - 50	17.6%
51 - 60	2.2%
61 - 70	12.8%
> 70	2.7%
Education	
High School	4.3%
Some College	8.7%
College Degree	9.4%
Graduate & Postgraduate	14.8%
Income	
< \$25,000	4.0%
\$25,000 - < \$50,000	8.3%
\$50,000 - < \$75,000	3.7%
> 75,000	16.3%

Table XII 6 Have you been required to remove flammable vegetation on your property at any time in your life (Q8, n = 159)?

Population weighted	0.8%
Property type status	
Resident Homeowner	0%
Absentee Homeowner	0%
Lot Owner	1.4%
Gender	
Male	1.0%
Female	0%
Age Group	
22 - 50	0%
51 - 60	0%
61 - 70	2.6%
> 70	0%
Education	
High School	0%
Some College	0%
College Degree	3.1%
Graduate & Postgraduate	0%
Income	
< \$25,000	0%
\$25,000 - < \$50,000	2.8%
\$50,000 - < \$75,000	0%
> 75,000	0%

Table XII 7 Have your friends, family and/or neighbors suffered property damage due to wildfire at any time in your life (Q8, n = 159)?

Population weighted	11.6%
Property type status	
Resident Homeowner	15.2%
Absentee Homeowner	10.3%
Lot Owner	10.8%
Gender	
Male	15.2%
Female	6.9%
Age Group	
22 - 50	17.6%
51 - 60	10.9%
61 - 70	15.8%
> 70	2.7%
Education	
High School	8.9%
Some College	10.9%
College Degree	6.3%
Graduate & Postgraduate	18.5%
Income	
< \$25,000	4.0%
\$25,000 - < \$50,000	8.3%
\$50,000 - < \$75,000	7.1%
> 75,000	20.4%

Table XII 8 Have you personally witnessed a wildfire at any time in your life (Q8, n = 159)?

Population weighted	33.1%
Property type status	
Resident Homeowner	41.3%
Absentee Homeowner	20.5%
Lot Owner	35.1%
Gender	
Male	33.3%
Female	32.8%
Age Group	
22 - 50	36.4%
51 - 60	32.6%
61 - 70	36.8%
> 70	27.0%
Education	
High School	21.7%
Some College	37.0%
College Degree	36.4%
Graduate & Postgraduate	48.1%
Income	
< \$25,000	20.8%
\$25,000 - < \$50,000	28.6%
\$50,000 - < \$75,000	37.0%
> 75,000	44.9%

Table XII 9 Have you experienced discomfort from smoke caused by wildfire at any time in your life (Q8, n = 159)?

Population weighted	22.6%
Property type status	
Resident Homeowner	32.6%
Absentee Homeowner	12.8%
Lot Owner	23.0%
Gender	
Male	22.4%
Female	21.1%
Age Group	
22 - 50	29.4%
51 - 60	26.1%
61 - 70	21.1%
> 70	13.5%
Education	
High School	8.7%
Some College	28.3%
College Degree	27.3%
Graduate & Postgraduate	33.3%
Income	
< \$25,000	12.0%
\$25,000 - < \$50,000	19.4%
\$50,000 - < \$75,000	25.9%
> 75,000	30.6%

Table XII 10 Have you felt fear or anxiety as a result of a wildfire at any time in your life (Q8, n = 159)?

Population weighted	12.1%
Property type status	
Resident Homeowner	23.9%
Absentee Homeowner	5.1%
Lot Owner	10.8%
Gender	
Male	10.2%
Female	15.5%
Age Group	
22 - 50	6.1%
51 - 60	13.0%
61 - 70	18.4%
> 70	10.8%
Education	
High School	13.3%
Some College	10.9%
College Degree	6.1%
Graduate & Postgraduate	14.8%
Income	
< \$25,000	12.0%
\$25,000 - < \$50,000	13.9%
\$50,000 - < \$75,000	11.1%
> 75,000	10.2%

Table XII 11 Have experienced none of fire related issues listed above (Q8, n = 159)?

Population weighted	34.5%
Property type status	
Resident Homeowner	34.8%
Absentee Homeowner	35.9%
Lot Owner	33.8%
Gender	
Male	29.3%
Female	43.1%
Age Group	
22 - 50	27.3%
51 - 60	30.4%
61 - 70	41.0%
> 70	39.5%
Education	
High School	48.9%
Some College	31.9%
College Degree	21.3%
Graduate & Postgraduate	25.9%
Income	
< \$25,000	33.3%
\$25,000 - < \$50,000	36.1%
\$50,000 - < \$75,000	40.7%
> 75,000	30.6%

Appendix 13

Action Index

Action Index Categories from Q9 and Q9a are listed as follows:

1. Asked local fire officials about how to reduce risk of property damage from wildfire.
2. Read information on protecting homes from wildfires.
3. Attended a public meeting about wildfire.
4. Called authorities about neighbors being careless with their outdoor burning.
5. Worked with local fire department on neighborhood and community fire protection.
6. Removed vegetation on my property to protect my home from fire.
7. Used fire resistant construction.
8. Created/maintained access to water.
9. Followed burning rules.
10. Obtained firefighting tools.
11. Used best practices (limit burns on property, camp and picnic responsibly, etc).

Note: Specific risk reduction activities written for Q9a are listed on the next page.

Table XIII 1 Other actions taken to help reduce the risk of fire in the Chilhowee Mountain area impacting property and lives (Q9a, n = 159).

Action Category	Actions
4. Called authority	• Called Blount County fire department for fire on Tower road.
6. Removed vegetation on my property to protect my home from fire.	• Periodically cut down dead southern pine beetle trees and chip up their limbs and other dead trees. • Remove dry leaves from around property. • Reduce debris and leaves. • Cut some trees; try to keep leaves raked up. • Had dead pine trees removed from property. • Keeps leaves away from home. • Cut grasses along Flats Rd. to stop fire from coming over the road. • Keeping the yard area clear and debris cleaned up in open acreage. • Keeping leaves clean up, garbage pick up around home if see smoke go on check out see what it burn. • The leaves fall when I'm not up there but remove them when I'm there.
7. Used fire resistant construction.	• Installed steel roof. • Used fire resistant siding (hardy plank) on home.
8. Created/maintained access to water.	• Installed 2 outside standpipes that can't freeze in the winter. • Installed outside water source. • Keep dry garden hose available. • Have generator to power well.
9. Followed burning rules.	• Pay close attention to burning restriction and burn permit rule • Made appeals in past for stepdad to get permits before burning and to be more careful.
10. Obtained fire fighting tools.	• Get fire distinguisher. • Installed smoke detector. • Have fire rakes
11. Used best practices.	• Do not allow smoke on property. • Make sure all cookouts are out before leaving. • Limit my own burns on property • Camp and picnic responsibly

Table XIII 2 Percentage of property owners by number of actions taken to help reduce the risk of wildfire (Q9, n = 159).

No. of Actions	Percent
0	50.6%
1	26.8%
2	15.8%
3	2.9%
4	2.7%
5	0.8%
8	0.4%

Appendix 14

Perceptions of Government Agencies

Table XIV 1 Perception of National Park Service in effectiveness in protecting private property from wildfire (Q19b).

	n	Low	Medium	High
Property type status				
Resident Homeowner	38	28.9%	39.5%	31.6%
Absentee Homeowner	29	17.2%	34.5%	48.3%
Lot Owner	39	20.5%	30.8%	48.7%
Gender				
Male	68	25.0%	33.8%	41.2%
Female	30	13.3%	36.7%	50.0%
Age Group				
22 - 50	20	10.0%	50.0%	40.0%
51 - 60	33	21.2%	27.3%	51.5%
61 - 70	27	22.2%	37.0%	40.7%
> 70	19	31.6%	31.6%	36.8%
Education				
High School	30	10.0%	40.0%	50.0%
Some College	31	22.6%	29.0%	48.4%
College Degree	23	30.4%	34.8%	34.8%
Graduate & Postgraduate	14	28.6%	28.6%	42.9%
Income				
< \$25,000	17	11.8%	41.2%	47.1%
\$25,000 - < \$50,000	29	27.6%	31.0%	41.4%
\$50,000 - < \$75,000	16	18.8%	18.8%	62.5%
> 75,000	30	20.0%	50.0%	30.0%

Table XIV 2 Perception of Tennessee Division of Forestry in effectiveness in protecting private property from wildfire (Q19f).

	n	Low	Medium	High
Property type status				
Resident Homeowner	39	28.2%	30.8%	41.0%
Absentee Homeowner	26	23.1%	38.5%	38.5%
Lot Owner	33	15.2%	36.4%	48.5%
Gender				
Male	62	25.8%	30.6%	43.5%
Female	27	11.1%	48.1%	40.7%
Age Group				
22 - 50	20	10.0%	50.0%	40.0%
51 - 60	27	22.3%	37.0%	40.7%
61 - 70	22	22.7%	36.4%	40.9%
> 70	18	27.8%	22.2%	50.0%
Education				
High School	27	14.8%	29.6%	55.6%
Some College	30	20.0%	40.0%	40.0%
College Degree	21	23.8%	33.3%	42.9%
Graduate & Postgraduate	10	30.0%	40.0%	30.0%
Income				
< \$25,000	14	7.1%	21.4%	71.4%
\$25,000 - < \$50,000	26	23.1%	42.3%	34.6%
\$50,000 - < \$75,000	17	29.4%	35.3%	35.3%
> 75,000	27	18.5%	44.4%	37.0%

Appendix 15

Q20. Attitudes toward Regulation for Preventive Measures

Table XV 1 Should class A fire resistant roofs on new construction within the county be a requirement for a county building permit (Q20a, n = 136)?

	Should not be required	Should be encouraged	Should be required
Property type status			
Resident Homeowner	22.7%	21.1%	19.3%
Absentee Homeowner	52.3%	60.5%	54.4%
Lot Owner	25.0%	18.4%	26.3%
Gender			
Male	22.8%	52.2%	25.0%
Female	14.3%	64.3%	21.4%
Age Group			
22 - 50	23.3%	63.3%	13.3%
51 - 60	27.3%	54.5%	18.2%
61 - 70	9.1%	60.6%	30.3%
> 70	19.2%	42.3%	38.5%
Education			
High School	21.6%	70.3%	8.1%
Some College	25.0%	52.3%	22.7%
College Degree	20.7%	44.8%	34.5%
Graduate & Postgraduate	13.6%	45.5%	40.9%
Income			
< \$25,000	15.0%	75.0%	10.0%
\$25,000 - < \$50,000	30.3%	57.6%	12.1%
\$50,000 - < \$75,000	20.8%	45.8%	33.3%
> 75,000	17.8%	46.7%	35.6%

Table XV 2 Should roads accessible to fire trucks on new subdivisions in the county be a requirement for a county building permit (Q20b, n = 133)?

	Should not be required	Should be encouraged	Should be required
Property type status			
Resident Homeowner	16.3%	30.2%	53.5%
Absentee Homeowner	16.7%	27.8%	55.6%
Lot Owner	7.0%	36.8%	56.1%
Gender			
Male	13.6%	31.8%	54.5%
Female	7.0%	32.6%	60.5%
Age Group			
22 - 50	16.1%	35.5%	48.4%
51 - 60	11.6%	39.5%	48.8%
61 - 70	6.3%	25.0%	68.8%
> 70	12.5%	20.8%	66.7%
Education			
High School	13.5%	37.8%	48.6%
Some College	12.2%	31.7%	56.1%
College Degree	10.0%	30.0%	60.0%
Graduate & Postgraduate	13.6%	27.3%	59.1%
Income			
< \$25,000	21.1%	42.1%	36.8%
\$25,000 - < \$50,000	6.9%	44.8%	48.3%
\$50,000 - < \$75,000	4.3%	30.4%	65.2%
> 75,000	15.6%	22.2%	62.2%

Table XV 3 Should a restriction or limit on construction in areas highly susceptible to wildfire, i.e. ridgetops, be a requirement for a county building permit (Q20c, n = 132)?

	Should not be required	Should be encouraged	Should be required
Property type status			
Resident Homeowner	21.4%	28.6%	50.0%
Absentee Homeowner	29.7%	37.8%	32.4%
Lot Owner	19.6%	44.6%	35.7%
Gender			
Male	26.1%	34.1%	39.8%
Female	16.3%	48.8%	34.9%
Age Group			
22 - 50	30.0%	40.0%	30.0%
51 - 60	38.1%	40.5%	21.4%
61 - 70	6.3%	46.9%	46.9%
> 70	8.3%	25.0%	66.7%
Education			
High School	21.6%	32.4%	45.9%
Some College	20.0%	35.0%	45.0%
College Degree	22.2%	44.4%	33.3%
Graduate & Postgraduate	28.6%	42.9%	28.6%
Income			
< \$25,000	21.1%	26.3%	52.6%
\$25,000 - < \$50,000	20.0%	43.3%	36.7%
\$50,000 - < \$75,000	9.5%	61.9%	28.6%
> 75,000	30.4%	32.6%	37.0%

**Table XV 4 Should roads signs in new developments be made of reflective metal
be a requirement for a county building permit (Q20d, n = 131)?**

	Should not be required	Should be encouraged	Should be required
Property type status			
Resident Homeowner	6.8%	27.3%	65.9%
Absentee Homeowner	16.7%	27.8%	55.6%
Lot Owner	9.1%	29.1%	61.8%
Gender			
Male	13.5%	28.1%	58.4%
Female	5.0%	25.0%	70.0%
Age Group			
22 - 50	20.0%	23.3%	56.7%
51 - 60	11.9%	23.8%	64.3%
61 - 70	3.3%	30.0%	66.7%
> 70	7.7%	30.8%	61.5%
Education			
High School	10.8%	35.1%	54.1%
Some College	14.3%	28.6%	57.1%
College Degree	3.4%	24.1%	72.4%
Graduate & Postgraduate	15.0%	10.0%	75.0%
Income			
< \$25,000	10.5%	31.6%	57.9%
\$25,000 - < \$50,000	6.9%	48.3%	44.8%
\$50,000 - < \$75,000	4.3%	26.1%	69.6%
> 75,000	15.9%	11.4%	72.7%

Table XV 5 Should a water source for fire control purpose, i.e. dry hydrant or pressurized hydrant accessible to firefighter be a requirement for a county building permit (Q20e, n = 127)?

	Should not be required	Should be encouraged	Should be required
Property type status			
Resident Homeowner	18.6%	30.2%	51.2%
Absentee Homeowner	20.0%	17.1%	62.9%
Lot Owner	9.4%	49.1%	41.5%
Gender			
Male	18.6%	31.4%	50.0%
Female	5.1%	46.2%	48.7%
Age Group			
22 - 50	18.5%	25.9%	55.6%
51 - 60	16.7%	47.6%	35.7%
61 - 70	9.7%	32.3%	58.1%
> 70	13.0%	30.4%	56.5%
Education			
High School	18.4%	36.8%	44.7%
Some College	10.0%	37.5%	52.5%
College Degree	19.2%	30.8%	50.0%
Graduate & Postgraduate	14.3%	38.1%	47.6%
Income			
< \$25,000	27.8%	27.8%	44.4%
\$25,000 - < \$50,000	7.4%	55.6%	37.0%
\$50,000 - < \$75,000	5.0%	25.0%	70.0%
> 75,000	17.4%	32.6%	50.0%

Table XV 6 Should a 30 foot fire-safe zone around a home (defensible space) be a requirement for a county building permit (Q20f, n = 130)?

	Should not be required	Should be encouraged	Should be required
Property type status			
Resident Homeowner	23.3%	55.8%	20.9%
Absentee Homeowner	26.3%	44.7%	28.9%
Lot Owner	13.2%	50.9%	35.8%
Gender			
Male	20.9%	45.3%	33.7%
Female	17.1%	58.5%	24.4%
Age Group			
22 - 50	24.1%	48.3%	27.6%
51 - 60	29.5%	50.0%	20.5%
61 - 70	10.3%	58.6%	31.0%
> 70	8.0%	36.0%	56.0%
Education			
High School	19.4%	44.4%	36.1%
Some College	24.4%	51.2%	24.4%
College Degree	17.9%	53.6%	28.6%
Graduate & Postgraduate	9.5%	47.6%	42.9%
Income			
< \$25,000	29.4%	52.9%	17.6%
\$25,000 - < \$50,000	16.7%	70.0%	13.3%
\$50,000 - < \$75,000	13.0%	34.8%	52.2%
> 75,000	20.9%	46.5%	32.6%

VITA

Piyarat Wongarin Chimchome was born in Phrae, Thailand. She received the B.Sc. and M.Sc. degree in Forestry from Kasetsart University, Bangkok, Thailand in 1983 and 1989, respectively. In 1995/96, she was awarded the United Kingdom Scholarship to study the M.Sc. degree in Environmental Science at the University of Aberdeen, Scotland. She also was awarded the Thai Ministry of Agriculture and Cooperatives Scholarship to further her PhD degree in Forestry, Forest Fire Management at the University of Tennessee, Knoxville in fall semester 2001. During the pursuit of her Ph.D., she also worked as a graduate research assistant/teaching assistant for Dr. J. Mark Fly in the Department of Forestry, Wildlife and Fisheries.

She has been working with the Royal Thai Forest Department (RFD) since her graduation in 1983. Starting at the Forest Land Management Division, she worked with the National Park Division from 1989 to 1999. In late 1999, she was assigned to the International Forestry Affairs Division of the RFD which was reorganized into the International Relation Division, Office of Planning and Information of the National Parks, Wildlife and Plant Conservation Department (NPD). Upon completion of her Doctorate studies, Piyarat resumes her career as a technical forest official for the same Department.